INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICSENGINEERING
COURSE DESCRIPTION

Course Title	**COMPUTATIONAL MATHEMATICS LABORATORY**				
Course Code	AHS102				
Program	B.Tech				
Semester	II	ME			
Course Type	Foundation				
Regulation	IARE- R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. B Praveena, Assistant Professor				

I COURSE OVERVIEW:

II. The aim of this course is to know about the basic principles of Engineering Mathematics and itsapplication in MATLAB by means of software. Nowadays the principles of MATLAB find widerange of applications in many situations such as signal processing and communications, imageandvideoprocessing,controlsystems,testandmeasurement,computationalfinance,andcomputational biology. Using MATLAB, one can analyze data, develop algorithms, and createmodelsandapplications.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10 + 2	-	-	Basic Principles of Algebra and Calculus

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computational Mathematics Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	DemonstratethebasicprinciplesofMATLAB.
II	Analyze the applications of Algebraand Calculus using MATLAB software.
III	Estimate the roots of Algebraic and Transcendental equations..
IV	Evaluate the characteristics of given curves bymeans of plottingagraph.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Solve** the algebraic and transcendental equations with in given range rangeusing MAT LAB programs. .	Apply

CO 2	**Utilize** MAT LAB programs for verifying properties of limits,derivatives of a function.	Apply
CO 3	**Interpret** rank,eigen values and vectors with matrix transformations.	Understand
CO 4	**Utilize** MAT LAB programs for solving differential equations and multiple integrals.	Apply
CO 5	**Make use of** of MAT LAB programs for interpolating values of differential equations numerically.	Apply
CO 6	**Use** MAT LAB programs for vector operations on vector field.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL

VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises
PO 2	**Problem analysis:** Problem analysis: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	CIA

PO 4	**Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	ProfessionalSkills:To produce engineering professiona lcapable of synthesizing and analyzing mechanical systems including allied engineering streams	1	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of Key Competencies**
CO 1	PO 1	Utilize the concept of calibration to a considerable extent appreciate (understanding) their importance and applicability (apply) in solving (complex) fluid flow engineering problems by applying the **principles of Mathematics and Engineering**	3
	PO 2	Identify (given **problem statement**)MAT LAB commands for synthesizing and analyzing the given data (provided **information and data**) by principles of Mathematics.	4
	PO 4	Apply (given **problem statement**)MAT LAB commands for analyzing the given data **information and data**) by using various algebraic functions numerically.	2
	PSO 1	Apply (**knowledge**) properties, various types and patterns of fluid flow configurations (apply) for solving design problems by applying the **in various engineering streams following mathematical rules and conditons.**	1
CO 2	PO 1	Identify (understanding) the appropriate MAT LAB programs for verifying limitsand derivatives of the givenfunctions and Understand the major role of these functions which exists as solutions **for integrals and differential equations of elementary functions by applying the principles of mathematics.**	3

	PO 2	Identify (given **problem statement**) the given problem and formulate MAT LAB program for solving and make use of mathematical method **information**to facilitate physical interpretation of the results obtained.	4
	PO 4	Apply (given **problem statement**) the given problem and formulate MAT LAB program for solving and make use of mathematical method MAT LABcommands for synthesizing and analyzing the given data **information**in various engineering streams following mathematical rules and conditons.	2
	PSO 1	Apply (knowledge) MAT LAB commands for synthesizing and analyzing the given data **in various engineering streams following mathematical rules and conditons.**	1
CO 3	PO 1	Interpret (**knowledge**) the rank and inverse of real and complex matrices using MAT LAB programs.	3
	PO 2	Apply **problem statement** MAT LAB program for decomposing the given matrix for (**complex**) solving complex engineering problems following principles ofmathematics. **results**.	4
	PO4	Apply (knowledge) MAT LAB programfor finding Eigen values and Eigen vectors along **with basic principles of mathematics to develop the solution.**	2
	PSO 1	Apply (knowledge)MAT LAB commands for synthesizing and analyzing the given data **in various engineering streams following mathematical rules and conditons.**	1
CO 4	PO 1	Identify (knowledge) appropriate MAT LAB programsforfinding length of the curves and area of the surfacefor with respect to **the fundamental operations of arithmetic(knowledge) for majority of functions by principlesofMathematics.**	3
	PO 2	Interpret **problem statement and formulate** the suitable MAT LAB program for solving double and triple integral in the given region.	2
	PSO 1	Apply (knowledge) MAT LAB commands for synthesizing and analyzing the given data in various engineering streams	1
CO 5	PO 1	Apply the knowledge of **Mathematics and Engineering fundamentals**the knowledge of MAT LAB programs. toSolve the algebraic and transcendental equations numerically with in given range .	3
	PSO 1	Apply **problem statement** MAT LAB commands for synthesizing and analyzing the given data in various engineering streams following mathematical rules and conditons.	1

CO 6	PO 1	Develop **Mathematics and Engineering fundamentals** the formulation of differential calculus of complex engineering problems which transforms vector functions, gradient, Divergence and curl using principle of mathematics to the realworld engineering problems by using MAT LAB programs.	3
	PO 2	Apply **principles of Sciences and Engineering fundamentals** the formulation of integral transformations to complex engineering problems related to surface and volume, line and surface of different geometrical models using principle of mathematics in the domain of engineering to reach conclusions by interpretation of results.	2
	PSO 1	Apply **understand the innovative and dynamic challenges** MAT LAB commands for synthesizing and analyzing the given data in various engineering streams following mathematical rules and conditons.	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES			PSO'S
	PO 1	PO 2	PO 4	PSO 1
CO 1	3	2	1	1
CO 2	3	2	1	1
CO 3	3	2	1	1
CO 4	3	1	-	1
CO 5	3	-	-	1
CO 6	3	1	-	1

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 3, PSO 3	SEE Exams	PO 1,PO 3, PO 5, PSO 3	Seminars	-
Laboratory Practices	PO 1,PO 3, PO 5, PSO 3	Student Viva	PO 1, PO 5	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**BASIC FEATURES**
	To Know the history and features of MATLAB, To Know the loca lenvironment of MATLAB
WEEK II	**ALGEBRA**
	Solving basic algebraic equations, Solving system of equations, Two dimensional plots.
WEEK III	**CALCULUS**
	Calculating limits, Solving differential equations, Finding definite integral.
WEEK IV	**MATRICES**
	Addition,subtraction and multiplication of matrices, Transpose of a matrix, Inverse of a matrix.
WEEK V	**SYSTEMOF LINEAREQUATIONS**
	Rank of a matrix, Gauss Jordan method, LU decomposition method.
WEEK VI	**LINEARTRANSFORMATION**
	Characteristic equation, Eigen values, Eigen vectors.
WEEK VII	**DIFFERENTIATIONANDINTEGRATION**
	a. Higher order differential equations, Double integrals, Triple integrals.
WEEK VIII	**INTERPOLATION AND CURVEFITTING**
	Lagrange polynomial, Straight linefit, Polynomial curve fit.
WEEK IX	**ROOT FINDING TECHNIQUES**
	Bisection method, Regulafalsemethod, NewtonRaphsonmethod.
WEEK X	**NUMERICAL DIFFERENTION AND INTEGRATION**
	Trapezoidal, Simpson‘smethod, Eulermethod, RungeKuttamethod.
WEEK XI	**3D PLOTTING**
	Line plotting, Surfaceplotting Volumeplotting.
WEEK XII	**VECTORCALCULUS**
	Gradient, Divergent, Curl.

TEXTBOOKS

1. 1. Dean G.Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press,Taylorand Francis Group,6thEdition,NewDelhi,2015.

REFERENCE BOOKS:

1. 1.Cleve Moler,Numerical Computing with MATLAB,SIAM,Philadelphia,2ndEdition,2008.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Understanding thebasic featuresof MATLAB.	CO 1	T1:1.1 R1:2.21

2	Determination of roots of agiven polynomial.	CO 1	T1:15.1 R1:2.25
3	Verification of basic properties of limits.	CO 2	T1:2.1 R1:2.21
4	Determination ofrank,inverse,transpose and obtaining the solution to linear system of equationsofamatrix.	CO 3	T1-15.6 R1:2.32
5	Interpret the Eigen values and Eigenvectors of a matrix.	CO 3	T1:15.5 R1:2
6	Determination of derivatives and integration toa Given function.	CO 4	T1:2.1 R1:2.8
7	Determination of bestfit curve to the given data	CO 6	T1:3.0 R1:2.9
8	Calculation of areaenclosed bounded bya region.	CO 4	T1:14.5 R1:5.1
9	Solving the higher order differential equations.	CO 4	T1:3.1 R1:5.21
10	Plotting agiven surface bounded in a region.	CO 4	T1:14.3-14.8 R1:5.1
11	Determination of gradient,divergence and cur of avector. .	CO 5	T1:14.2 R1:2.2
12	Determination of roots to algebraic and transcendental equations by bisection method, Method of false position and Newton-Raphson method	CO 6	T1:2.2 R1:2.25

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Algebraic equations:** Apply MAT LAB programs to algebraic equations
2	**Differentiation:** Apply MAT LAB programs differential equations and matrices .
3	**Matrices:** Apply MAT LAB programs to eigen values and eigen vectors.
4	**Numerical methods** Apply MAT LAB programs to numerical methods
5	**Vector calculus:** Apply MAT LAB programs to vector calculus

Signature of Course Coordinator **HOD,ME**
Ms. B Praveena, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**AERONAUTICAL ENGINEERING**				
Course Name	**LINEAR ALGEBRA & ORDINARY DIFFERENTIAL EQUATIONS**				
Course Code	AHS002				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	IARE -R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. L Indira, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	10+2	-	

II COURSE OVERVIEW:

The Linear algebra is a sub-field of mathematics concerned with vectors, matrices, and linear transforms. Calculus is the branch of mathematics which majorly deals with derivatives and integrals. Linear algebra is a key foundation to the field of machine learning. The course includes types of Matrices, Rank, methods of finding rank, Eigen values and Eigen vectors, maxima and minima of functions of several variables, solutions of higher order ordinary differential equations and Fourier series. Matrices are used in computer animations, color image processing. Eigen values are used by engineers to discover new and better designs for the future. The laws of physics are generally written down as differential equations. So, differential equations have wide applications in various engineering and science disciplines. This course enables the students to gain basic knowledge on the mathematics which is used in modeling the real time engineering problems very often.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Liner algebra and calculus	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
30 %	Understand
60 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

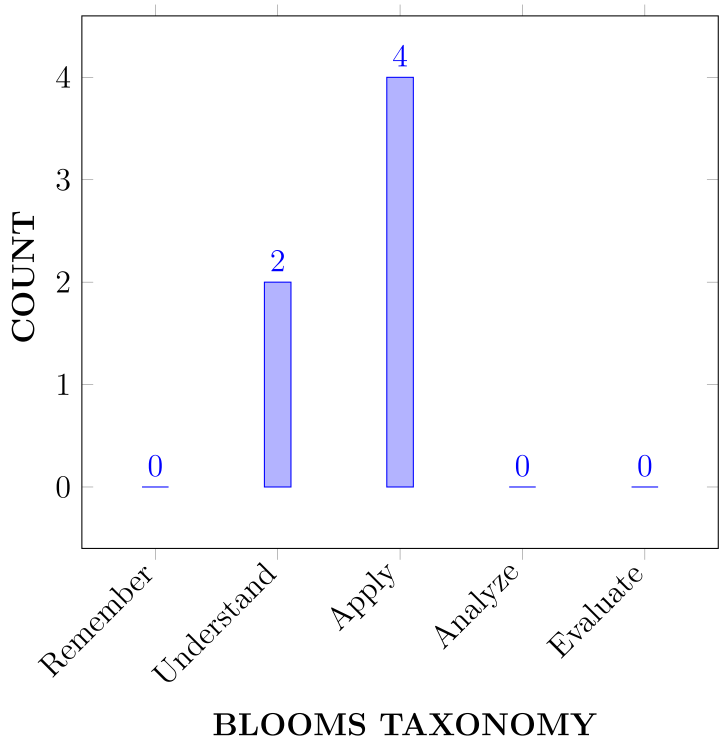
I	The principles of Eigen value analysis and linear transformations, Matrix rank finding methods.
II	The analytical methods for solving higher order differential equations with constant coefficients.
III	The calculus of functions of several variables and the concept of maxima-minima for a three-dimensional surface

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Calculate** the rank and inverse of real and complex matrices with elementary transformation methods.	Apply
CO 2	**Compute** the diagonally equivalent matrix and Cayley Hamiltonion equation of the given matrix by using Eigen values and Eigen vectors.	Apply
CO 3	**Interpret** the properties of differential equation of first order and first degree and orthogonal trajectories byusing integration factor method	Understand
CO 4	**Solve** the Second and higher order linear homogeneous and non homogeneous differential equations with constant coefficients by using substitution method.	Apply
CO 5	**Interpret** the extreme values for functions of several variables by using parial derivatives .	Understand
CO 6	**Apply** mean–value theorems in establishing some mathematical inequalities	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Synthesize and analyze aircraft structures, propulsion, production technologies and computer aided engineering in aeronautical systems including air traffic controls standards.	-	-
PSO 2	Focus on broad knowledge of aeronautical engineering in innovative, dynamic and challenging environment for design and development of new products. .	-	-
PSO 3	Make use of design, computational and experimental tools for research and innovation in aerospace technologies and allied streams, to become successful professional, entrepreneurs and desire higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-		-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	- -
CO 6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the role of rank and inverse of real and complex matrices in solving complex engineering problems by using elementary transformation methods (**principles of mathematics** and **scientific methodology**).	2
CO 2	PO 1	Determine the diagonally equivalent matrix of given matrix involved in the complex engineering problems modeled by matrices with help of Eigen values and Eigen vectors (**principles of mathematics** and **scientific methodology)**).	2
	PO 2	Understand the **statement** and **formulation** of a complex engineering problem **modeled** by matrices with help of Eigen values and Eigen vectors and diagonalization to **develop** the solution and reaching substantiated conclusions by the **interpretation of results**	5
CO 3	PO 1	Identify whether the given differential equation of first order and first degree is exact or not by using integration factor method (**principles of mathematics** and **scientific methodology**)	2
CO 4	PO 1	Solve the complex engineering problems modeled by Second and higher order linear homogeneous differential equations (principles of mathematics) with constant coefficients by using substitution method (**principles of mathematics** and **scientific methodology**)	2
	PO 2	Understand the **statement** and **formulation** of a complex engineering problem **Modeled** by linear differential equations and solve them using substitution method along with basic principles of mathematics to **develop** the solution and reaching substantiated conclusions by the **interpretation of results** .	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	PO 1	Explain the mean–value theorems for the single variable functions and apply them in the complex engineering problems modeled by functions of single variables with their geometrical interpretation (**principles of mathematics** and **scientific methodology**).	2
CO 6	PO 1	Interpret the extreme values for functions of several variables and apply them in the complex engineering problems modeled by functions of several variableswith the help of partial derivatives (**principles of mathematics** and **scientific methodology**).	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	67	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	4	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO1,PO2	SEE Exams	PO1,PO2	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5Tech-talk	PO1,PO2	Open Ended Experiments	-
Assignments		concept video		mini project	

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**THEORY OF MATRICES**
	Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew- Hermitian and unitary matrices; Elementary row and column transformations, elementary matrix, finding rank of a matrix by reducing to Echelon form and normal form; Finding the inverse of a matrix using elementary row/column transformations: Gauss-Jordan method; Solving of linear system of equations by LU decomposition method.
MODULE II	**LINEAR TRANSFORMATIONS**
	Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Linear transformation; Eigen values and Eigen vectors of a matrix; Properties of Eigen values and Eigen vectors of real and complex matrices; Diagonalization of matrix.
MODULE III	**DIFFERENTIAL EQUATIONS OF FIRST ORDER AND THEIR APPLICATIONS**
	Solution of first order linear differential equations by exact, non exact, linear equations; Bernoulli equation. Applications of first order differential equations: Orthogonal trajectories; Newton's law of cooling; Law of natural growth and decay.

MODULE IV	**HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS**
	Linear differential equations of second and higher order with constant coefficients, non-homogeneous term of the f(x)=e^{ax},sinax,cosaxand f (x) = x^n , $e^{ax}v(x)$, $x^n v(x)$; Method of variation of parameter; Application to electrical circuits and Simple Harmonic Motion
MODULE V	**FUNCTIONS OF SINGLE AND SEVERAL VARIABLES**
	Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof; Functions of several variables: Partial differentiation, chain rule, total derivative, Euler's theorem, functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers

TEXTBOOKS

1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition,2014. .

2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition,2012.

REFERENCE BOOKS:

1. RK Jain & SRK Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition,2016

2. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-1", Tata McGraw Hill Education, 1st Edition, 2009..

3. Srimanthapa & SubothC.Bhunia,"EngineeringMathematics", Oxford Publishers, 3rd Edition ,2015

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/108/111108157

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Introduction to outcome based education		
CONTENT DELIVERY (THEORY)			
2	Theory of matrices: types of real matrices	CO1	T2:32.1R1:4.1 1
3	Real matrices:symmetric, skew-symmetric matrices	CO1	T2:32.1 R1:4.2
4	Real Matrices: orthogonal matrices	CO1	T2:32.1 R1:4.3
5	Complex matrices:Hermitian, Skew- Hermitian	CO1	T2:32.1 R1:4.3
6	Complex matrices: unitary matrices	CO1	T2:32.5 R1:4.6
7	Elementary row and column transformations	CO1	T2:32.5 R1:4.6
8	Rank of a matrix by echelon form	CO1	T2:32.4 R1:4.5

9	Rank of a matrix by normal form	CO1	T2:32.7 R1:4.8
10	Inverse of a matrix by Gauss-Jordan method	CO1	T2-7.1 R1:7.4
11	Eigen values of a matrix	CO2	T2-7.1 R1:7.4
12	Eigen vectors of a matrix	CO2	T2-7.1 R1:7.4
13	Diagonalizationof matrix by linear transformation.	CO 2	T2:7.1 R1:7.4
14	Cayley-Hamilton theorem- statement, verifications	CO 2	T2:7.1 R1:7.4
15	Applications of Cayley – Hamilton theorem	CO 2	T3-2.9 R1:2.1
16	Linear dependence and independence of vectors	CO 2	T3-2.5 R1:2.8
17	First order linear differential equations	CO3	T3-2.5 R1:2.8
18	Bernoulli's differential equations	CO3	T3-2.5 R1:2.8
19	Exact differential equations	CO3	T3-2.5 R1:2.8
20	Non exact differential equations	CO3	T3-2.5 R1:2.8
21	Equations reducible to exact form	CO3	T3-2.61 R1:2.10
22	Orthogonal trajectories	CO3	T1-7.1 R2:7.5
23	Newton's law of cooling	CO3	T3-2.61 R1:2.10
24	Law of natural growth and decay	CO3	T1-7.1 R2:7.6
25	Application method of Lagrange multipliers	CO3	T1-7.1 R2:7.7
26	Method of Lagrange multipliers	CO3	T3-2.5 R1:2.8
27	higher order Linear differential equations	CO4	T3-2.5 R1:2.8
28	Linear differential equations of second and higher order with polynomial coefficients	CO4	T3-2.5 R1:2.8
29	Non-homogeneous term of the type f (x) =e^{ax}	CO4	T3-2.5 R1:2.8
30	Q(x) is of the type f(x) = sinax or cosax	CO4	T2-7.1 R1:7.4
31	Non-homogeneous term of the type f (x) = X^n	CO4	T2:7.1 R1:7.4
32	Non-homogeneous term of the type f (x) = $e^{ax}V(x)$	CO4	T2:7.1 R1:7.4
33	Method of variation of parameters	CO4	T3-2.9 R1:2.1
34	Mean value theorems:1. Rolle's theorem	CO5,CO 6	T3-2.5 R1:2.8
35	Mean value theorems:2. Lagrange's theorem	CO5,CO 6	T3-2.5 R1:2.8
36	Mean value theorems:3. Cauchy's theorem	CO5,CO 6	T2:7.1 R1:7.4
37	Functions of several variables: Partial differentiation	CO5,CO 6	T3-2.9 R1:2.1
38	Jacobian transformations	CO5,CO 6	T3-2.5 R1:2.8
39	Functional dependence	CO5,CO 6	T2:7.1R1:7.4
40	Maxima and minima of functions with two variables	CO5,CO 6	T3-2.9 R1:2.1
41	Maxima and minima of functions with three variables	CO5,CO 6	T3-2.5R1:2.8
PROBLEM SOLVING/ CASE STUDIES			
42	Rank of the matrix by Echelon and normal form	CO1	T2:32.1 R1:4.2
43	Solving system of linear non homogeneous equations	CO1	T2:32.1 R1:4.3

44	Eigen values and eigen vectors of the matrix	CO2	T2:32.1 R1:4.3
45	Finding spectral matrix by linear transformation.	CO2	T2-7.1 R1:7.4
46	Verification of Caley- Hamilton theorem	CO2	T2-7.1 R1:7.4
47	Finding powers of the matrix by Caley -Hamilton theorem	CO2	T2:7.1 R1:7.4
48	Solving first order differential equations	CO3	T2:7.1 R1:7.4
49	Solving Non-Homogeneous Differential Equations.	CO3	T3-2.5 R1:2.8
50	Solving linear and exact differential equations	CO3	T3-2.5 R1:2.8
51	Finding C.F and P.I. of higher order differential equations	CO9	T3-2.5 R1:2.8
52	Solving Second Order Non-homogeneous differential equations by method of variation of parameters	CO4	T3-2.5 R1:2.8
53	Solving higher differential equations of different types	CO4	T3-2.61 R1:2.10
54	Jacobian transformation in Cartesian and Polar Forms	CO 5,CO 6	T2:7.1 R1:7.4
55	Finding functional relationship.	CO 5,CO 6	T3-2.9 R1:2.1
56	Finding max.and min. of functions of two variables	CO 5,CO 6	T3-2.5 R1:2.8
	DISCUSSION OF DEFINITION AND TERMINOLOGY		
57	Real, complex matrices and rank of a matrix	CO1	T3-2.5 R1:2.8
58	Eigen values and eigen vectors, diagonalization	CO2	T3-2.5 R1:2.8
59	First order linear, exact and non-exact D.Es.	CO3	T3-2.5 R1:2.8
60	Higher order differential equations	CO4	T3-2.5 R1:2.8
61	Mean value theorems, Jacobian transformations, functionally dependent and independent	CO5	T3-2.61 R1:2.10
	DISCUSSION OF QUESTION BANK		
62	Theory of matrices	CO1	T2:7.1R1:7.4
63	Linear transformations	CO2	T3-2.9R1:2.1
64	First order and degree differential equations	CO3	T3-2.5R1:2.8
65	Higher order differential equations	CO4	T2:32.1R1:4.3
66	Functions of several variables	CO5, CO 6	T2-7.1R1:7.4

Signature of Course Coordinator **HOD,AE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCEINCE AND ENGINEERING**				
Course Title	**COMPUTATIONAL MATHEMATICS AND INTEGRAL CALCULUS**				
Course Code	AHS003				
Program	B. Tech				
Semester	I				
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. V Subbalaxmi, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	I	Basic Principles of complex functions

II COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes Types of Interpolation, Curve fitting, Numerical solutions of Ordinary Differential Equations, Multiple Integrals, Vector Calculus and Special functions. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computational Mathematics And Integral Calculus	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
36 %	Understand
64 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

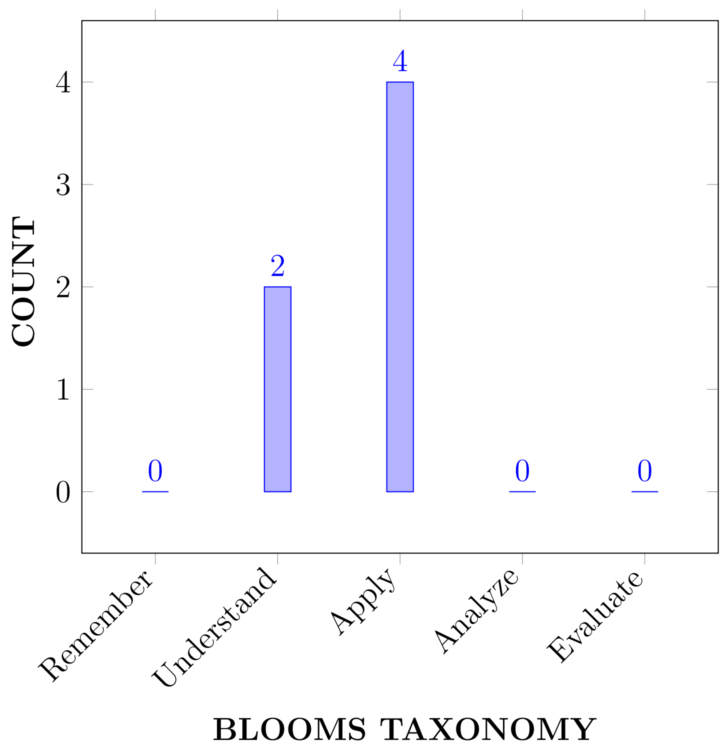
I	Enrich the knowledge of solving algebraic, transcendental and differential equation by numerical methods.
II	Apply multiple integration to evaluate mass, area and volume of the plane
III	Apply gradient, divergence and curl to evaluate the integration over a vector field
IV	Apply the Bessel's equation to solve them under special conditions with the help of series solutions.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Apply** numerical methods for solving algebric ,transcendental equations and interpolating the data	Apply
CO 2	**Make use of** least squares methods for fitting straight lines,the second degree, exponential and power curves .	Apply
CO 3	**Utilize** numerical methods for solving linear diffrential equations with initial conditions	Apply
CO 4	**Identify** the limits of definite integrals for calculating the area of solids.	Understand
CO 5	**Extend** vector operations and theorems for finding line,surface and volume integrals .	Apply
CO 6	**Determine** characterstics of special functions for solving proper and improper integrals	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	-	Seminar/ Confer-ences/ Research Papers
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-		-	-	-	-	-	-		-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-		-	-	-	-	-	-	-	-	-	

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Apply** the **basic properties** of numerical methods for solving algebric ,transcendental equations and interpolating the data algebra and applicability in solving (complex) majority of functions by applying **Mathematical principles**.	2
	PO 2	**Apply** the of numerical methods as a **formulation** of mathematical function in **complex engineering problems** which transformations a algibric and transcendental equations using **principle of mathematics** to attain conclusion by the **interpretation of results** .	4
CO 2	PO 1	**Make use of** the **basic properties** of least squares methods for solving fitting straight lines,the second degree, exponential and power curves by using **Mathematical principle** .	2
CO3	PO 1	**Utilize** the **basic properties** of numerical methods for solving linear diffrential equations with initial conditions by applying **Mathematical principles**.	2
	PO 2	**Apply** the of numerical methods as a **formulation** of mathematical function in **complex engineering problems** linear diffrential equations with initial conditions using **principle of mathematics** to attain conclusion by the **interpretation of results** .	4
CO4	PO 1	**Identify** the **basic properties** of the limits of definite integrals for calculating the area of solids by applying **Mathematical principles**.	2
	PO 2	**Identify** the integrals for calculating the area as a **formulation** of mathematical function in **complex engineering problems** which multiple integral using **principle of mathematics** to attain conclusion by the **interpretation of results**	4
CO5	PO1	**Extend** the vector operations and theorems for finding line,surface and volume integrals by using **priniciples of Mathematics** .	2
CO6	PO1	**Identify** the **Formulation** of improper integrals and their classification for applicability in solving special functions by applying the **principles of mathematics**.	2
	PO 2	**Solve** the of improper integrals as a **formulation** of mathematical function in **complex engineering problems** which transformatimations of equations using **principle of mathematics** to attain conclusion by the **interpretation of results** .	4

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	4	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	4	-	-		-	-	-	-	-	-		-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	4	-	-	-	-	-	-	-	-	-		-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	40	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	40	-	-		-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	8	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	✓	5 Minutes Video	✓	Open Ended Experiments	-
Assignments					

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester OBE Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ROOT FINDING TECHNIQUES AND INTERPOLATION**
	Solving algebraic and transcendental equations by bisection method, method of false position Newton-Raphson method; Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton's forward interpolation, Newton's backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange's interpolation, Newton's divided difference interpolation.
MODULE II	**CURVE FITTING AND NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**
	Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares. Taylor's series method; Step by step methods: Euler's, modified Euler's and Runge-Kutta method.
MODULE III	**MULTIPLE INTEGRALS**
	Double and triple integrals; Change of order of integration. Change of variables: Polar, cylindrical and spherical; Finding the area of a region using double integration and volume of a region using triple integration.
MODULE IV	**VECTOR CALCULUS**
	Scalar and vector point functions; Gradient, divergence, curl and their related properties; Solenoidal and irrotational vector point functions; Scalar potential function; Laplacian operator; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.
MODULE V	**SPECIAL FUNCTIONS**
	Gamma function, properties of gamma function; Ordinary point and regular singular point of differential equations; Series solutions to differential equations around zero, Frobenius method about zero; Bessel's differential equation: Bessel functions properties, recurrence relations, orthogonality, generating function, trigonometric expansions involving Bessel functions.

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition,2010
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition,2015

REFERENCE BOOKS:

1. T.K.V Iyengar, B.Krishna Gandhi, "Engineering Mathematics - III", S. Chand & Co., 12th Edition, 2015..
2. Churchill, R.V. and Brown, J.W, "Complex Variables and Applications", Tata Mc Graw-Hill, 8th Edition, 2012.

WEB REFERENCES:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resourcs/#Mathematics
3. http://www.sosmath.com
4. http://www.mathworld.wolfram.com

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Introduction to outcome based education		
CONTENT DELIVERY (THEORY)			
2	Define Algebraic and Transcendental equations	CO 1	T1:12.1,R1:4.2
3	Apply Bisection method to find the root	CO 1	T1:12.3, R1:4.4
4	Apply False Position method to find the root	CO 1	T1:12.3, R1:4.6
5	Apply Newton-Raphson method to find roots	CO 1	T1:12.3, R1:4.7
6	Define what interpolation is	CO 1	T1:12.4, R1:4.13
7	Explain the relation between symbols	CO 1	T1:12.4, R1:4.15
8	Solve the problems by Newton's forward method	CO 1	T1:12.4, R1:4.20
9	Solve the problems by Newton's backward method	CO 1	T1:22.9 R1:5.8
10	Solve the problems by Gauss forward method	CO 1	T1:13.1, R1:5.3
11	Solve the problems by Gauss backward method	CO 1	T1:13.2, R1:5.5
12	Solve the problems by lagrange's and Newtons dividend difference	CO 1	T1:13.3, R1:5.9
13	Define Algebraic and Transcendental equations	CO 1	T1:13.4, R1:5.10

14	Apply Bisection method to find the root	CO 1	T1:14.1, R1:6.1
15	Solve the problems by lagrange's and Newtons dividend difference	CO 1	T1:14.2 , R1:6.1
16	Solve a straight line	CO 2	T1:14.4, R1:6.2
17	Solve a second degree parabola	CO 2	T1:15.2 , R1:6.6
18	Solve an exponential curve	CO 2	T1:15.1, R1:7.4,
19	Solve the ODE by Taylor's series method	CO 3	T1:15.1, R1:6.5
20	Solve the ODE by Euler's Method- Euler's modified method	CO 3	T1:15.3, R1:7.9
21	Explain the ODE by Taylor's series method	CO 3	T2: 7.14, R1:1.6
22	Explain the ODE Euler's modified method	CO 3	T2: 7.15, R1:1.63
23	Solve the ODE by Runge-Kutta Methods	CO 3	T2: 7.15, R1:1.65
24	Calculate double and triple integrations	CO 4	T2: 16.5, R1:7.32
25	Use the Change of order for multiple integrals	CO 4	T2: 16.6, R1:7.36
26	Use the Change of variables in multiple integrals	CO 4	T2: 16.7, R1:7.36
27	Apply double integration for finding the area	CO 4	T2: 16.8, R1:7.41
28	Apply triple integration for finding the volume	CO 4	T2: 16.9, R1:7.42
29	Define vector calculus and vector fields and their properties	CO 5	T2: 16.9, R1:7.42
30	Determine Gradient, divergent and curl of vector fields	CO 5	T2: 7.14, R1:1.6
31	Calculate line integral along smooth path and find work done	CO 5	T2: 7.15, R1:1.65
32	Calculate the surface area of field	CO 5	T2: 7.15, R1:1.65
33	Calculate volume of field	CO 5	T2: 7.15, R1:1.65
34	Use Green's theorem to evaluate line integrals along simple closed contours on the plane	CO 5	T2: 16.5, R1:7.32
35	Use Stokes' theorem to give a physical interpretation of the curl of a vector field	CO 5	T2: 16.6, R1:7.36
36	Use the divergence theorem to give a physical interpretation of the divergence of a vector field	CO 5	T2: 16.7, R1:7.36
37	Apply gamma function for improper integrals	CO 6	T2: 16.7, R1:7.36

38	Motivation for series solution Ordinary and regular point of a differential equation	CO 6	T2: 16.8, R1:7.41
39	Transformation of non-zero singular point to zero singular point series solutions of differential equations around zero	CO 6	T2: 16.8, R1:7.41
40	Frobenius Method about zero	CO 6	T2: 16.9, R1:7.42
41	Explain the Bessel functions	CO 6	T2: 16.5, R1:7.32
42	Determine the solution of ordinary differential equations in series form	CO 6	T1:12.3, R1:4.4
43	Apply the Frobenius method to obtain a series solution for the given linear ODE	CO 6	T1:12.3, R1:4.7
44	Demonstrate Bessel's Differential equation	CO 6	T1:12.4, R1:4.13
PROBLEM SOLVING/ CASE STUDIES			
45	Solving problems on bisection,false position method	CO 1	T1:17.1-17.2 R1:16.1-16.2
46	Solving problems on Newton Raphson method	CO 1	T1:17.5-17.6 R1:16.3.1
47	Solving problems on interpolation methods	CO 1	T1:17.1-17.2 R1:16.1-16.2
48	Solving problems on straightlines ,second degree .exponential curves least squares method	CO 2	T1:17.5-17.6 R1:16.3.1
49	Solving problems onTaylor's series method	CO 3	T1:17.1-17.2 R1:16.1-16.2
50	Solving problems onStep by step methods: Euler's, modified Euler's	CO 3	T1:23.10 R1:8.1
51	Solving problems on Runge-Kutta method	CO 3	T1:23.1 R1:9.2
52	Solving problems on Double and triple integrals	CO 4	T1:23.1 R1:9.4
53	Solving problems on Vector integral theorems	CO 5	T1:23.1 R1:9.9
54	Solving problems on properties of gamma function	CO 6	T1:23.10 R1:8.1
55	Solving problems on properties of Bessel function, Recurrence relations of Bessel function, Generating function and orthogonality of Bessel function	CO 6	T1:17.1-17.2 R1:16.1-16.2

56	Solving problems onTrigonometric expansions involving Bessel function.	CO 6	T1:17.1-17.2 R1:16.1-16.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions and terminology of Module I on Root finding techniques and interpolation	CO 1	T1:23.10 R1:6.8
58	Definitions and terminology of Module II on Curve fitting and numerical solution of ordinary differential equations	CO 2, CO 3	T1:23.10 R1:7.5
59	Definitions and terminology of Module III on Multiple integrals	CO 4	T1:23.10 R1:8.1
60	Definitions and terminology of Module IV on Vector calculus	CO 6	T2:27.12 R1:11.10
61	Definitions and terminology of Module V on Special functions	CO 6	T1:17.1-17.2 R1:16.1-16.2
DISCUSSION OF QUESTION BANK			
62	Discussion of Question Bank of Module I on Root Finding Techniques and Interpolation	CO 1	T1:23.10 R1:8.1
63	Discussion of Question Bank of Module II on Curve Fitting and Numerical Solution of Ordinary Differential Equations	CO 2, CO 3	T1:23.10 R1:6.8
64	Discussion of Question Bank of Module III on Multiple Integrals	CO 4	T1:23.10 R1:7.5
65	Discussion of Question Bank of Module IV on Vector calculus	CO 5	T2:27.12 R1:11.10
66	Discussion of Question Bank of Module V on Special Functions	CO 6	T1:17.1-17.2 R1:16.1-16.2

Course Coordinator: **HOD, CSE**
Ms V Subbalaxmi , Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**ENGINEERING PHYSICS**				
Course Code	AHS006				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	3	2
Course Coordinator	Mr. K. Saibaba, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Prerequisites
10+2	-	Basic Principles of Physics

II COURSE OVERVIEW:

This course develops abstract and critical reasoning by studying mathematical and logical proofs and assumptions as applied in basic physics and to make connections between physics and other branches of sciences and technology. The topics covered include nano materials, LASER, dielectric and magnetic properties, principles of quantum mechanics and semiconductors physics. The course helps students to gain knowledge of basic principles and appreciate the diverse applications in technological fields in respective branches and also in their lives.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Physics	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): he SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
0 %	Remember
60 %	Understand
40 %	Apply
0 %	Analyze

Table 1: The expected percentage of cognitive level of questions in SEE

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/Alternative Assessment Tool.

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Table 2: Assessment pattern for CIA

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.
Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Assignment	Seminar	Term Paper
40%	40%	20%

Table 3: Assessment Pattern

VI COURSE OBJECTIVES:

The students will try to learn:

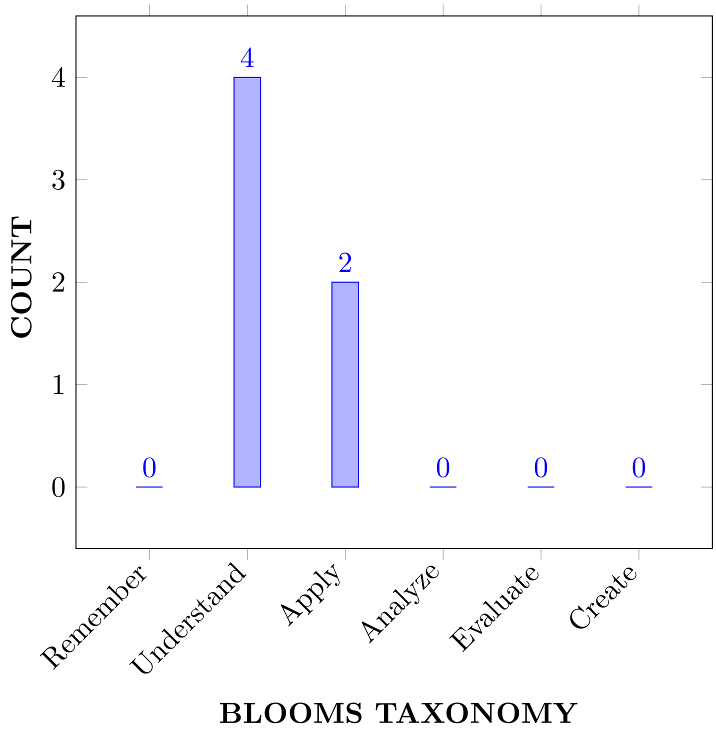
I	Develop strong fundamentals of nanomaterials.
II	Meliorate the knowledge of theoretical and technological aspects of LASER.
III	Correlate principles with applications of the quantum mechanics, dielectric and magnetic materials.
IV	Enrich knowledge in modern engineering materials like semiconductors.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** the properties of dielectric and magnetic materials suitable for engineering applications.	Understand
CO 2	**Compare** the concepts of LASER and normal light in terms of mechanism and working principles for applications in various fields and scientific practices.	Understand
CO 3	**Illustrate** basic principle, properties and production techniques of nanomaterials.	Understand
CO 4	**Make use of** knowledge of nanomaterials to different applications in day to day life.	Apply
CO 5	**Apply** the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.	Apply
CO 6	**Demonstrate** the classification of solids and important aspects of semiconductors in terms of carrier concentration and Fermi level.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Outcomes	
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems..	3	SEE/CIE/Quiz/ AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	SEE/CIE/Quiz/ AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	SEE/CIE/Quiz/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	1	AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH POs,PSOs:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	✓	-	-	-	-	-	-	-		-	-	✓
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	-	-		-	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	POs PSOs	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Relate** principles of different types of polarization mechanism and expression for polarizability to the properties of functional materials and for solving engineering problems by applying these principles of science.	3
	PO 2	**Explain** the given **problem statement** and **formulate** polarization versus applied electric field related to ferroelectric materials from the provided **information** and **data** by the **interpretation of hysteresis loop**.	4
	PO 1	**Utilize** spin and orbital motion of electrons in determining **magnetic moment** of materials in terms of Bohr magneton materials having specific **engineering applications**.	3

Course Outcomes	POs PSOs	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 4	**Identify** the use of magnetic materials and their magnetization values for the **research based knowledge** and **technological development.**	2
	PSO 3	**Make use of** Make use of modern computer tools to determine remnant magnetization and coercivity values from B-H curve and gain knowledge helpful **for higher studies**.	1
CO 2	PO 1	**Compare** the concepts of LASER and normal light in terms of mechanism, explain types of lasers and **working principle** for applications in different fields and scientific practices.	3
CO 3	PO 1	**Explain** the basic principles, properties and applications of nano materials by using **surface to volume ratio** and **quantum confinement effect.**	3
CO 4	PO 1	**Develop** the knowledge about different techniques of producing nano materials by using basic principles of nano materials	3
	PO 2	**Explain** the given **problem statement** and **formulate** procedure for fabrication of nano materials from the **information** and **data** by the **interpretation of properties of bulk materials**.	4
	PO 4	**Identify** the use of nano materials for the **research based knowledge** and **technological development.**	2
CO 5	PO 1	**Outline** drawbacks of classical mechanics, basic principles **dual nature** of matter wave, **derive** mathematical wave equation of matter waves and come to **conclusion** of quantization of energy used in quantum dots.	3
	PO 2	**Explain** the given **problem statement** and formulate quantum confinement problems related to particle enclosed in small dimension from the provided **information** and **data** in reaching substantial conclusions by the **interpretation of results**.	4
CO 6	PO 1	**Illustrate** the charge transport mechanism in intrinsic and extrinsic semiconductors using energy level diagrams, calculate their charge carrier concentration and use those expressions to integrate with other engineering disciplines .	3
	PO 4	**Identify** the use of these semiconductors under study and their conduction mechanism for the **research based knowledge** and **technological development**.	2
	PO 2	**Explain** the given **problem statement** and formulate mobility and conductivity aspects of a material from the provided **information** and **data** in reaching substantial conclusions by the **interpretation of Hall coefficient value**.	4

Note: For Key Attributes refer **Annexure-1**

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	4	-	2	-	-	-	-	-	-	-		-	-	1
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	4	-	2	-	-	-	-	-	-	-		-	-	-
CO 5	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	4	-	2	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/PSO:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	40	-	18	-	-	-	-	-	-	-		-	-	30
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	18	-	-	-	-	-	-	-		-	-	-
CO 5	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	18	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (CO-PO/PSO MAPPING):

COs and POs and COs and PSOs on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1-5 $<C \leq 40\%$ – Low/ Slight

2 - $40\ \% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	1	-	-	-	-	-	-	-		-	-	1
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	1	-	-	-	-	-	-	-		-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	1	-	-	-	-	-	-	-		-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
TOTAL	18	8	-	3	-		-	-	-	-	-	-	-	-	1
AVERAGE	3	2	-	1	-		-	-	-	-	-	-	-	-	1

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	✓	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

x	Assessment of mini projects by experts	✓	End Semester OBE Feedback
x	Assessment of activities / Modeling and Experimental Tools in Engineering by Experts	-	-

XVIII SYLLABUS:

UNIT I	**DIELECTRIC AND MAGNETIC PROPERTIES**
	Dielectric properties: Basic definitions, electronic, ionic and orientation polarizations-qualitative; Internal field in solids; Magnetic properties: Basic definitions, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, domain theory of ferro magnetism on the basis of hysteresis curve.
UNIT II	**LASERS**
	Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, Einstein's coefficients, ruby laser, He-Ne laser, semiconductor diode laser and applications of lasers.
UNIT III	**NANOMATERIAL**
	Nanomaterial: Origin of nanomaterial, nano scale, surface to volume ratio, quantum confinement; Properties of nanomaterials: Physical, chemical, electrical, optical, magnetic and mechanical. Bottom-up fabrication: Sol-gel; Top-down fabrication: Chemical vapour deposition; Applications of nanomaterials, characterization by XRD, TEM.

UNIT IV	**QUANTUM MECHANICS**
	Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, De-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Time-independent Schrödinger equation for wave function, Born interpretation of the wave function, Schrödinger equation for one dimensional problems–particle in a box.
UNIT V	**SEMICONDUCTOR PHYSICS**
	Semiconductor physics: Fermi level in intrinsic and extrinsic semiconductors, calculation of carrier concentration in intrinsic and extrinsic semiconductors, energy gap, direct and indirect band gap semiconductors, Hall effect.

TEXTBOOKS

1. Dr. K Vijay Kumar and Dr. S Chandralingam — Modern Engineering Physics‖ Chand & Co.NewDelhi,1st Edition, 2010.
2. P. K. Palanisamy —Engineering Physics‖,Scitech Publishers, 4th Edition, 2014.

REFERENCE BOOKS:

1. V. Rajendran—Engineering Physics‖, Tata McGraw Hill Book Publishers, 1st Edition, 2010.
2. R. K. Gaur, S. L. Gupta, -Engineering Physics‖, DhanpatRai Publications, 8th Edition,2001.
3. A. J. Dekker-Solid State Physics‖Macmillan India ltd, 1st Edition, 2000.
4. Hitendra K. Malik, A. K. Singh-Engineering Physics‖McGraw Hill Education, 1st Edition, 2009.

WEB REFERENCES

1. http://link.springer.com/book
2. http://www.thpys.physics.ox.ac.uk
3. http://sciencedirect.com/science
4. http://www.e-booksdirectory.com

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be some changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT THEORY(DELIVERY)			
2	Acquire knowledge of basic terms related to dielectric materials.	CO 1	T1:13.5 R1:1.3
3	Discuss different polarization mechanisms in dielectrics	CO 1	T1:13.5 R1:1.3
4	Derive expression for total electric field at a given point inside dielectrics.	CO 1	T1:13.5 R1:1.3

5	Acquire knowledge of basic terms related to magnetic materials.	CO 1	T1:14.7 R1:3.4
6	Describe magnetic moment in an atom in terms of Bohr Magneton	CO 1	T1:15.7 R1:4.10
7	Classify different magnetic materials based on electron theory.	CO 1	T1:16.8 R1:4.15
8	Examine the spontaneous magnetization in ferro-magnets based on orientation of domains.	CO 1	T1:16.9 R1:5.4
9	Explain the principle involved in Lasers	CO 2	T1:17.9 R1:5.8
10	Review basic phenomena's of laser	CO 2	T1:18.10 R1:6.8
11	Discuss functioning of laser system	CO 2	T1:19.9 R1:7.5
12	Derive relation between Einstein's Coefficients	CO 2	T1:23.10 R1:7.5
13	Explain the principle and working of Ruby laser	CO 2	T1:23.10 R1:8.1
14	Explain the principle and working of Helium-Neon laser	CO 2	T1:23.1 R1:9.2
15	Explain the principle and working of semiconductor diode laser	CO 2	T1:23.1 R1:9.4
16	Explain the principle and working of Helium-Neon laser	CO 2	T1:23.1 R1:9.9
17	Explain the principle and working of semiconductor diode laser	CO 2	T1:23.1 R1:9.10
18	Discuss the uses of lasers	CO 2	T2:27.5 R1:10.2
19	Identify the principle of nano technology	CO 3	T2:27.7 R1:11.3
20	Recall origin of nanomaterials	CO 5	T2:27.8 R1:11.6
21	Acquire knowledge of basic principle of nanomaterials.	CO 3	T2:27.12 R1:11.7
22	Analyze nano material with their properties	CO 3	T2:27.12 R1:11.8
23	Develop nanomaterials in sol gel method	CO 4	T2:27.12 R1:11.9
24	Develop nanomaterials chemical method	CO 4	T2:27.12 R1:11.10
25	Discuss applications of nanomaterials	CO 4	T2:27.14 R1:12.3
26	Analyze nanomaterials by XRD	CO 4	T2:27.1 R1:12.7
27	Analyze nanomaterials by TEM	CO 4	T2:27.17 R1:12.15

28	Understand dual nature of radiation	CO 5	T2:27.18 R1:12.19
29	Correlate dual nature to material particle	CO 5	T2:27.19 R2:14.4
30	Analyze matter wave concept mathematically	CO 5	T2:27.20 R2:14.5
31	Describe matter waves and Heisenberg's Uncertainty Principle	CO 5	T2:30.19 R2:14.5
32	Identify existence of matter wave experimentally	CO 5	T2:30.20 R2:15.5
33	Derive wave equation of matter wave	CO 5	T2:32.19 R2:16.5
34	Correlate wave function to probability density.	CO 5	T2:32.20 R2:16.5
35	Derive the solution of wave equation in terms of Potential box	CO 5	T2:33.1 R2:16.6
36	Apply to three dimensions	CO 5	T2:34.1 R2:17.1
37	Explain basic concepts of semiconductors	CO 6	T2:35.2 R2:17.2
38	Derive carrier concentration in intrinsic Semiconductors	CO 6	T2:36.1 R2:18.1
39	Identify Fermi level in semiconductors	CO 6	T2:39.19 R2:16.5
40	Determine energy gap mathematically	CO 6	T2:40.19 R2:16.5
41	Compare Direct &Indirect Band Gap semiconductors, Hall Effect	CO 6	T2:41.19 R2:16.5
PROBLEM SOLVING			
1	Dielectric constant, capacitance, permittivity	CO 1	T2:16.5; R3:8.10
2	Electric susceptibility, Polarization vector	CO 1	T2:16.5; R3:8.10
3	Polarizability	CO 1	T1:3.3.1; R3:3.2
4	Magnetic moment, Magnetic induction, Permeability	CO 1	T2:16.5; R3:8.10
5	Intensity of magnetization, Magnetic susceptibility	CO 1	T2:16.5; R3:8.10
6	Wavelength and Energy bandgap	CO 2	T2:16.5; R3:8.10
7	Divergence	CO 2	T2:16.5; R3:8.10
8	Relative population of two states	CO 2	T1:3.3.1; R3:3.2

9	Number of photons emitted	CO 2	T1:3.3.1; R3:3.2
10	De-broglie wavelength	CO 5	T1:3.3.1; R3:3.2
11	Energies associated with one dimensional potential box	CO 5	T2:16.5; R3:8.10
12	Intrinsic carrier concentration, Fermi level in semiconductors	CO 6	T2:16.5; R3:8.10
13	Carrier concentration based on Hall coefficient	CO 6	T1:3.3.1; R3:3.2
14	Mobility and conductivity based on Hall coefficient	CO 6	T2:16.5; R3:8.10
15	Diffusion and drift	CO 6	T2:16.5; R3:8.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Dielectric And Magnetic Properties	CO 1	T2:16.5; R3:8.10
2	LASER	CO 2	T1:3.3.1; R3:3.2
3	Nanomaterial	CO 3, CO 4	T2:16.5; R3:8.10
4	Quantum Mechanics	CO 5	T2:16.5; R3:8.10
5	Semiconductor Physics	CO 6	T2:16.5; R3:8.10
DISCUSSION OF QUESTION BANK			
1	Dielectric And Magnetic Properties	CO 1	T2:16.5; R3:8.10
2	LASER	CO 2	T1:3.3.1; R3:3.2
3	Nanomaterial	CO 3, CO 4	T2:16.5; R3:8.10
4	Quantum Mechanics	CO 5	T2:16.5; R3:8.10
5	Semiconductor Physics	CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD**

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences (**Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions	**10**

	5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	
PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**

PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project.	**12**

	6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	
PO 10	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally" 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**
PO 11	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**

PO 12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**ENGINEERING CHEMISTRY**				
Course Code	**AHS005**				
Program	**B.Tech**				
Semester	**I**				
Course Type	**FOUNDATION**				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	3	1.5
Course Coordinator	Dr V Anitha Rani, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Vital principles of chemistry

II COURSE OVERVIEW:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the Intermediate level. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Chemistry	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE UNITs and each UNIT carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with either or choice will be drawn from each UNIT. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE UNITs and each UNIT carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each UNIT. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
50%	Understand
50%	Apply
0 %	Analyze
0%	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

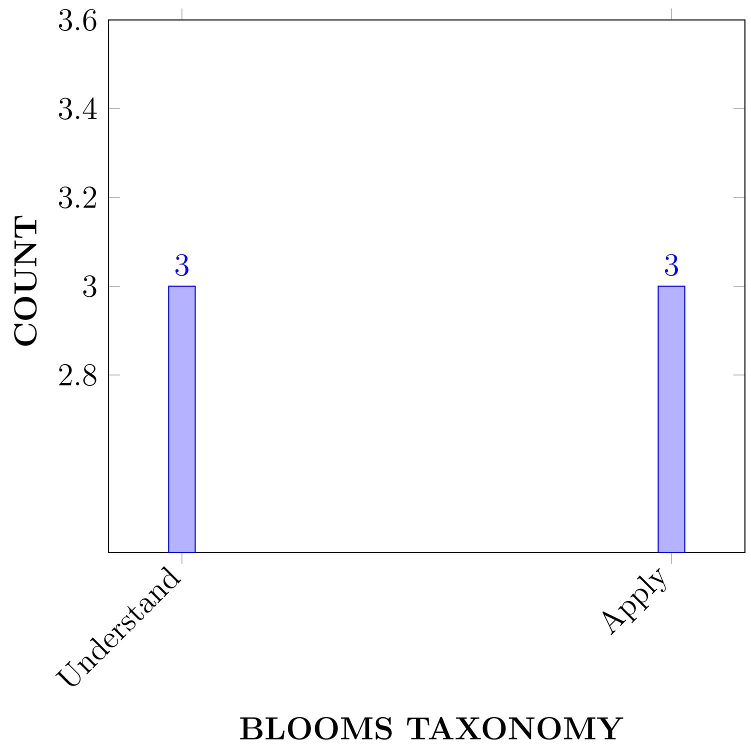
I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The microscopic chemistry in terms of atomic, molecular orbitals and Intermolecular forces.
IV	The different molecular organic chemical reactions that are used in the synthesis of molecules.
V	The properties, separation techniques of natural gas and crude oil along with potential applications in major chemical reactions.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the electrochemical principles, corrosion process in metals for protection of different metals from corrosion.	Understand
CO 2	**Utilize** electrochemical cell parameters, electrochemical active surface area, current and over potential under given condition for calculating the electromotive force and electrode potential.	Apply
CO 3	**Identify** the hardness of water by different treatment methods for finding the hardness causing salts in water.	Apply
CO 4	**Illustrate** the molecular orbital energy level diagrams of different molecules and theories of bonding for understanding the magnetic properties of coordination compounds.	Understand
CO 5	**Explain** the mechanism of different chemical reactions, stereo isomers for finding the optically active compounds and synthesizing the drug molecules.	Understand
CO 6	**Make use of** green synthesis methods, different types of solid, liquid and gaseous fuels in terms of calorific value for utilizing in industries and automobiles.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2.5	SEE/CIE/Quiz/ AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	SEE/CIE/Quiz/ AAT
PO 7	**Environment and sustainability:** understand the impact of the professional engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	SEE/CIE/Quiz/ AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build the prototype of UAVs and aero-foil models for testing by using low speed wind tunnel towards research in the area of experimental aerodynamics.	-	-
PSO 2	Focus on formulation and evaluation of aircraft elastic bodies for characterization of aero elastic phenomena.	-	-
PSO 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	✓	-	-	-	-	-	-	-	

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the electrochemical properties for producing electrical energy (understand) by using principles of science for solving engineering problems.	2
CO 2	PO 1	Choose different electrodes for finding pH of unknown solutions by applying mathematical expressions of cell potential by using principles of science and mathematics for solving engineering problems	3
	PO 2	Identify the problem formulation and abstraction for calculating electrode potential under non standard conditions by applying Nernst equation from the provided information.	2
CO3	PO1	Explain the concept of corrosion processes in metals by exposing to acidic environment for solving engineering problems by applying the principles of science	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO2	Identify the problem and formulate for finding the hardness of water in terms of CaCO3 equivalents with given information and data by applying principles of science.	2
CO4	PO1	Explain the formation of molecular orbitals by linear combination of atomic orbitals, splitting of d orbitals for formation of octahedral, tetrahedral and square planar complexes for solving engineering problems by applying the principles of science.	2
CO5	PO1	Illustrate the structural and stereo isomers of optically active compounds, different types of molecular organic reactions for synthesizing drugs by using principles of science for solving engineering problems.	2
CO6	PO1	Classify different types of solid, liquid and gaseous fuels with their characteristics and calorific value by using principles of science and mathematics for solving engineering problems.	3
	PO2	Identify the given problem and formulate for finding the calorific value of fuel with the given information and data by applying principles of science.	2
	PO7	Make use of gaseous fuels like LPG, CNG to reduce the pollutants in atmosphere and know the impact in socio economic and environmental contexts for sustainable development.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	20.0	-	-	-	-	66.6	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	1	-	-	-	-	2	-	-	-	-	-	-	-	-
TOTAL	15	3	-	-	-	-	2	-	-	-	-	-	-	-	-
AVERAGE	2.5	1	-	-	-	-	2	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	5 minutes video	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	✓	-	-	-	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

x	Early Semester Feedback	✓	End Semester OBE Feedback
x	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

UNIT I	**ELECTROCHEMISTRY AND BATTERIES**
	Electro chemical cells: Electrode potential, standard electrode potential, types of electrodes; Calomel, Quinhydrone and glass electrode; Nernst equation; Electrochemical series and its applications; Numerical problems; Batteries: Primary (Dry cell) and secondary batteries (Lead-acid storage battery and Lithium ion battery). Causes and effects of corrosion: Theories of chemical and electrochemical corrosion, mechanism of electrochemical corrosion; Types of corrosion: Galvanic, water-line and pitting corrosion; Factors affecting rate of corrosion; Corrosion control methods: Cathodic protection, sacrificial anode and impressed current; Surface coatings: Metallic coatings- Methods of coating- Hot dipping, cementation, electroplating and Electroless plating of copper.
UNIT II	**CORROSION AND ITS CONTROL**
	Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions
UNIT III	**WATER TECHNOLOGY**
	Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement. Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.
UNIT IV	**MATERIALS CHEMISTRY**
	Materials chemistry: Polymers-classification with examples, polymerization-addition, condensation and co-polymerization; Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics; Preparation, properties and applications of polyvinyl chloride, Teflon, Bakelite and Nylon-6, 6; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers: Characteristics of fibers, preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples; Properties: Viscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples..

UNIT V	**FUELS AND COMBUSTION**
	Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.

TEXTBOOKS

1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, 2017.
2. Shashi Chawla, "Engineering Chemistry", Dhanat Rai and Company, 2011, 1st Edition.
3. R.T. Morrison, RN Boyd and SK Bhattacharya, "Organic Chemistry", Pearson, 7th Edition, 2011
4. K.F. Purcell and J.C. Kotz, "Inorganic Chemistry", Cengage learning, 2017.

REFERENCE BOOKS:

1. K. P. C. Volhardt and N. E. Schore, "Organic Chemistry Structure and Functions", Oxford Publications, 7th Edition 2010.
2. B. H. Mahan, "University Chemistry", Narosa Publishers, 4th Edition, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Concept of Electro chemical cells	CO1	T1,T2
3	Numerical problems on EMF: Galvanic Cells	CO 2	T1,T2
4	Types of Electrodes: Calomel, Quinhydrone and Glass electrode	CO 2	T1,T2
5	Nernst equation and its applications	CO 2	T1,T2
6	Batteries: Primary cells (dry cells)	CO 1	T1,T2
7	Secondary cells (lead-Acid cell). Applications of batteries	CO 1	T1,T2
8	Corrosion-Definition ,Causes and effects of corrosion, Theories of corrosion – Chemical corrosion theory	CO 1	T1,T2

9	Types of corrosion (water line and pitting), Factors affecting rate of corrosion	CO 1	T1,T2
10	Corrosion control methods – Cathodic protection and metallic coating.	CO 1	T1,T2
11	Hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems.	CO 3	T1,T2
12	Estimation of temporary and permanent hardness of water by EDTA	CO 3	T1,T2
13	Potable water and its specifications, steps involved in its treatment of water.	CO 3	T1,T2
14	Boiler troubles – Priming and foaming, caustic embrittlement	CO 3	T1,T2
15	Treatment of boiler feed water – Internal treatment (Phosphate, carbonate and calgon conditioning)	CO 3	T1,T2
16	Ion exchange process, steps involved in the treatment of this process	CO 3	T1,T2
17	Sterilization of potable water by chlorination and ozonization	CO 3	T1,T2
18	purification of water by reverse osmosis process. Numerical problems	CO 3	T1,T2
19	Shapes of Atomic Orbitals	CO 4	T1,T2
20	Linear combination of Atomic orbitals (LACO)	CO 4	T1,T2
21	Molecular orbitals of diatomic molecules N2 O2 and F2.	CO 4	T1,T2
22	Molecular orbitals diatomic CO and NO molecule	CO 4	T1,T2
23	Crystal Field Theory (CFT), Salient Features of CFT-Crystal Fields	CO 4	T1,T2
24	Splitting of transition metal ion d- orbitals in Tetrahedral	CO 4	T1,T2
25	Splitting of transition metal ion Octahedral and square planar geometries	CO 4	T1,T2
26	Band structure of solids and effect of doping on conductance	CO 4	T1,T2
27	Introduction to representation of 3-dimensional structures	CO 5	T1,T2
28	Structural and stereoisomers of organic compounds	CO 5	T3
29	Configurations, symmetry and chirality.	CO 5	T3
30	Enantiomers, diastereomers, optical activity and Absolute configuration	CO 5	T3
31	Conformation alanalysis of n- butane	CO 5	T3
32	Nucleophilic substitution reactions, Mechanism of SN1, SN2 reactions	CO 5	T3
33	Electrophilic and nucleophilic addition reactions; Addition of HBr to Propene; Markownikoff and anti Markownikoff's additions	CO 5	T3
34	Grignard additions on carbonyl compounds, EliminationreactionsDehydro halogenations of alkylhalides	CO 5	T3
35	Oxidation reactions: Oxidation of alcohols using KMnO4 and chromicacid.	CO 5	T3
36	Reduction reactions: Reduction of carbonyl compounds using LiAlH4& NaBH4	CO 5	T3

37	Hydroboration of olefins	CO 5	T3
38	Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.		T3
39	Definition, classification of fuels and characteristics of a good fuels	CO 5	T1,T2
40	Solid fuel Coal, analysis of coal- proximate analysis	CO 6	T1,T2
41	Analysis of coal -ultimate analysis.	CO 6	T1,T2
42	Liquid fuels: Petroleum and its refining Cracking: Fixed bed catalytic cracking;	CO 6	T1,T2
43	Knocking: Octane and cetane numbers	CO 6	T1,T2
44	Gaseous fuels: Composition, characteristics and applications of Natural gas, LPG and CNG	CO 6	T1,T2
45	Combustion: Calorific value-Gross calorific value(GCV) and net calorific value(NCV)	CO 6	T1,T2
46	Calculation of air quantity required for complete combustion of fuel, numerical problems.	CO 6	T1,T2
PROBLEM SOLVING			
1	Probelms on EMF	CO 1	T1:3.3.1; R3:3.2
2	Probelms on Nernst equation	CO 1	T2:16.5; R3:8.10
3	Determination of Electrode potential	CO 2	T2:16.5; R3:8.10
4	Determination of Hardness	CO 3	T1:3.3.1; R3:3.2
5	Determination of Hardness by EDTA	CO 3	T2:16.5; R3:8.10
6	Crystal field stabalization energy	CO 4	T2:16.5; R3:8.10
7	Proximate Analysis of coal	CO 6	T1:3.3.1; R3:3.2
8	ultimate Analysis of coal	CO 6	T2:16.5; R3:8.10
9	Dulungs Equation for coal analysis	CO 6	T2:16.5; R3:8.10
10	Probelms on Combustion	CO 6	T1:3.3.1; R3:3.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Electro Chemistry and Batteries	CO 1	T2:16.5; R3:8.10
2	Water and Its Treatment	CO 2	T1:3.3.1; R3:3.2
3	Molecular Structure and Theories of Bonding	CO 3	T2:16.5; R3:8.10
4	Streo chemistry,Reaction Mechanisim	CO 4	T2:16.5; R3:8.10

5	Fuels and Combustion	CO 6	T2:16.5; R3:8.10
DISCUSSION OF QUESTION BANK			
1	Electro Chemistry and Batteries	CO 1	T2:16.5; R3:8.10
2	Water and Its Treatment	CO 2	T1:3.3.1; R3:3.2
3	Molecular Structure and Theories of Bonding	CO 3	T2:16.5; R3:8.10
4	Streo chemistry,Reaction Mechanisim	CO 4	T2:16.5; R3:8.10
5	Fuels and Combustion	CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

Course Title	**COMPUTER PROGRAMMING**				
Course Code	ACS001				
Program	B.Tech				
Semester	I	AE|ME			
	II	CSE|IT|ECE |EEE			
Course Type	Foundationl				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	4	2
Course Coordinator	Mr.P Ravinder , Assistant Professor				
Course Faculty	Dr J Sirisha Devi, Associate Professor, CSE Dept				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACSS001	I	Basic Programming Concepts	-

II COURSE OVERVIEW:

The course emphasis on the problem-solving aspects in using C programming. It is the fundamental course and is interdisciplinary in nature for all engineering applications. The students will understand programming language, programming, concepts of loops, reading a set of data, step wise refinements, functions, control structures, arrays, dynamic memory allocations, enumerated data types, structures, unions, and file handling. This course provides adequate knowledge to solve problems in their respective domains.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
PPSC	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	✓	MOOC
x	Open Ended Experiments	✓	Seminars	✓	Mini Project	✓	Videos
✓	Others: Quiz						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
16.66%	Remember
25 %	Understand
58.33 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI COURSE OBJECTIVES:

The students will try to learn:

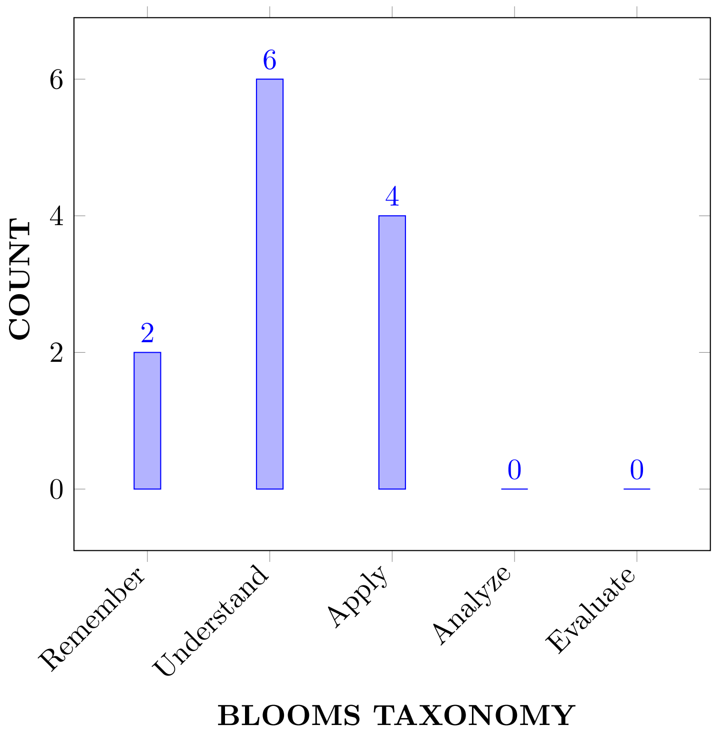
I	Learn adequate knowledge by problem solving techniques.
II	Understand programming skills using the fundamentals and basics of C Language.
III	Improve problem solving skills using arrays, strings, and functions
IV	Understand the dynamics of memory by pointers.
V	Study files creation process with access permissions.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** problem solving steps in terms of algorithms, pseudocode, flowcharts and programs with basic data types and operations for Mathematical and Engineering problems.	Understand
CO 2	**Implement** derived data types, operators in C program statements.	Apply
CO 3	**Construct** programs involving decision structures, loops, arrays and strings.	Apply
CO 4	**Make use of** various types of functions, parameters, and return values for complex problem solving.	Apply
CO 5	**Illustrate** the static and dynamic memory management with the help of structures, unios and pointers.	Understand
CO 6	**Extend** file input and output operations in implementation of real time applications.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES ARE ASSESSED:

Program	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** : Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** : Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments

PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Assignments
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	Seminars, Viva
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	1	5 minutes video

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	2	Projects
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	3	Lectures, Assignments
PSO 3	**Successful Career and Entrepreneurship:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	3	Lectures, Assignments

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE	**PROGRAM OUTCOMES**												**PSO'S**		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	-	-	-	✓	-	-	-	-	✓	-	✓	-	-	-
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	-
CO 3	✓	✓	-	-	✓	-	-	-	-	✓	-	✓	✓	-	✓

CO 4	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	-	-	✓
CO 5	✓	-	-	-	✓	-	-	-	-	✓	-	✓	-	-	-
CO 6	✓	-	-	-	✓	-	-	-	-	✓	-	✓	✓	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Understand the basics of computers; **Fundamentals** of Computer System and memory organization, and **identify** the components of the computer system.	3
CO 2	PO 1	Developing algorithms and draw flowcharts for solving **mathematical** and **engineering problems** related to **areas of computer science.**	3
	PO 2	Understand the various symbols to **drawa** flowchart, **identify** the appropriate symbols to solve a problem, then **formulate** the solution, and **interpret** the result for the **improvement** of the solution.	5
	PO3	**Recognize** an appropriate control structure to **design** and **develop** a solution for a **real-time** scenario, and communicating effectively with engineering community.	3
	PO5	Describe the operators, their precedence, and associativity while evaluating expressions in **software program**.	1
	PSO1	Understand the features of procedural programming for **designing** and **analysing** computer programs for **problem-solving**.	3
CO 3	PO 1	Apply the knowledge of **mathematics, C language fundamentals** to design, develop, and debug programs to solve **engineering** problems	3
	PO 2	Understand the **problem statement**, identify the **data requirements, design**, and **develop** a system for an engineering problem, **validate** and **interpret** the results.	5
	PSO 1	**Understand** automatic type conversion rules to **determine** the magnitude and precision of a mixed datatype expression in the areas of **software development.**	4
CO 4	PO 1	Describe the **fundamental programming** constructs, and articulate how they are used to **develop a program** with a desired runtime execution flow.	3
	PO 2	**Identify** the appropriate datatypes to **formulate, develop** and **analyze** the solution to achieve **engineering** objectives.	5

	PO 3	Recognize right **data representation** formats based on the **requirements** for **developing programs** in **real-time scenarios** by **managing** the **design process**, and communicating effectively with **engineering** community.	7
	PO 5	Describe the operators, their precedence, and associativity while evaluating expressions in **software program.**	1
CO 5	PO 1	Understand branching statements, loop statements, and apply the fundamentals of **mathematics, science** and **engineering.**	3
	PO 2	Understand the **problem statement, control** the flow of data, **design** the solution and **analyse** the same to **validate** the results in a program to solve complex engineering problems.	5
	PO 3	**Recognize** an appropriate control structure to **design** and **develop** a solution for a **real-time** scenario, and **communicating** effectively with engineering community.	6
CO 6	PO 1	Make use of **engineering techniques** to design and develop solutions for real-time **computational problems.**	3
	PSO 1	**Identify** tasks in which the numerical techniques are **applicable, develop** programs, and hence use computers effectively to solve**real-time applications.**	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	1	-	-	-	-	2	-	4	-	-	-
CO 2	3	5	3	-	1	-	-	-	-	2	-	3	3	-	-
CO 3	3	5	-	-	1	-	-	-	-	2	-	3	4	1	1
CO 4	3	5	7	-	1	-	-	-	-	2	-	3	-	1	1
CO 5	3	5	6	-	1	-	-	-	-	2	-	3	-	-	-
CO 6	3	-	-	-	1	-	-	-	-	2	-	3	2	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	100	-	-	-	100	-	-	-	-	40	-	50	-	-	-

CO 2	100	50	30	-	100	-	-	-	-	40	-	50	50	-	-
CO 3	100	50	-	-	100	-	-	-	-	40	-	50	67	50	50
CO 4	100	50	70	-	100	-	-	-	-	40	-	50	-	50	50
CO 5	100	50	60	-	100	-	-	-	-	40	-	50	-	-	-
CO 6	100	-	-	-	100	-	-	-	-	40	-	50	34	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
2 - 40 % $< C < 60\%$ –Moderate
1-5 $< C \leq 40\%$ – Low/ Slight
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	3	-	-	-	-	2	-	2	-	-	-
CO 2	3	2	1	-	3	-	-	-	-	2	-	2	2	-	-
CO 3	3	2	-	-	3	-	-	-	-	2	-	2	3	-	2
CO 4	3	2	3	-	3	-	-	-	-	2	-	2	-	-	2
CO 5	3	2	3	-	3	-	-	-	-	2	-	2	-	-	-
CO 6	3	-	-	-	3	-	-	-	-	2	-	2	1	-	-
TOTAL	18	8	7	-	18	-	-	-	-	10	-	10	6	-	4
AVERAGE	3	2	2	-	3	-	-	-	-	1.67	-	1.67	2	-	2

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1,PO 2, PO 3, PO 4	SEE Exams	PO 1, PO 2, PO 3, PO 4	Seminars	PO 3
Laboratory Practices	PO 1	Student Viva	PO3	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	PO 2	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

X	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Introduction to computers: Computer systems, computing environments, computer languages, creating and running programs, algorithms, flowcharts; Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types; Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions, formatted input and output.
MODULE II	**CONTROL STRUCTRES**
	Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements; Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays; Strings concepts: String handling functions, array of strings.
MODULE III	**ARRAYS AND FUNCTIONS**
	Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directives. Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers.
MODULE IV	**POINTERS AND STRUCTURES**
	Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, passing structures through pointers, self referential structures, unions, bit fields, typedef, enumerations; Dynamic memory allocation: Basic concepts, library functions.
MODULE V	**FILE HANDLING AND APPLICATIONS IN C**
	Files: Streams, basic file operations, file types, file opening modes, file input and output functions, file status functions, file positioning functions, command line arguments.

TEXT BOOKS

1. Byron Gottfried, —Programming with C, Schaum's Outlines Series, McGraw Hill Education, 3rd Edition, 2017.

2. Reema Thareja —Programming in C, Oxford university press, 2nd Edition, 2016.

REFERENCE BOOKS:

1. W. Kernighan Brian, Dennis M. Ritchie —The C Programming Language, PHI Learning, Second Edition, 1988.

2. YashavantKanetkar —Exploring C, BPB Publishers, Second Edition, 2003..
3. Schildt Herbert —C: The Complete Reference, Tata McGraw Hill Education, Fourth Edition, 2014.

Web References:

1. https://www.bfoit.org/itp/Programming.html
2. https://www.khanacademy.org/computing/computer-programming
3. https://www.edx.org/course/programming-basics-iitbombayx-cs101-1x-0
4. https://www.edx.org/course/introduction-computer-science-harvardx-cs50x

E-Text Books:

1. http://www.freebookcentre.net/Language/Free-C-Programming-Books-Download.htm
2. http://www.imada.sdu.dk/ svalle/courses/dm14-2005/mirror/c/
3. http://www.enggnotebook.weebly.com/uploads/2/2/7/1/22718186/ge6151-notes.pdf

MOOC Course:

1. https://www.alison.com/courses/Introduction-to-Programming-in-c
2. http://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-effective-programming-in-c- and-c-january-iap-2014/index.htm

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
1-2	Introduction to Computers: computer systems, computing environments, Computer languages, creating and running programs	CO 1	T2: 1.1-1.2
3-4	Algorithms, flowcharts; Introduction to C language: Computer languages, History of C, basic structure of C programs, process of compiling and running a C program	CO 2	T2: 2.1-2.2
5-6	C tokens, keywords, identifiers, constants, strings	CO 2	T2: 1.4-1.5
7-8	Special symbols, variables, data types	CO 3	T2:2.1-2.2
9-10	Operators and expressions	CO 3	T2: 2.3-2.6,7
11-12	Simple if, if-else, else if ladder, Nested if and Case Statement-switch statement	CO 3	T2:3.1-3.5
13-14	While, for and do while loops	CO 5	T2: 5.2-5.3
15–16	Jump statements, break, continue, goto statements	CO 7	T2: 6.1-6.6

17–18	Concepts, one dimensional arrays, declaration and initialization of one-dimensional arrays	CO 9 4	T2: 6.7
19–20	Two dimensional arrays, initialization and accessing	CO 13	T2: 8.1-8.3
21-22	Multi-dimensional arrays; Strings: Arrays of characters	CO 13	T2: 11.1-11.5
23-24	Variable length character strings, inputting character strings, character library functions, string handling functions	CO 15	T2: 4.1-4.5
25	Need for user defined functions, function declaration, function prototype	CO 15	T1:7 T2: 6.9
26	Category of functions, inter function communication, function calls	CO 11	T1:10T2:10
27	Parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions,	CO 16	T2:10.3-10.5
28	Storage classes, preprocessor directives	CO 16	T1:8.9
29	Structure definition, initialization, accessing structures, nested structures	CO 16	T2: 12.3-12.4
30	Unions, C programming examples, BitFields, typedef, enumerations	CO 16	T2:12.4
31-32	Arrays of structures, structures and functions, passing structures through pointers, self-referential structures	CO 17	T2:2.1-2.2
33-34	Unions, bit fields, typedef, enumerations	CO 17	T2: 2.3-2.6,7
35–36	Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays	CO 19	T2: 5.2-5.3
37	Pointers as functions arguments, functions returning pointers	CO 19	T2: 5.2-5.3
38	Dynamic memory allocation: Basic concepts, library functions	CO 20	T2: 6.1-6.6
39	Streams, basic file operations, file types, file opening modes, input and output operations with files	CO 20	T2:10.4
40-41	Special functions for working with files, file positioning functions	CO 21	R3:12.1-12.3
42	Command line arguments. Searching	CO 22	R3:12.4
43	Sorting algorithms bubble, insertion, selection	CO 23	T2:11.4 R7:13.1
44-45	Algorithm complexity through example programs	CO 23	T2:11.4 R7:13.1
44-45	Algorithms and Flowcharts	CO 1	T2:2.1-2.2, R4:1.4
	Operators, Precedence and Associativity of Operators, Expression Evaluation	CO2	T2:2.3-2.6,
46-46	Simple if, if-else, else if ladder, Nested if and Case Statement-switch statement	CO 2	T2:3.1-3.5

47-48	While, for and do while loops, Jump statements, break, continue, goto statements	CO 3	T2:5.2-5.3,T2:6.1-6.6
48-49	One dimensional arrays	CO 3	T2: 8.1-8.2, R4:15.1
50-51	Strings and its operations	CO 3	T2: 8.3, R4: 15.1
51-52	User defined Functions, Parameter passing mechanisms, passing arrays to functions, passing strings to functions,	CO 4	T1:10, T2:10.1 10.2, T2:10.3-10.4, R4:8.3-8.5
52-53	Recursion	CO 4	T2:10.5
54-55	Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays Pointers as functions arguments, functions returning pointers, Dynamic Memory Allocation	CO 4	T2:3.1,R4:11
56-57	Storage classes, pre-processor directives	CO 5	T2:6.1-6.6
58-59	Structure definition, initialization, accessing structures	CO 5	T1:8.9,T2:2.3-2.5
60-61	Unions, bit fields, typedef, enumerations, command line arguments	CO 5	T2: 12.3-12.4,R4:13.4
61-62	File Handling	CO 6	T2:10.4,R4
62-63	Introduction	CO 1,2	T2:1.1-1.5,T2:2.1
63-64	Control Structures	CO 3	T2: 3.1 –3.5, T2:5.2 – 5.3
65-66	Arrays and Functions	CO 4	T2: 8.1 –8.3, R4:15.1
67-68	Pointer and Structures	CO 5	T2: 12.3–12.4,R4: 13.2–13.4,T1: 8.9
69-70	File Handling and Applications In C	CO 6	T2: 10.4,T2: 14.1– 14.4
71-72	Module I	CO 1,2	T2:1.1-1.5,T2:2.1-2.6

73-74	Module II	CO 3	T2: 3.1 –3.5, T2:5.2 – 5.3
75-76	Module III	CO 4	T2: 8.1 –8.3, R4:15.1
77-78	Module IV	CO 5	T2: 12.3–12.4,R4: 13.2–13.4,T1: 8.9
79-80	Module V	CO 6	T2: 10.4,T2: 14.1– 14.4

Signature of Course Coordinator **HOD,CSE**
Mr. P Ravinder Assistant Professor

iare.png

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">AERONAUTICAL ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">ENGLISH FOR COMMUNICATION</td></tr>
<tr><td>Course Code</td><td colspan="5">AHS001</td></tr>
<tr><td>Program</td><td colspan="5">B. Tech</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Course Type</td><td colspan="5">Foundation</td></tr>
<tr><td>Regulation</td><td colspan="5">R-16</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>2</td><td>-</td><td>2</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Dr. Jetty Wilson, Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The principle aim of the course is that the students will have awareness about the importance of English language in the contemporary times and also it emphasizes the students to learn this language as a skill (listening skill, speaking skill, reading skill and writing skill). Moreover, the course benefits the students how to solve their day-to-day problems in speaking English language. Besides, it assists the students to reduce the mother tongue influence and acquire the knowledge of neutral accent. The course provides theoretical and practical knowledge of English language and it enables students to participate in debates about informative, persuasive, didactic, and commercial purposes.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
English	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	LCD / PPT	x	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	✓	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
37%	Remember
63 %	Understand
-	Apply
-	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

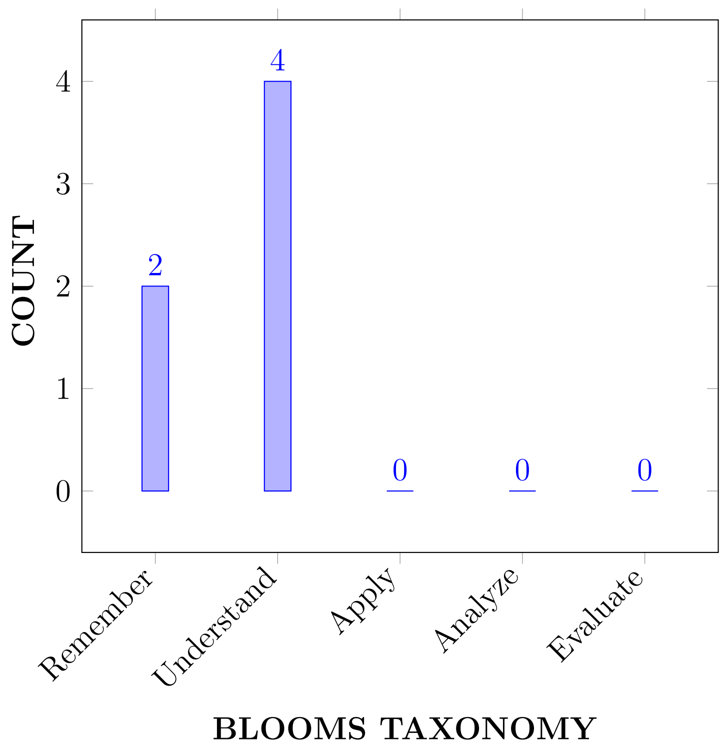
I	Communicate in an intelligible English pronunciation to meet the global standards.
II	Effectively use of four language skills (listening skill, speaking skill, reading skill and writing skill) in day-to-day affairs.
III	A critical aspect of speaking and reading for interpreting in-depth meaning between the sentences.
IV	Develop the art of writing in English keeping the standards of reader's understanding levels.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Describe** that Listening skills are essential to leadership which is useful in the real-world situations.	Remember
CO 2	**Illustrate** appropriate speaking strategies such as keeping the discussion going, turn-taking, asking for clarification or confirmation, paraphrasing, keeping the discussion on topic, and trying to reach a consensus.	Understand
CO 3	**Define** the value of English as a Lingua-Franca and recall the knowledge in soft skills for the perfect language usage.	Understand
CO 4	**Explain** the effective usage of functional English grammar and lexical items at academic and non-academic platforms.	Remember
CO 5	**Understand** the importance of critical reading to catch on the in-depth meaning of a written text at various levels of professional career.	Understand
CO 6	**Demonstrate** the role of written communication as a key aspect to meet the academic and professional challenges.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 10	**Communication :** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (Communication). "Students should demonstrate the ability to communicate effectively in writing / Orally." 1. Clarity (Writing); 2. Grammar/Punctuation (Writing); 3. References (Writing); 4. Speaking Style (Oral); 5. Subject Matter (Oral).	5	Seminar/ Conferences/ Research Papers IE/AAT / Discussion

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, analyze, design and supervise sub-structures and superstructures for residential and public buildings, industrial structures, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.	-	-
PSO 2	Focus on broad knowledge of aeronautical engineering in innovative, dynamic challenging environment for design and development of new products.	-	-
PSO 3	Make use of advanced software for creating modern avenues to succeed as an entrepreneur or to pursue higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	✓-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Discuss the heeds of functional grammar and punctuation tools in speaking and writing by generating the clarity of an audio text.	5
CO 2	PO 10	Illustrate essential aspects of grammar as well as punctuation marks for speaking or writing towards a discussion on a topic to give the clarity.	5
CO3	PO 10	Choose suitable grammatical structures and punctuation marks at speaking and writing areas maintaining clarity at professional platform.	5
CO4	PO 10	Interpret the grammatical knowledge and punctuation marks systematically towards providing the clarity in speaking and writing.	5
CO5	PO 10	Demonstrate the role of grammar and punctuation marks understanding the meaning between the sentences as well as paragraphs in speaking or writing for a clarity.	5
CO6	PO 10	Describe the clarity of grammatical usage and the obligation of punctuation marks in speaking and writing.	5

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 4	-	-	-	-		-	-	-	-	5	-		-	-	-
CO 5	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	5	-		-	-	- -

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	100	-		-	-	-
CO 2	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 3	-		-	-	-	-	-	-	-	100	-	-	-	-	-
CO 4	-	-	-	-		-	-	-	-	100	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	100	-	-	- -	-	-
CO 6	-	-	-	-		-	-	-	-	100	-		-	-	- -

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	
CO 2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-
AVERAGE	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	✓
Assignments					

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**GENERAL INTRODUCTION AND LISTENING SKILL**
	Introduction to communication skills; Communication process; Elements of communication; Soft skills vs. hard skills; Importance of soft skills for engineers; Listening skills; Significance; Stages of listening; Barriers and effectiveness of listening; Listening comprehension.
MODULE II	**SPEAKING SKILL**
	Significance; Essentials; Barriers and effectiveness of speaking; Verbal and non-verbal communication. Generating talks based on visual prompts; Public speaking; Exposure to structured talks; Addressing a small group or a large formal gathering; Oral presentation; Power point presentation.

MODULE III	**VOCABULARY AND GRAMMAR**
	The concept of Word Formation; Root words from foreign languages and their use in English; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms; Antonyms; Standard abbreviations; Idioms and phrases; One-word substitutes Sentence structure; Uses of phrases and clauses; Punctuation; Subject verb agreement; Modifiers; Articles; Prepositions.
MODULE IV	**READING SKILL**
	Significance, Techniques of reading, Skimming-Reading for the gist of a text, Scanning - Reading for specific information, Intensive, Extensive reading, Reading comprehension, Reading for information transfer, Text to diagram, Diagram to text.
MODULE V	**WRITING SKILL**
	Significance; Effectiveness of writing; Organizing principles of Paragraphs in documents; Writing Introduction and conclusion; Techniques for writing precisely, Letter writing; Formal and Informal letter writing, E-mail writing, Report Writing.

TEXTBOOKS

1. Handbook of English (Prepared by the faculty of English, IARE).

REFERENCE BOOKS:

1. 1. Norman Whitby, Business Benchmark: Pre-Intermediate to Intermediate – BEC Preliminary, Cambridge University Press, 2nd Edition,2008.
2. Devaki Reddy, Shreesh Chaudhary, Technical English, Macmillan, 1st Edition,2009.
3. Rutherford, Andrea J, Basic Communication Skills for Technology, Pearson Education,2nd Edition, 2010.
4. Raymond Murphy, Essential English Grammar with Answers, Cambridge University Press, 2nd Edition,2010.
5. Dr. N V Sudershan, President Kalam's Call to the Nation, Bala Bharathi Publications, Secunderabad, 1st Edition,2003

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on mapping COs with POs. (OBE)		
CONTENT DELIVERY (THEORY)			
2	Introduction to communication skills.	CO 1	T1:06.06
3	Communication process.	CO 1	T1:06.09
4	Soft skills vs hard skills.	CO 3	T1:09.10
5	Significance of LSRW skills.	CO 1	T1:10.11
6	Significance of listening skill.	CO 1	TI:12.16
7	Different stages of listening.	CO 1	T1:16.18
8	Barriers of listening skill.	CO 1	TI:18.21
9	Different types of listeners.	CO 1	TI:21.22
10	Effectiveness of listening skill.	CO 1	T1:22.24
11	Phonetics: Listening to the sounds of English language.	CO 1	T1:24.29
12	Introduction to speaking skills.	CO 2	T1:30.32
13	Effectiveness of speaking skills.	CO 2	T1:33.34
14	Verbal and non-verbal communication.	CO 2	T1:34.35
15	Generating talks based on visual or written prompts.	CO 2	T1:36.37
16	Developing public speaking skills.	CO 2	T1:38.39
17	Oral presentation with power-point.	CO 3	TI:39.42
18	The concept of word formation.	CO 4	T1:43.100
19	Antonyms and synonyms.	CO 4	TI:49.56
20	Idioms and phrases.	CO 4	TI:57.60
21	One-word substitutes.	CO 4	TI:60.62
22	Root words from foreign languages and their usage in English.	CO 4	TI:60.62
23	Sentence structure.	CO 4	T1:58.62
24	Punctuation tools and their role in a language.	CO 4	TI:63.66
25	Subject-verb agreement.	CO 4	TI:66.69
26	Usage of Adjectives.	CO 4	TI:70.73
27	Significance of articles and their usage	CO 4	TI:74.75
28	The usage of prepositions.	CO 4	T1:76.77
29	Significance of reading skill.	CO 5	T1:78.79
30	Different techniques of reading skill.	CO 6	T1:80.82
31	How to Read Your Textbook More Efficiently.	CO 6	TI:83.85
32	Different types of reading comprehension.	CO 6	TI:85.86
33	Reading for information transfer.	CO 6	TI:85.96
34	Significance and effectiveness of writing skill.	CO 6	TI:96.98

35	Organizing principles of a paragraph in documents and types of paragraphs.	CO 5	T1:101.103
36	Writing introduction and conclusion.	CO 5	T1:103.103
37	Techniques for writing precis.	CO 8	T1:103.103
38	Introduction to informal letters.	CO 7	TI:105.108
39	Introduction to formal letters.	CO 7	TI:109.110
40	Introduction of email writing and formal and informal emails.	CO 7	TI:111.112
41	Significance of Report Writing.	CO 8	TI: 113. 114
PROBLEM SOLVING/ CASE STUDIES			
42	The aspects to improve listening comprehension Discuss in detail.	CO 1	TI:10,11
43	Different types of listeners with examples	CO 1	TI: 19,21
44	The sounds of English language	CO 1	TI:23,27
45	verbal communication or written communication.	CO 2	TI: 27,30
46	Various difficulties in public speaking.	CO 2	TI: 32,33
47	Different ways of greeting people in formal and informal situation and discuss how do they matter in communication?	CO 2	TI: 35,37
48	‘Oral presentation requires a good planning’.	CO 2	TI:36,38
49	Power point presentation and the ways to make Power point presentation.	CO 2	TI: 37,38
50	Methods that are used to establish the process of building vocabulary with examples from the most used words in spoken English.	CO 4	TI:39,41
51	The usage of idioms and phrases in spoken English.	CO 4	TI: 47,50
52	‘Structure proposition-evaluation’ -Reading technique.	CO 5	TI:56,58
53	Active reading, detailed reading, and speed-reading techniques used in different situations.	CO 5	TI: 79,81
54	The elements of paragraph writing in detail.	CO 8	TI:100,102
55	Logical bridges and Verbal bridges in writing.	CO 8	TI:102,104
56	Soft skills and Interpersonal Communication.	CO 8	TI:102,104
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Soft skills and Interpersonal Communication.	CO 1	TI 8,9
58	Language acquisition is a process.	CO 1	TI: 11,12
59	Communication.	CO 1	TI: 14,16
60	Time management.	CO 3	TI:9,10
61	Stress management.	CO 3	TI:9,10
DISCUSSION OF QUESTION BANK			
62	Soft Skills for difficult situations in terms of reassurance and reliability.	CO 3	TI:9,10
63	Verbal and non-verbal communication.	CO 2	TI: 34,35

64	Honesty, Respect, Self-Control and Accountability their role in building long lasting interpersonal skills?	CO 3	TI: 9,10
65	Etiquette and manners. Its importance in social, personal and professional communication.	CO 23	TI: 9,10
66	Problem solving and decision making.	CO 3	TI: 9,10

Signature of Course Coordinator **HOD**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUER SCIENCE AND ENGINEERING**				
Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHS010				
Program	B.Tech				
Semester	II	CSE			
Course Type	Foundation				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. J Suresh Goud, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic principles of statistics

II COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes probability, random variables, probability distributions, correlation, regression, sampling distribution, testing of hypothesis and analysis of variance. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Fluid Dynamics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
30 %	Understand
60%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

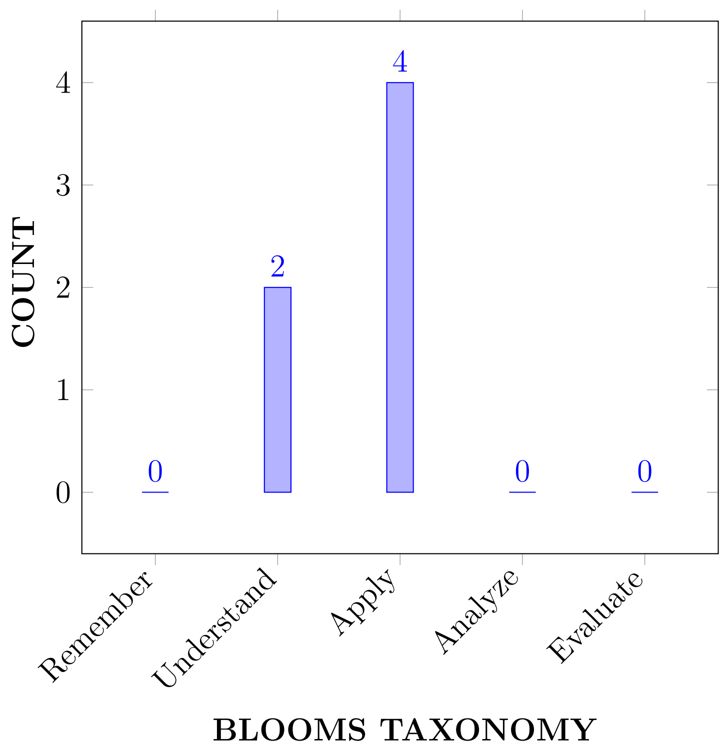
I	Enrich the knowledge of probability on single random variables and probability distributions.
II	Apply the concept of correlation and regression to find covariance.
III	Analyze the given data for appropriate test of hypothesis.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the parameters of random variate Probability distributions including Binomial, Poisson and Normal distribution by using their probability functions, expectation and variance.	Understand
CO 2	**Interpret** the concepts of discrete and continuous probability distribution, CLT problems, correlations and Regression Analysis for statistical forecasting.	Understand
CO 3	**Make use of** the concept of sampling distribution of statistical data by using behavior of the sample mean.	Apply
CO 4	**Apply** the concept of estimation in real-world problems of signal processing and testing of hypothesis to predict the significance difference, types of errors in the sample means.	Apply
CO 5	**Calculate** the role of statistical hypotheses, confidence intervals, the tests of hypotheses for large samples in making decisions over statistical claims in hypothesis testing	Apply
CO 6	**Identify** the tests of hypothesis for small samples and comparing three variables of ANOVA in making decisions over statistical claims in hypothesis testing	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Seminar
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	-	-	✓	-	-	-	-	-	-	-		-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	**PO 1**	Explain (understanding) the concept of random variables and their role in solving complex engineering problems involving random events and uncertainty by using Mathematical functions (principles of mathematics).	2
	PO 4	The expected values, variances for the given discrete random variables will be quantitatively measured by using statistical computer software (R-software).	1
CO 2	**PO 1**	Interpret the Probability distributions such as Binomial, Poisson and Normal distribution (Understanding) with the support of evaluation of integrals (principles of mathematics) and appreciate their importance and applicability (Apply) in solving complex engineering problems involving uncertainty.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which involves the events of uncertainty, Model it with suitable probability distribution and Apply the concepts of discrete or continuous distributions along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
CO 3	**PO 1**	Interpret (Understand) the results of Bivariate and Correlation Analysis by using ratios, square roots, straight lines and planes (principles of mathematics) for statistical forecasting (Apply)in complex engineering problems involving bivariate or multivariate data.	2
CO 4	**PO 1**	Select appropriate statistical methods (understand) for solving some real-time complex engineering problems governed by correlation with the knowledge of fundamental principles of mathematics.	2
	PO 4	Interpret the results of Bivariate and Multivariate Regression and quantifying the degree of closeness between two or more variables by using statistical computer software (R-software, SPSS-software).	1
CO 5	**PO 1**	Apply tests of hypotheses which involves the role of mathematical tools like statements, sets, ratios and percentages (principles of mathematics) for both large samples and small samples (knowledge) in making decisions over statistical claims that arise in complex engineering problems which requires sampling inspections.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Understand the statement and formulation of a complex engineering problem which needs verification of truth values of numerical or statistical hypothesis, collect the necessary information and data through sampling techniques, apply tests of hypotheses (both large and small samples) along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
	PO 4	Make Use of R software package in computing confidence intervals, statistical averages and hypothesis testing. (Computer software relevance)	1
CO 6	**PO 1**	Identify the role of types of statistical hypotheses, types of errors, sampling distributions of means and confidence intervals with the aid of statements and sets, percentages (principles of mathematics) in hypothesis testing of complex engineering problems which requires sampling inspections.	2
	PO 4	Test for the assessment of goodness of fit of the given probability distribution model by using statistical quantitative methods and statistical computer software (R-software).	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	1	-	-	-	-	-	-	-		-	-	-
CO 5	2	5	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	-	1	-	-	-	-	-	-	-		-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	50.0	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	-	1	-	-	-	-	-	-	-		-	-	-
TOTAL	18	4	-	4	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 4	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

X	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**SINGLE RANDOM VARIABLES AND PROBABILITY DISTRIBUTION**
	Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation; Binomial distribution, Poisson distribution and normal distribution.
MODULE II	**MULTIPLE RANDOM VARIABLES**
	Joint probability distributions, joint probability mass, density function, marginal probability mass, density functions; Correlation: Coefficient of correlation, the rank correlation; Regression: Regression coefficient, the lines of regression, multiple correlation and regression.
MODULE III	**SAMPLING DISTRIBUTION AND TESTING OF HYPOTHESIS**

	Sampling: Definitions of population, sampling, statistic, parameter; Types of sampling, expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of means and sampling distribution of variance. Estimation: Point estimation, interval estimations; Testing of hypothesis: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two sided test.
MODULE IV	**LARGE SAMPLE TESTS**
	Test of hypothesis for single mean and significance difference between two sample means, Tests of significance difference between sample proportion and population proportion and difference between two sample proportions.
MODULE V	**SMALL SAMPLE TESTS AND ANOVA**
	Small sample tests: Student t-distribution, its properties: Test of significance difference between sample mean and population mean; difference between means of two small samples. Snedecor's F-distribution and its properties; Test of equality of two population variances Chi-square distribution and it's properties; Test of equality of two population variances Chi-square distribution, it's properties, Chi-square test of goodness of fit; ANOVA: Analysis of variance, one way classification, two way classification.

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons Publishers, 9th Edition, 2014.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.

REFERENCE BOOKS:

1. T.K.V Iyengar, B.Krishna Gandhi, "Probability and Statistics", S. Chand & Co., 6th Edition, 2014.
2. G.C.Beri, "Business Statistics", Tata McGraw-Hill Publications, 2nd Edition, 2005.
3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

WEB REFERENCES:

1. http://e4uhu.com/down/Applied/9th
2. https://toaz.info/32fa2f50-8490-42cf-9e6a-f50cb7ea9a5b
3. http://www.mathworld.wolfram.com

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	Course outcomes	Reference
OBE DISCUSSION			
1	Identify the types of sampling (random, stratified, systematic, cluster). Identify the misuses of statistics. Student will use appropriate statistical methods to collect, organize, display, and analyze relevant data. Probability & Statistics introduces students to the basic concepts and logic of statistical reasoning and gives the students introductory-level practical ability to choose, generate, and properly interpret appropriate descriptive and inferential methods. Identify the types of data (qualitative, quantitative, discrete, and continuous).		
CONTENT DELIVERY (THEORY)			
2	Introduction on probability, conditional probability	CO 1	T2:26.3
3	Mathematical mean, Discrete Random variables	CO 1	R2:21.48
4	Mean and variance, probability distribution of discrete Random variables.	CO 1	T2:26.6 R2:21.50
5	Continuous Random variables	CO 1	T2:26.7 R2:21.51
6	Mean and variance, probability distribution of continuous Random variables.	CO 1	T2:26.8
7	Properties of random variables	CO 1	T2:26.10
8	Binomial distribution	CO 1	T2:26.14 R2:21.55
9	Poisson distribution	CO 1	T2:26.15 R2:21.58
10	Normal distribution.	CO 1	T2:26.16 R2:21.61
11	Joint probability distributions	CO 2	T2:25.12 R2:21.24
12	joint probability mass, density function	CO 2	T2:25.16 R2:21.29
13	marginal probability mass, density functions	CO 2	T2:25.14 R2:21.31
14	Correlation	CO 2	T2:25.14 R2:21.33
15	Karl Pearson's Coefficient of correlation	CO 2	R2:21.33
16	Rank correlation and Properties of correlation	CO 2	T2:27.2 R2:21.64
17	The linear model to a bivariate data	CO 2	T2:27.2

18	Regression coefficients	CO 2	T2:27.2 R2:21.67
19	Properties of Regression coefficients	CO 2	T2:27.2
20	Angle between two lines of regression	CO 2	T2:27.3 R2:21.71
21	Lines of regression and the multiple correlation of bivariate data	CO 2	T2:27.4 R2:21.68
22	Sampling: Definitions	CO 3	T2:27.7 R2:21.74
23	Types of sampling	CO 3	T2:27.12 R2:21.75
24	Parameter vs. statistics, standard error	CO 3	T2:27.8 R2:21.72
25	Type I and type II errors,	CO 3	T2:27.8 R2:21.73
26	Estimation	CO 4	T2:27.14 R2:21.78
27	Point estimation	CO 4	T2:27.19 R2:21.814
28	interval estimations	CO 4	T2:27.12 R2:21.82
29	Critical region, confidence interval, level of significance. One sided test, two-sided test.	CO 5	T2:27.18 R2:21.82
30	Tests of significance of single mean	CO 5	T2:26.15 R2:21.58
31	Test of difference between means	CO 5	T2:26.16 R2:21.61
32	Tests of significance of single proportion	CO 5	T2:25.14 R2:21.33
33	Test of difference between proportions	CO 5	R2:21.33
34	Small sample tests Test of equality of two population variances	CO 6	T2:27.2 R2:21.64
35	Student t-distribution, its properties. Test of significance difference between sample mean and population mean.	CO 6	T2:27.2
36	difference between means of two small samples	CO 6	T2:26.16 R2:21.61
37	Snedecor's F-distribution properties.	CO 6	T2:25.12 R2:21.24
38	Chi-square distribution and it's properties	CO 6	T2:25.16 R2:21.29
39	Applications of chi square –Distribution	CO 6	T2:27.14 R2:21.78
40	Definition of Analysis of variance	CO 6	T2:27.19 R2:21.814
41	One way classification, two way classification	CO 6	T2:27.12 R2:21.82

PROBLEM SOLVING/ CASE STUDIES			
42	Problem solving session on discrete random variable	CO 1	T2:26.3
43	Problem solving session on continuous random variables	CO 1	R2:21.48
44	Problem solving session on Binomial distribution	CO 1	T2:26.6 R2:21.50
45	Problem solving session on Poisson distribution	CO 1	T2:26.7 R2:21.51
46	Problem solving session on Normal distribution	CO 1	T2:26.8
47	Problem solving session on Joint probability distributions	CO 1	T2:26.10
48	Problem solving session on Karl Pearson's correlation	CO 2	T2:26.14 R2:21.55
49	Problem solving session on Spearman's rank correlation, linear regression	CO 2	T2:26.15 R2:21.58
50	Problem solving session on sampling distribution of means	CO 3	T2:26.16 R2:21.61
51	Problem solving session on Estimation	CO 4	T2:25.12 R2:21.24
52	Problem solving session on point and internal estimation	CO 4	T2:25.16 R2:21.29
53	Problem solving session on large sample tests	CO 5	T2:25.14 R2:21.31
54	Problem solving session on t-test	CO 6	T2:25.14 R2:21.33
55	Problem solving session on F-test and chi square – test	CO 6	R2:21.33
56	Problem solving session on One way classification, two way classification	CO 6	T2:27.2 R2:21.64
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions & terminology discussion on probability and random variables	CO 1	T2:26.6 R2:21.50
58	Definitions & terminology discussion on joint probability distributions, correlation and regression..	CO 2	T2:26.7 R2:21.51
59	Definitions & terminology discussion on sampling distribution and Estimation.	CO 3, CO 4	T2:25.14 R2:21.33
60	Definitions & terminology discussion on Tests of Hypothesis.	CO 5	R2:21.33
61	Definitions & terminology discussion on Tests of significance and ANOVA.	CO 6	R2:21.33

DISCUSSION OF QUESTION BANK			
62	Question bank discussion on probability and random variables.	CO 1	T2:26.6 R2:21.50
63	Question bank discussion on joint probability distributions and correlation, regression.	CO 2	T2:26.7 R2:21.51
64	Question bank discussion on sampling distribution and Estimation.	CO 3,CO 4	T2:25.14 R2:21.33
65	Question bank discussion on Tests of Hypothesis.	CO 5	R2:21.33
66	Question bank discussion on Tests of significance and ANOVA.	CO 6	R2:21.33

Course Coordinator:
Mr. J Suresh Goud

HOD CSE

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**				
Course Title	**ENVIRONMENTAL STUDIES**				
Course Code	AHS009				
Program	B.Tech				
Semester	II				
Course Type	FOUNDATION				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr V Anitha Rani, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credit
10+2	-	-	Basic Principles of Science	-

II COURSE OVERVIEW:

Environmental study is interconnected interrelated and interdependent subject. Hence, it is multidisciplinary in nature. The present course is framed by expert committee of UGC under the direction of honorable supreme court to be as a core module syllabus for all branches of higher education and to be implemented in all universities over India. The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course description is multidisciplinary nature of environmental studies, natural resources Renewable and non-renewable resources Ecosystems Biodiversity and its conservation Environmental pollution Social issues and the environment Human population and the environment Pollution control acts and field work. The course is divided into five chapters for convenience of academic teaching followed by field visits.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Environmental Studies	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

x	Chalk & Talk	✓	Quiz	✓	Assignments	x	MOOC's
✓	LCD / PPT	✓	Seminars	x	Mini Project	✓	Videos
✓	Open Ended Experiments						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The emphasis on the questions is broadly based on the following criteria:

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
50%	Understand
50%	Apply
0 %	Analyze
0%	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz/AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

The AAT chosen for this course is given in section XI.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

I	The interrelationship between living organism and environment.
II	The importance of environment by assessing its impact on the human world
III	The knowledge on themes of biodiversity, natural resources, pollution control and waste management.
IV	The constitutional protection given for the safety of environment.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the basic concept of environment, earths major cycle and its function related food chain, food web, and ecological pyramid for the importance of ecosystem and flow of energy in ecosystem	Understand
CO 2	**Classify** natural resource and necessity of natural resource conservationfor sustainable use and proper use.	Understand
CO 3	**Utilize** renewable and non-renewable energy resource for future growing energy needs.	Apply
CO 4	**Explain** the value of biodiversity hotspots, endangered and endemic species, in- situ and ex situ conservation methods for protecting the biodiversity.	Apply
CO 5	**Relate** the cause and effects of pollution related to Air, Water, Soil and Noise their control and treatment technologies.	Understand
CO 6	**Summarize** the concepts of Environmental Impact Assessment, global environmental problem, international summits, to minimize the problems towards sustainable future.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL

VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIE/Quiz/AAT
PO 4	**Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE/Quiz/AAT
PO 7	**Environment and sustainability:** understand the impact of the professional engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity	-	-
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 2	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 6	✓	-	-	✓	-	-	✓	-	-	-	-	-	-	-	

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the basic concept of environment, earths major cycle and its function related food chain, food web, and ecological pyramid for the importance of ecosystem and flow of energy in ecosystem by using principles of science for solving engineering problems.	2
	PO 7	Summarize about the toxicity of heavy metals on the biotic and abiotic components in in socio economic Environmental and politics contexts for Sustainable development.	3
CO 2	PO 1	Classify about different types of natural resources and their applicability and illustrate the utility of renewable resources efficiency by using principles of science for solving engineering problems.	2
	PO 7	Identify renewable and non renewable resources, Alternate energy resources and understand the impact in socio economic Environmental and politics contexts for Sustainable development.	3
CO3	PO 1	Explain the renewable and non renewable energy resource by using principles of science for solving engineering problems.	2
	PO 7	Utilize renewable and non renewable resources, Alternate energy resources and understand the impact in socio economic, politics and Environmental contexts for Sustainable development.	3
CO4	PO 1	Explain the fundamentals of Biodiversity and biotic resources, importance of biodiversity, the ecological values, India is mega diversity nation, the threats to biodiversity and importance of conservation of biodiversity by applying the principle of science for solving engineering problems.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 7	Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation, impact of biodiversity loss and National biodiversity act with the in socio economic, politics and Environmental contexts for Sustainable development.	3
CO5	PO 1	Relate the effect of pollutants on air, water and soil that causes the environmental pollution for solving engineering problems by applying the principles of science.	2
	PO 7	Explain the causes and effects of air pollution, water pollution, soil pollution and noise pollution and understand the impact in socio economic, politics and environmental contexts for sustainable development.	3
CO 6	PO 1	Explain the concepts of environmental impact assessment, global environmental problems, international summits, to minimize the problems towards sustainable future for solving engineering problems by applying the principles of science.	2
	PO 4	Recognize the methods and process of primary, secondary and tertiary treatment of waste water and understand the technology behind the pollution control devices.	2
	PO 7	Identify the environmental laws, population and its explosion green buildings in the context in socio economic, politics and Environmental contexts for Sustainable development.	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	3	-	-	-	-		-	-	-
CO 2	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	2	-	-	2	-	-	3	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 2	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 3	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 5	66.6	-	-	-	-	-	100	-	-	-	-	-	-	-	-
CO 6	66.6	-	-	18	-	-	100	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	3	-	-	-	-	-	-	-	
CO 2	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	3	-	-	1	-	-	3	-	-	-	-	-	-	-	-
TOTAL	18	-	-	1	-	-	18	-	-	-	-	-	-	-	-
AVERAGE	3	-	-	1	-	-	3	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓	Seminars	✓
Concept Video	-	Mini Project	-	Student Viva	-	Mini Project	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
x	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**ENVIRONMENT AND ECOSYSTEMS**
	Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles Hydrological cycle, Phosphorous cycle, Nitrogen cycle. Biomagnifications.
MODULE II	**NATURAL RESOURCES**
	INatural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.
MODULE III	**BIODIVERSITY AND BIOTIC RESOURCES**
	Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation; Endangered and Endemic species, Hot spots of biodiversity.Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National biodiversity act.
MODULE IV	**ENVIRONMENTAL POLLUTION, POLLUTION CONTROL TECHNOLOGIES AND GLOBAL ENVIRONMENTAL PROBLEMS**
	Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary; Concepts of bioremediation; Global environmental problems and global efforts: Global Warming, Climate change, Sea level rise, ozone depletion, ozone depleting substances, deforestation and desertification; International conventions / protocols: Earth summit, Kyoto protocol and Montreal protocol.
MODULE V	**ENVIRONMENTAL LEGISLATIONS AND SUSTAINABLE DEVELOPMENT**
	Environmental legislations: Environmental protection act, air act1981, water act, forest act. municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rules, Environmental impact assessment(EIA); Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building.

TEXTBOOKS

1. Benny Joseph, "Environmental Studies", Tata Mc Graw Hill Publishing Co. Ltd, New Delhi, 1st Edition, 2006.
2. Erach Bharucha, "Textbook of Environmental Studies for Under Graduate Courses", Orient Black Swan, 2nd Edition, 2013.
3. Dr. P. D Sharma, "Ecology and Environment", Rastogi Publications, New Delhi, 12th Edition, 2015.

REFERENCE BOOKS:

1. Tyler Miller, Scott Spoolman, "Environmental Science", Cengage Learning, 14th Edition, 2012.
2. Anubha Kaushik, "Perspectives in Environmental Science", New Age International, New Delhi.4th Edition, 2006.
3. Gilbert M. Masters, Wendell P. Ela, "Introduction to Environmental Engineering and Science, Pearson, 3rd Edition, 2007

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Explain the scope and importance of Environment and need for Public Awareness	CO 1	T1:1.1.3 R1:2.1
2	Identify scope and importance of ecosystem	CO1	T1:1.1.4 R1:2.7.1
3	Explain Structure and function of ecosystem	CO1	T1:1.1.6 R1:2.7.4
4	Relate the Food chain food web and pyramids	CO1	T1:1.7.2 R1:2.15
5	Realate the Flow of energy	CO1	T1:1.7.2 R1:2.16
6	Explain the Biogeochemical cycles.	CO1	T1:1.7.6 R1:2.17
7	Interpret the Biomagnifications.	CO1	T1:1.7.3 R1:2.19
8	Classify the Living and non living resources	CO 2	T1:2.1 R1:2.21
9	Explain the Water resources: use and over utilization of surface and ground water	CO 2	T1:2.2.2 R1:2.3
10	Explain the Floods and Drought	CO 2	T1:2.2.4 R1:4.1

11	Relate dams: befit and problems	CO 2	T1:2.3.1 R1:4.3
12	Explain the Mineral resources: use and exploitation of minerals	CO 2	T1:2.4 R1:4.8
13	Relate the Energy resources and introduction and applications	CO 3	T1:2.5.2 R1:4.6
14	Explain the Wind energy and its application	CO 3	T1:2.5.3 R1:4.6
15	Explain Land resources	CO 2	T1:2.4 R1:4.8
16	Identify renewable and non renewable resources	CO 3	T1:2.5.3 R1:4.6
17	Recall the Biodiversity and Biotic introduction and definition.	CO 4	T1:3.1 R1:4.5
18	Relate the Classification of biodiversity	CO 4	T1:3.2.2 R1:4.8
19	Explain the Values of biodiversity	CO 4	T1:3.3.1 R1:4.7
20	Identify India is mega diversity nation	CO 4	T1:3.4 R1:4.9
21	Recognize Hot spots of biodiversity	CO 4	T1: 3.4 R1:4.10
22	Explain the Threats to biodiversity	CO 4	T1: 3.5 R1:1.10
23	Explain the Man wild life conflict	CO 4	T1:3.5.2 R1:1.10
24	Relate the Conservation of Biodiversity	CO 4	T1:3.7 R1:1.16
25	Recall National biodiversity act	CO 4	T1: 3.9 R1:1.16
26	Recall the Environmental pollution : Introduction and classification	CO 5	T1: 4.1 R1:1.16
27	Explain the Air pollution: primary and secondary pollutants, effects and its control	CO 5	T1: 4.2 R1:1.11
28	Explain the Water pollution: types effects and control of water pollution	CO 5	T1:4.6 R1:5.2
29	Explain the Soil pollution: sources effects and control of soil pollution	CO 5	T1: 4.8 R1:5.2
30	Explain the Noise pollution: sources effects and control of noise pollution	CO 5	T1: 4.13 R1:5.10
31	Explain the Municipal waste management	CO 5	T1: 4.16 R1:5.2.3
32	Explain the solid waste management	CO 5	T1:4.16.3 R1:5.2.4
33	Identify the E-waste: characteristics and its management	CO 5	T1: 5.5 R1:5.4
34	Explain the Global environmental problems: climate change and impact on human	CO 5	T1: 5.6 R1:5.5

35	Recognize the Ozone depletion and consequences	CO 5	T1: 5.10 R1:5.6
36	Summarize the International protocols	CO 5	T1: 4.1 R1:1.16
37	Relate the Environmental protection act.	CO 6	T1:7.3
38	Relate the air act, water act	CO 6	T1:7.3
39	Relate forest act, wild life act	CO 6	T1:7.3
40	Relate the Hazardous waste management and handling rules 2016	CO 6	T1:7.10
41	Illustrate the EIA structure and concept of sustainable development	CO 6	T1: 8.1
42	Identify towards sustainable features: concepts of sustainable development	CO 6	T1: 8.2
43	Relate the Consequences of population and its explosion	CO 6	T2: 8.2.3 T3:2
44	Explain the Crazy consumerism urban sprawl	CO 6	T2:8.2.3, T3:7
45	Explain the Environmental education	CO 6	T2:8.4, T3:7
46	Explain the Environmental ethics and concepts of green buildings	CO 6	T2:8.12, T3:15,21
PROBLEM SOLVING			
1	Food chain and pyramids	CO 1	T1:3.3.1; R3:3.2
2	Probelms on utilization of water	CO 1	T2:16.5; R3:8.10
3	Biodiversity	CO 2	T2:16.5; R3:8.10
4	kyto protocol	CO 3	T1:3.3.1; R3:3.2
5	Deforestation	CO 3	T2:16.5; R3:8.10
6	population	CO 4	T2:16.5; R3:8.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Environment and Ecosystems	CO 1	T2:16.5; R3:8.10
2	Natural Resources	CO 2	T1:3.3.1; R3:3.2
3	Biodiversity and Biotic Resouces	CO 3	T2:16.5; R3:8.10
4	Enivironment pollution	CO 4	T2:16.5; R3:8.10
5	Environmental Legistration and sustainable development	CO 6	T2:16.5; R3:8.10

DISCUSSION OF QUESTION BANK			
1	Environment and Ecosystems	CO 1	T2:16.5; R3:8.10
2	Natural Resources	CO 2	T1:3.3.1; R3:3.2
3	Biodiversity and Biotic Resouces	CO 3	T2:16.5; R3:8.10
4	Enivironment pollution	CO 4	T2:16.5; R3:8.10
5	Environmental Legistration and sustainable development	CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD,AERO**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">COMPUTER SCIENCE AND ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">DATA STRUCTURES</td></tr>
<tr><td>Course Code</td><td colspan="5">ACS002</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Regulation</td><td colspan="5">R-16</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>1</td><td>4</td><td>3</td><td>1.5</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Dr V.Sitharamulu, Associate Professor</td></tr>
</table>

I COURSE OVERVIEW:

The course covers some of the general-purpose data structures and algorithms, and software development. Topics covered include managing complexity, analysis, static data structures, dynamic data structures and hashing mechanisms. The main objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter in real life. This course reaches to student by power point presentations, lecture notes, and lab which involve the problem solving in mathematical and engineering areas.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS001	I	Computer Programming

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Structures	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20	Remember
40	Understand
25	Apply
15	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI COURSE OBJECTIVES:

The students will try to learn:

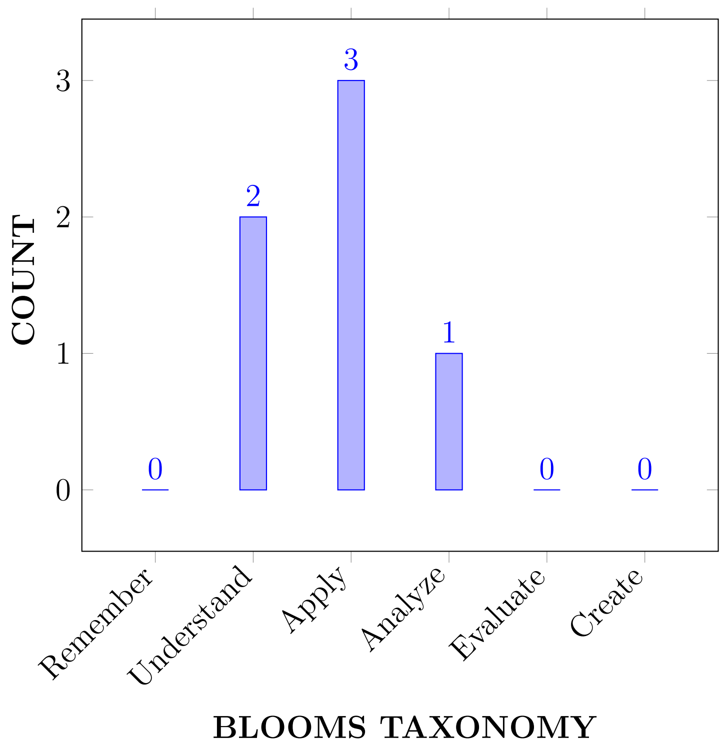
I	The skills needed to understand and analyze performance trade-offs of different algorithms implementations and asymptotic analysis of their running time and memory usage.
II	The knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and sorting, selection and searching.
III	The fundamentals of Non-linear Data structure to store, retrieve, and process data efficiently.
IV	The implementing these data structures and algorithms and Understand essential for future programming and software engineering courses.
V	Analyze and choose appropriate data structure to solve problems in real world.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Interpret** the complexity of algorithm using the asymptotic notations.	Understand
CO 2	**Select** appropriate searching and sorting technique for a given problem.	Apply
CO 3	**Construct** programs on performing operations on linear and nonlinear data structures for organization of a data	Apply
CO 4	**Make use of** linear data structures and nonlinear data structures solving real time applications.	Apply
CO 5	**Describe** hashing techniques and collision resolution methods for efficiently accessing data with respect to performance.	Understand
CO 6	**Compare** various types of data structures ; in terms of implementation, operations and performance.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Outcomes	
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIA/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIA/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIA/SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIA/SEE

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIA/SEE/Open ended Experiments
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	Tech Talk/Concept Videos/Open ended Experiments
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	Tech Talk/Concept Videos/Open ended Experiments

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		**Strength**	**Proficiency Assessed by**
PSO 1	**Understand** design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	3	CIA/ SEE/ Tech Talk/ Concept Videos
PSO 2	**Focus on** improving software reliability, network security information retrieval systems.	2	CIA/ SEE/ Tech Talk/ Concept Videos
PSO 3	**Make use of** modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	CIA/ SEE/ Tech Talk/ Concept Videos

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 5	✓	-	✓	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
CO 6	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of Key competencies matched.**
CO1	PO 1	**Understand** (knowledge) the concept of conventional digital communication system and (understand) various types of pulse analog modulation techniques for signals analysis by applying the principles of **mathematics, science,** and **engineering fundamentals**.	3
	PO 2	**Problem Analysis** on different types of algorithms to analyze space and time complexities.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	**Design the Solutions** for finding space and time complexities of a complex algorithm and representing it by asymptotic notations	2
	PO 10	**Subject matter and speaking style** assessed in explanation of various algorithms, algorithm complexity.	2
	PSO1	**Design and analyze** complex algorithms and specify its space and time complexities and representing it by asymptotic notations for faster processing of data.	3
	PSO3	**Make use of modern** computer tools for finding space and time complexities of a complex algorithm	1
CO 2	PO 1	**Make use** of broad knowledge of searching and sorting techniques for an efficient search from a data structure and optimize the efficiency of other algorithms by applying the knowledge of mathematics, science, Engineering fundamentals.	1
	PO 2	**Problem Analysis** on different types of search sort algorithms to analyze space and time complexities.	5
	PO 3	**Design/Development of Solutions** using appropriate searching and sorting techniques for designing a solution for complex Engineering problems.	2
	PO 5	**Implementation of**different sorting and searching techniques for given problem with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of searching and sorting along with efficiency of searching and sorting techniques in terms of space and time complexity	2
	PO 12	**Keeping current in CSE and advanced engineering concepts** of various searching , sorting and respective time and space complexity by tech talk, concept videos and open ended experiments.	3
	PSO1	**Understand**complex problems and analyzing it and apply appropriate sorting and searching techniques for data processing.	4
	PSO2	**Applying**various selecting and sorting techniques while designing and developing information retrieval systems and its applications	2
	PSO3	**Make use of** various selecting and sorting techniques and extend the knowledge for advance frame works and platforms which are necessary for engineering practices and higher studies or become an entrepreneur.	1
CO 3	PO 1	**Make use of** linear and nonlinear data structures to organize the data in a particular way so to use them in the most effective way by applying the basic knowledge of mathematics, science, engineering fundamentals	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	**Problem analysis:** Organizing the given data in particular way by performing the operations on linear and nonlinear data structures to use the data in the most effective way.	7
	PO 3	**Recognize the** need of linear and nonlinear data structures such as linked list, array, stack and queue by Designing solutions for complex Engineering.	5
	PO 4	**Conduct Investigations** Conduct Investigations of Complex Problems: Ability to apply operations on linear and nonlinear data structures in order to organize the given data in a particular way	4
	PO 5	**Implementation of** Implementation of different operations on linear and nonlinear data structures for given problem with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of linear and nonlinear data structures like linked lists, stacks and queues	2
	PO 12	**Keeping current in** CSE and advanced engineering concepts of linear and nonlinear data structures like linked lists, stacks and queues by tech talk, concept videos and open-ended experiments	3
	PSO1	**Understand** complex problems and analyzing it and apply appropriate operations on linear or nonlinear data structures for Developing the solution.	5
	PSO2	**Applying** various linear or nonlinear data structures while designing and developing information retrieval systems and its applications	2
	PSO3	**Make use of** various linear or nonlinear data structures and extend the knowledge for advance frame works and platforms which are necessary for engineering practices and higher studies or become an entrepreneur.	1
CO 4	PO 1	**Make use of** linear and nonlinear data structures for solving real time applications by applying the basic knowledge of mathematics, science, engineering fundamentals	3
	PO 2	**Problem analysis:**Solving real time applications by performing the operations on linear or nonlinear data structures.	7
	PO 3	**Recognize the** need of linear and nonlinear data structures such as linked list, array, stack and queue for Designing real time applications.	2
	PO 4	**Conduct Investigations of Complex Problems:** Ability to apply operations on linear or nonlinear data structures in order to solve real time applications.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 5	**Implementation of** different operations on linear and nonlinear data structures for solving real time applications with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of linear and nonlinear data structures like linked lists, stacks, queues, trees and graphs	2
	PO 12	**Keeping current** in CSE and advanced engineering concepts of linear and nonlinear data structures like linked lists, stacks, queues, trees and graphs by tech talk, concept videos and open-ended experiments for solving real time applications.	3
	PSO1	**Understand** complex problems and analyzing it and apply appropriate operations on linear or nonlinear data structures for solving real time applications.	5
	PSO2	**Applying** various linear or nonlinear data structures while designing and developing information retrieval systems and its applications	1
	PSO3	**Make use of** various linear or nonlinear data structures and extend the knowledge for advance frame works and platforms which are necessary for engineering practices and higher studies or become an entrepreneur.	1
CO 5	PO 1	**Understand** the knowledge of hashing techniques and collision resolution methods and implementing for specified problem domain using knowledge of mathematics, science and engineering fundamentals	1
	PO 3	**Design the Solution** for efficiently accessing data with respect to performance by using hashing techniques and collision resolution methods	2
	PO 5	**Implementation of** hashing techniques and collision resolution methods for efficiently accessing data with respect to performance with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of Hashing, Collision techniques	2
	PSO1	**Understand** complex problems and analyzing it and apply appropriate hashing techniques and collision resolution methods for efficiently accessing data with respect to performance.	4
	PSO2	**Applying** various hashing techniques and collision resolution methods while designing and developing information retrieval systems and its applications	1
	PSO3	**Build** sufficient knowledge hashing techniques and collision resolution methods so that new product can be developed, which leads to become successful entrepreneur in the present market.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 6	PO 1	**Understand** various types of data structures in terms of implementations and choose appropriate data structure for specified problem domain using knowledge of mathematics, science and engineering fundamentals	3
	PO 2	**Problem Analysis:** Recognize the importance of suitable data structures in checking the efficiency of algorithms used for complex engineering problems.	7
	PO 3	**Design the Solution** complex problems or efficiently accessing data with respect to performance by using hashing techniques and collision resolution methods	5
	PO 4	**Conduct Investigations of Complex Problems:** Ability to apply operations on linear or nonlinear data structures in order to solve real time applications.	4
	PO 5	**Understand** the Implementation of various types of data structures with the help of computer software	1
	PO 10	**Subject matter and speaking** style assessed in explanation of Implementation of various types of data structures.	2
	PO 12	**Keeping current in CSE** and advanced engineering concepts of Implementation of various types of data structures by tech talk, concept videos and open ended experiments	3
	PSO 1	**Understand** complex problems and analyzing it and apply Implementation of various types of data structures.	5
	PSO 2	**Applying** Implementation of various types of data structures while designing and developing information retrieval systems and its applications	1
	PSO 3	**Build** sufficient knowledge Implementation of various types of data structures so that new product can be developed, which leads to become successful entrepreneur in the present market.	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	1	4	2	-	-	-	-	-	-	2	-	-	3	-	1
CO 2	1	5	2	-	1	-	-	-	-	2	-	3	4	2	1
CO 3	2	7	5	4	1	-	-	-	-	2	-	3	5	2	1
CO 4	3	7	2	4	1	-	-	-	-	2	-	3	5	1	1
CO 5	1	-	2	-	1	-	-	-	-	2	-	-	4	1	1
CO 6	3	7	5	4	1	-	-	-	-	2	-	3	5	1	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	12	2	2	2
CO 1	33.3	40	20	-	-	-	-	-	-	40	-	-	50	-	50
CO 2	33.3	50	20	-	100	-	-	-	-	40	-	25	66.6	100	50
CO 3	66.6	70	50	36.3	100	-	-	-	-	40	-	25	83.3	100	50
CO 4	100	70	20	36.3	100	-	-	-	-	40	-	-	66.6	50	50
CO 5	33.3	-	20	-	100	-	-	-	-	40	-	-	66.6	50	50
CO 6	100	70	50	36.3	100	-	-	-	-	40	-	25	83.3	50	50

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	-	-	-	-	-	-	1	-	-	2	-	2
CO 2	1	2	1	-	3	-	-	-	-	1	-	1	3	3	2
CO 3	3	3	2	1	3	-	-	-	-	1	-	1	3	3	2
CO 4	3	3	1	1	3	-	-	-	-	1	-	1	3	2	2
CO 5	1	-	1	-	3	-	-	-	-	1	-	-	3	2	2
CO 6	3	3	2	1	3	-	-	-	-	1	-	1	3	2	2
TOTAL	**12**	**12**	**8**	**3**	**15**	**-**	**-**	**-**	**-**	**6**	**-**	**4**	**17**	**12**	**12**
AVERAGE	**2.0**	**2.4**	**1.3**	**1.0**	**3.0**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2.8**	**2.4**	**2.0**

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
Seminars	-	Student Viva	-	Certification	-
Laboratory Practices	-	5 Minutes Video	-	Open Ended Experiments	-
Term Paper	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING**
	Basic concepts: Introduction to data structures, classification of data structures, operations on data structures; Algorithms Specification ,Recursive algorithms ,Data Abstraction, Performance analysis-time complexity and space complexity, Asymptotic Notation-Big O ,Omega and Theta notations. Introduction to Linear and Non Linear data structures, Searching techniques: Linear search, Binary search; Sorting techniques: Bubble, Selection, Insertion, Quick and Merge Sort and comparison of sorting algorithms
MODULE II	**LINEAR DATA STRUCTURES**
	Stacks: Primitive operations, implementation of stacks using Arrays, applications of stacks arithmetic expression conversion and evaluation; Queues: Primitive operations; Implementation of queues using Array, applications of linear queue, circular queue and double ended queue (deque).
MODULE III	**LINKED LISTS**
	Linked lists: Introduction, singly linked list, representation of a linked list in memory, operations on a single linked list; Applications of linked lists: Polynomial representation and sparse matrix manipulation. Types of linked lists: Circular linked lists, doubly linked lists; Linked list representation and operations of Stack, linked list representation and operations of queue
MODULE IV	**NON LINEAR DATA STRUCTURES**
	Trees: Basic concept, binary tree, binary tree representation, array and linked representations, binary tree traversal, binary search tree, tree variants, application of trees; Graphs: Basic concept, graph terminology, graph implementation, graph traversals, Application of graphs, Priority Queue.
MODULE V	**BINARY TREES AND HASHING**
	Binary search trees: Binary search trees, properties and operations; Balanced search trees: AVL trees; Introduction to M-Way search trees, B trees; Hashing and collision: Introduction, hash tables, hash functions, collisions, applications of hashing.

TEXTBOOKS

1. Mark A. Weiss, —Data Structures and Algorithm Analysis in C, Pearson, 2nd Edition, 1996.
2. Ellis Horowitz, Satraj Sahni, Susan Anderson Freed, —Fundamentals of Data Structures in C‖, Universities Press, 2nd Edition, 2008.

REFERENCE BOOKS:

1. Reema Thareja, —Data Structures using C, Oxford University Press, 2nd Edition, 2014
2. S. Lipschutz, —Data Structures‖, Tata McGraw Hill Education, 1st Edition, 2008.
3. D. Samanta, —Classic Data Structures‖, PHI Learning, 2nd Edition, 2004.
4. Tanenbaum, Langsam, Augenstein, —Data Structures Using C‖, Pearson, 1st Edition, 2003.

WEB REFERENCES:

1. http://www.tutorialspoint.com/data-structures-algorithms
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.studytonight.com/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/datastructures

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	https://lms.iare.ac.in/index?route=course/details&course_id=188
CONTENT DELIVERY (THEORY)			
1	Basic concepts: Introduction to Data Structures	CO 3	T1:1.1.3 R2 : 1.2
2	Classification of data structures	CO 3	T1:1.1.3 R2 : 1.4
3	Operations on data Structures	CO 3	T1:1.2
4	Recursive algorithm, Performance Analysis	CO1	T1:1.2 T1:5.1
5	Searching techniques: Linear search and binary search	CO 2, CO 6	T1:5.1

6	Searching techniques: Fibonacci search and companding	CO 2, CO 6	T1:5.1
8	Sorting techniques: Bubble sort, selection sort and companding	CO 2	R1:14.5
9	Sorting techniques: Insertion sort, Quick sort	CO 2,	T1:5.2 R2 : 10.2
10	Merge sort ,comparison of sorting algorithms	CO 2, CO 6	T1:5.2 R2 : 10.2
13	Stacks: Primitive operations, implementation of stacks using Arrays	CO3,	T1:7.1
14	Applications of stacks arithmetic expression conversion and evaluation	CO 3, CO 4	T1:7.2
16	Queues: Primitive operations; Implementation of queues using Array	CO 3,	T1:8.1
17	Applications of linear queue, circular queue	CO 3, CO 4	T1:8.4
18	Double ended queue (deque)l	CO 3	R2 : 5.4
19	Linked lists: Introduction, singly linked list, representation of a linked list in memory	CO 3,	T1:9.1
20	Operations on a single linked list :creation, insertion and deletion	CO3,	T1:9.2
21	Applications of linked lists	CO 3, CO 4	T1:9.3
22	Operations on a double linked lists :creation, insertion and deletion	CO 3,	T1:9.4
23	Operations on a double linked lists : deletion ,traversal.	CO 3,	T1:9.4
24	single linked list :polynomial expression	CO 3	T1:9.3
25	single linked list :Sparse matrix manipulation.	CO3,	T1:9.3
26	Operations on a Circular linked lists: creation, insertion and deletion	CO 3,	T1:9
30	Operations on a Circular linked lists: deletion, traversal	CO3, CO 4	T1:9
31	Linked list representation and operations of Stack	CO3,	T1:9.7
32	Linked list representation and operations of queue	CO 4,	T1:9.8
37	Trees: Basic concept, Tree terminology	CO 3,	T1:13.1

CONTENT DELIVERY (THEORY)			
38	Binary tree :Binary Tree properties	CO 3,	T1:13.1
39	Binary tree representation using array	CO 3,	T1:13.2
40	Binary tree representation using linked list	CO 4,	T1:13.2
41	Binary tree traversal, binary tree variants	CO4,	T1:13.2
42	Application of trees	CO 4	T1:13.2.3
44	Graphs: Basic concept, graph terminology	CO 3	R2 : 8.2
45	Types of graphs, Representation of graph	CO 3	R2 : 8.2
46	Graph traversals :DFS and BFS, Application of graphs	CO 4	T2:6.2
48	Minimum Spanning Trees-Prims and Kruskal algorithms	CO 4	T1:6.1 T2:5.6
50	Binary search trees, properties	CO 3	T1:13.2.3
51	Binary search trees operations	CO 4	T1:13.2.3
52	AVL trees	CO 3	T1:14.3
53	M- Way search trees, B trees	CO 4	T1:14.3
54	Hashing, Collision	CO 5	R2 : 6.4
7	Problems on linear search, binary search and Fibonacci search.	CO 4	T1:5.1
11	Problems on bubble sort, selection and insertion sort	CO 4, CO 6	T1:5.2 R2 : 10.2
12	Problems on quick and merge sort	CO 4, CO 6	T1:5.2 R2 : 10.2
15	Problems on Arithmetic expression conversion and evaluation	CO 4,	T1:7.2
27	Problems on single linked list to add, delete element	CO 4,	T1:9.8
28	Problems on double linked list to add, delete element	CO 4,	T1:9.8
33	Problems on circular linked list to add, delete element	CO 4,	T1:9.4
34	Problems on double linked list to add, delete element	CO 4,	T1:9.3
35	Problems on stack using linked list	CO 4,	T1:9.7
36	Problems on queue using linked list	CO 4,	T1:9.8
43	Problems on Binary tree :creation ,insertion and deletion of a node	CO 4,	T1:13.2
47	Problems on Graph Traversal: DFS and BFS	CO 4,	T2:6.2

49	Problems on MST: Prim's and Kruskal's	CO 4,	T1:6.1 T2:5.6
55	Problems on Binary search tree	CO 4	T1:14.3
56	Problems oh hashing	CO 5	R2 : 6.4
DISCUSSION ON DEFINITION AND TERMINOLOGY			
57	Definitions on Data Structures, searching and sorting	CO2	T1:1 R1:14
58	Definitions on Linear Data Structures	CO 3	T1:7,.T1:8
59	Definitions on Linked Lists	CO 3	T1:9
60	Definitions on Non Linear data Structures	CO 3	T1:7.5
61	Definitions on Binary Trees and Hashing	CO 3,CO 5	T1:14
DISCUSSION ON QUESTION BANK			
62	Module I	CO 1, CO2,CO6	T1:1 R1:14
63	Module I I	CO 3,CO 4,CO 6	T1:9
64	Module III	CO 3,CO 4,CO 6	T1:2.5
65	Module IV	CO 3,CO 4,CO 6	T1: 4.1
66	Module V	CO 3,CO 5,CO 6	T1: 5.1

Course Coordinator **HOD,CSE**
Dr V.Sitharamulu

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**Computer Science Engineering**				
Course Title	**FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGG**				
Course Code	AEE001				
Program	B.Tech				
Semester	II	CSE/IT			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr.K Lingaswamy, Assistant Professor,EEE				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS002	I	Linear Algebra and Ordinary Differential Equations
B.Tech	AHS003	I	Computational Mathematics and Integral Calculus

II COURSE OVERVIEW:

This course introduces the concepts of basic electrical engineering parameters, quantities, analysis of DC circuits. The course teaches different fundamental laws Ohms laws, Kirchhoff laws and different electrical concepts. The students will be able to analyze networks using graph theory and circuit theorems like Thevenin's and Norton's theorems. It also describes the concept of AC circuits and their applications.It also describes introduction to three phase circuits and the concept of semiconductor diodes, bipolar junction transistors and their applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Fundamentals of Electrical and Electronics Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
17%	Remember
50%	Understand
33%	Apply
0%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

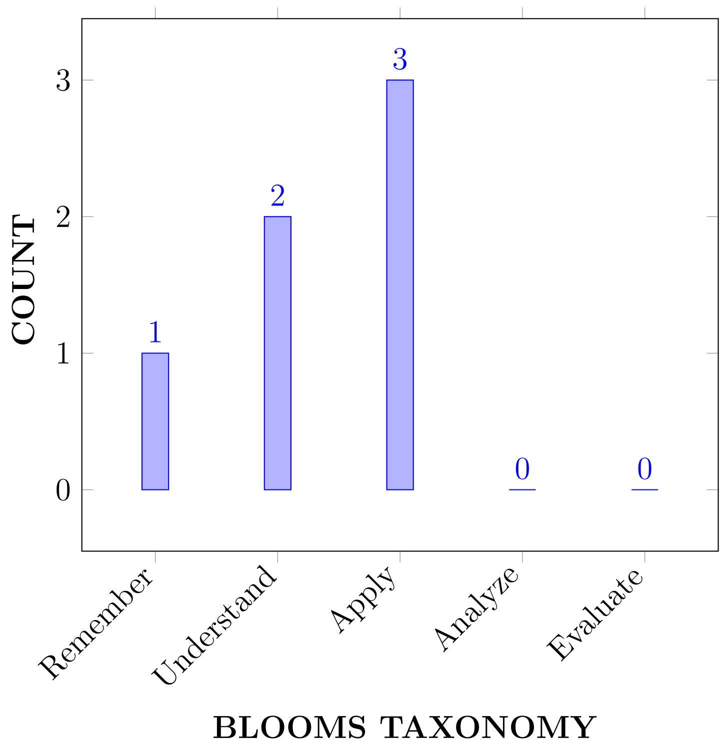
I	The fundamentals of electrical circuits and analysis of circuits with DC excitation using circuit laws.
II	The application of circuit laws in network theorems and graph theory to simplify complex networks.
III	Analyze series and parallel AC circuits using complex notation.
IV	Illustrate the V-I characteristics of various diodes and bi-polar junction transistor.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Solve** complex electrical circuits by applying network reduction techniques for reducing into a simplified circuit.	Apply
CO 2	**Make use of** various network theorems and graph theory for simplifying complex electrical networks.	Apply
CO 3	**Define** basic nomenclature of single phase AC circuits for obtaining impedance, admittance of series and parallel circuits.	Remember
CO 4	**Interpret** the power factor in single phase circuits with various combination of network elements for computing active and reactive power.	Understand
CO 5	**Apply** the PN junction characteristics for the doide applications such as switch and rectifier.	Apply
CO 6	**Extend** the biasing techniques for bipolar and uni-polar transistor amplifier circuits considering stability condition for establishing a proper operating point.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	1	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	**PO 1**	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using mathematical principles and various source transformation techniques are adopted for solving complex circuits.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Derive standard expressions for equivalent resistances, inductances and capacitance by using series-parallel networks i.e mathematical calculations.	1
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts by using computer programs.	1
CO 2	PO 1	Demonstrate the various network theorems in order to determine the same using principles of mathematics, science, and engineering fundamentals.	3
	PO 2	Verify various network theorems for their validation using mathematical calculations.	1
	PSO 1	Simplify complex electrical networks by applying various circuit theorems by using computer programs.	1
CO 3	PO 1	Make use of Alternating quantity for obtaining form, peak factor concept of impedance and admittance using the knowledge of mathematics, science, and engineering fundamentals.	3
CO 4	PO 1	Understand the power factor in single phase AC circuits using the knowledge of mathematics and engineering fundamentals.	3
	PSO 1	Give the power factor in single phase AC circuits with different elements by writing computer programs.	1
CO 5	PO 1	Outline of materials and brief description of formation of semi-conductor devices by using basic fundamentals of science and engineering.	3
	PO 2	Recognize (knowledge) the working and characteristics of diode and understand application which is rectifier circuit using engineering knowledge, and types of rectifiers.	3
CO 6	PO 1	List out various transistor configurations and discuss their working using principles of science and mathematical principles.	3
	PO 2	Explain the concept of biasing and load lines and their applicability in solving problems and working of transistors as switch and amplifier.	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 2	100	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	-	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 5	100	25	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	100	25	-	-	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $< C \leq 40\%$ – Low/ Slight
2 - 40 % $< C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-		-	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-		-	-	-
TOTAL	**18**	**4**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**
AVERAGE	**3**	**0.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.5**	**0**	**0**

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ELECTRIC CIRCUIT ELEMENTS**
	Electric circuit elements: Voltage and current sources, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance.
MODULE II	**NETWORK ANALYSIS AND THEOREMS**
	Network analysis: Nodal analysis with independent and dependant sources, modified nodal analysis, mesh analysis, notion of network graph, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages; Network theorems: Voltage shift theorem, zero current theorem, Tellegen's theorem, reciprocity, substitution theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer theorem.
MODULE III	**AC CIRCUITS**
	RLC circuits: Natural, step and sinusoidal steady state responses, series and parallel RLC circuits. AC signal measurement: Complex, apparent, active and reactive power, power factor. Introduction to three phase supply: Three phase circuits, star-delta transformations, balance and unbalanced three phase load, power measurement, two wattmeter method.
MODULE IV	**SEMICONDUCTOR DIODE AND APPLICATIONS**
	P-N junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, Zener diode as a voltage regulator.
MODULE V	**BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS**
	DC characteristics, CE, CB, CC configurations, biasing, load line, Transistor as an amplifier.

TEXTBOOKS

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6thEdition,2004.
2. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1stEdition,2013.
3. WillianmHayt, Jack E Kemmerly S M Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7thEdition,2010.
4. J P J Millman, C CHalkias, SatyabrataJit, "Millmans Electronic Devices and Circuits", Tata McGraw Hill, 2ndEdition,1998.
5. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI / PHI, 9th Edition, 2006.
6. V K Mehta, Rohit Mehta, —Principles of electrical engineering, S CHAND, 1st Edition, 2003.

REFERENCE BOOKS:

1. David A Bell, “Electric Circuits”, Oxford University Press, 9thEdition,2016.
2. U A Bakshi,Atul P Godse “Basic Electrical and Electronics Engineering”TechnicalPublications, 9thEdition,2016.
3. A Bruce Carlson, “Circuits”, Cengage Learning, 1stEdition,2008.
4. M Arshad, “Network Analysis and Circuits”, Infinity Science Press, 9thEdition,2016.

WEB REFERENCES:

1. http://www.igniteengineers.com
2. http://www.ocw.nthu.edu.tw
3. http://www.uotechnology.edu.iq

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/computer-science-engineering-autonomous/fundamentals -of-electrical-and-electronics-engineering

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Electrical Circuits: Basic definitions, Types of elements	CO 1	T1-5.2 to 5.3
3	Ohm's Law, Kirchhoff Laws	CO 1	T1-5.4 to 5.5
4	Series, parallel circuits	CO 2	T1-5.5 to 5.8
5	Derivation for Star-delta and delta-star transformations	CO 2	T1-5.8 to 5.9
6	Mesh analysis and Nodal Analysis	CO 2	T1-5.11 to 5.12
7	Representation of alternating quantities	CO 3	T1-5.14 to 5.15
8	RMS and Average values of an AC signal	CO 2	T1-5.16 to 5.16
9	Form and peak factor, concept of impedance and admittance	CO 2	T1-5.16 to 5.16
10	Superposition theorem for DC excitations circuits	CO 3	T1-6.1 to 6.3

11	Reciprocity theorem for DC excitation	CO 3	T1-6.8 to 6.9
12	Thevenin's theorem for DC excitations circuits	CO 3	T1-6.2 to 6.3
13	Norton's theorem for DC excitations circuits	CO 3	T1-6.3 to 6.4
14	Maximum power transfer theorem for DC excitations circuits	CO 3	T1-11.1
15	Incidence matrix for planar networks	CO 3	T1-11.2 to 11.3
16	Basic Cut Set matrix for planar networks	CO 3	T1-11.2 to 11.3
17	Basic Tie Set matrix for planar networks	CO 3	T1-11.9 to 11.10
18	Understand the representation of rectangular and polar forms	CO 4	R2-7.1 to 7.2
19	Understand the concepts of alternating quantities.	CO 3	R2-7.4
20	Analyze the real, reactive, apparent power and complex power.	CO 4	R2-7.3
21	Explain the concept of power factor in single phase AC circuits.	CO 4	R2-7.3.1 to 7.3.2
22	Understand the consisting of single phase AC circuit consisting of R.	CO 4	R2-7.3.3 to 7.3.6
23	Understand the consisting of single phase AC circuit consisting of L.	CO 4	R2-7.6
24	Understand the consisting of single phase AC circuit consisting of C	CO 4	T1-13.1 to 13.3
25	Understand the consisting of single phase AC circuit consisting of RL combination.	CO 4	T1-13.1 to 13.3
26	Understand the consisting of single phase AC circuit consisting of RC combination	CO 4	T1-13.5 to 13.6
27	Understand the consisting of single phase AC circuit consisting of RLC combination.	CO 4	T1-13.6 to 13.7
28	Understand the concept of duality and dual networks.	CO 4	T1-13.7 to 13.9
29	Understand the concept of P-N junction diode, symbol	CO 5	T1-13.8
30	Learn the V-I characteristics of P-N junction diode	CO 5	T1-17.1 to 17.2
31	Discuss the concept of half wave rectifier and full wave rectifier	CO 5	T1-17.3 to 17.4
32	Understand the bridge rectifiers and filters	CO 5	T1-17.6 to 17.7
33	Discuss the concept of diode as a switch, Zener diode as a voltage regulator	CO 5	T1-13.11
34	Know the concept of Transistors and Understand the configurations	CO 6	T1-13.12
35	Understand the DC characteristics of transistor	CO 6	T1-13.13

36	Understand the biasing and load line analysis.	CO 6	T1-13.13
37	Discuss how transistor acts as an amplifier.	CO 6	T1-13.13
PROBLEM SOLVING/ CASE STUDIES			
42	Numerical Examples on electrical quantities, Ohm's law, KCL, KVL	CO 1	T1-5.8 to 5.9
43	Numerical Examples on series, parallel elements and star to delta transformation and mesh analysis	CO 2	T1-5.5 to 5.8
44	Numerical Examples on nodal analysis and alternating quantities	CO 2	T1-6.8 to 6.9
45	Numerical Examples on Superposition theorem	CO 2	T1-6.2 to 6.3
46	Numerical Examples on reciprocity and maximum power transfer theorems	CO 5	R2-7.1 to 7.2
47	Numerical Examples on Thevenin's and Norton's theorems	CO 2	T1-13.1 to 13.3
48	Numerical Examples on Basic cut set and Tie set matrices	CO 2	T1-13.5 to 13.6
49	Numerical Examples on Single phase AC circuit with only R	CO 3	T1-13.6 to 13.7
50	Numerical Examples on Single phase AC circuit with only L	CO 3	T1-13.1 to 13.3
51	Numerical Examples on Single phase AC circuit with only C	CO 3	T1-13.13
52	Numerical Examples on Single phase AC circuit with RL combination	CO 3	T1-13.16 to 13.18
53	Numerical Examples on Single phase AC circuit with RC combination	CO 4	T1-13.14
54	Numerical Examples on Single phase AC circuit with RLC combination	CO 4	T1-13.16 to 13.18
55	Numerical Examples on dual and duality	CO 4	T1-13.19
56	Numerical Examples on Rectifiers	CO 5	T1-13.19
57	Numerical Examples on transistors	CO 6	T1-13.19
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions and terminology from basics of electrical circuits	CO 1	T1-5.1 to 5.3
58	Definitions on network theorems	CO 2	T1-6.1 to 6.3
59	Definitions on single phase AC circuits	CO 3	R2-7.1 to 7.2
60	Definitions on semiconductor diode and applications	CO 5	T1-13.1 to 13.3
61	Definitions on bipolar junction transistor and applications	CO 6	T1-13.11
DISCUSSION OF QUESTION BANK			
62	Questions from electrical circuits	CO 1	T1-5.1 to 5.3
63	Questions from network theorems	CO 2	T1-6.1 to 6.3

64	Questions from single phase AC circuits	CO 3	R2-7.1 to 7.2
65	Questions from semiconductor diode and applications	CO 5	T1-13.1 to 13.3
66	Questions from bipolar junction transistor and applications	CO 6	T1-13.11

Signature of Course Coordinator **HOD,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY

COURSE DESCRIPTION

Course Title	DATA STRUCTURES LABORATORY				
Course Code	ACS102				
Program	B.Tech				
Semester	II	IT			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Ms.B Rekha, Assistant Professor,IT				

I COURSE OVERVIEW:

A data structure is a particular way of organizing data in a computer so that it can be used effectively. It covers the design and analysis of fundamental data structures and engages learners to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications. A Data Structure is a particular way of storing and organizing data in a computer so that it can be stored, retrieved, or updated efficiently. Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by an address. This course is essential for image viewer software, in this images are linked with each other so, images uses a linked list to view the previous and the next images using the previous and next buttons. Web pages can be accessed using the previous and the next URL links which are linked using linked list. The music players also use the same technique to switch between music. To keep the track of turns in a multi player game, a circular linked list is used.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS002	II	Data Structures
B.Tech	ACS101	I	Computer Programming Laboratory

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Structures Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

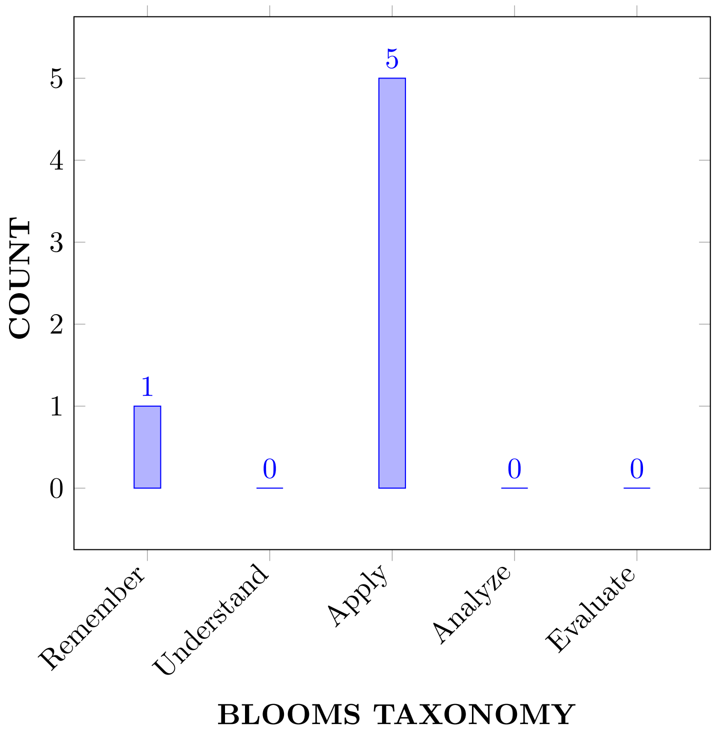
I	Implement linear and non linear data structures.
II	Analyze various algorithms based on their time complexity. .
III	Choose appropriate data structure and algorithm design method for a specific application.
IV	Identify suitable data structure to solve various computing problems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Identify** appropriate searching technique for efficient retrieval of data stored location. .	Apply
CO 2	**choose** sorting technique to represent data in specified format to to optimize data searching.	Apply
CO 3	**Make use of** stacks and queues representation, operations and their applications to organize specified data	Understand
CO 4	**utilize** linked lists to implement and perform operations for for organizing specified data	Apply
CO 5	**Construct** tree to perform different traversal techniques	Apply
CO 6	**Select** Appropriate graph traversal techniques to visit the vertices of a graph	Remember

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences	3	Lab Exercises
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	Lab Exercises
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	2	Lab Exercises
PO 5	**Modern Tool Usage:**Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	1	Lab Exercises
PO 6	**The Engineer and Society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice	2	Lab Exercises
PO 7	**Environment and Sustainability** Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development	2	Lab Exercises
PO 8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice	3	Lab Exercises
PO 9	**Individual and Teamwork** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	3	Lab Exercises

PO 10	**Communication:** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	4	Lab Exercises
PO 12	**Life - Long Learning:**Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2	Lab Exercises
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges..	2	Lab Exercises
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	No. of Key Competencies
CO 1	PO 1	Identify appropriate searching technique for efficient retrieval of data stored location by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	Identify appropriate searching technique for efficient retrieval of data stored location by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	**Identify** appropriate searching technique for efficient retrieval of data stored location by applying **Design/Development of Solutions**	3

	PO 4	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying Computer software / simulation packages / diagnostic equipment / technical library resources / literature search toolsl	1
	PO 6	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying **reasoning informed by the contextual knowledge**	2
	PO 8	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	Identify**apply**appropriate searching technique for efficient retrieval of data stored location by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	Identify appropriate searching technique for efficient retrieval of data stored location in **search engines**	2
	PSO 2	Identify appropriate searching technique for efficient retrieval of data stored location in **mobile and web applications development**	2
	PSO 3	Identify appropriate searching technique for efficient retrieval of data stored location **in shipping real world software, using industry standard tools**	3
CO 2	PO 1	choose sorting technique to represent data in specified format to optimize data searching by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	choose sorting technique to represent data in specified format to optimize data searching by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	**Identify** choose sorting technique to represent data in specified format to optimize data searching by applying **Design/Development of Solutions**	3
	PO 4	**choose** sorting technique to represent data in specified format to optimize data searching by applying **Conduct Investigations of Complex Problems**	2

	PO 5	choose sorting technique to represent data in specified format to optimize data searching by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search toolsl**	1
	PO 6	choose sorting technique to **represent** data in specified format to optimize data searching by applying **reasoning informed by the contextual knowledge**	2
	PO 8	**choose** sorting technique to represent data in specified format to optimize data searching by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	choose sorting technique to **represent** data in specified format to optimize data searching by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	choose**Apply** sorting technique to represent data in specified format to optimize data searching by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	**choose** sorting technique to **represent** data in specified format to optimize data searching by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	choose**Apply** sorting technique to represent data in specified format to optimize data searching in **search engines**	2
	PSO 2	choose**Apply** sorting technique to represent data in specified format to optimize data searching in **mobile and web applications development**	2
	PSO 3	choose**Apply** sorting technique to represent data in specified format to optimize data searching **in shipping real world software, using industry standard tools**	3
CO 3	PO 1	Make use of stacks and queues representation, operations and their applications to organize specified data by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	Make use of stacks and queues representation, operations and their applications to organize specified data by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	**Identify**, **Make use of** stacks and queues representation, operations and their applications to organize specified data by applying **Design/Development of Solutions**	3

	PO 4	Make use of **Apply**stacks and queues representation, operations and their applications to organize specified data by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Make use of stacks and queues representation, operations and their applications to organize specified data by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search tools**	1
	PO 6	**Make use of** stacks and queues representation, operations and their applications to organize specified data by applying **reasoning informed by the contextual knowledge**	2
	PO 8	Make use of stacks and queues **representation**, operations and their applications to organize specified data by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	**Make use of** stacks and queues representation, operations and their applications to organize specified data by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	Make use of stacks and queues representation, **operations and their applications** to organize specified data by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	Make use of stacks and queues **representation**, operations and their applications to organize specified data by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	Make use of stacks and queues **representation**, operations and their applications to organize specified data in **search engines**	2
	PSO 2	Make use of stacks and queues **representation**, operations and their applications to organize specified data **mobile and web applications development**	2
	PSO 3	Make use of stacks and queues **representation**, operations and their applications to organize specified data **in shipping real world software, using industry standard tools**	2
CO 4	PO 1	utilize linked lists to implement and perform operations for organizing specified data by applying the **principles of Mathematics and Engineering , Scientific principles and methodology,engineering disciplines to integrate / support study**	3

	PO 2	utilize linked lists to implement and perform operations for organizing specified data by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	utilize**Apply** linked lists to **implement** and perform operations for organizing specified data by applying **Design/Development of Solutions**	3
	PO 4	utilize linked lists to **implement** and perform operations for organizing specified data by applying **Conduct Investigations of Complex Problems**	2
	PO 5	utilize linked lists to implement and perform operations for organizing specified data by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search toolsl**	1
	PO 6	utilize linked lists to implement and perform operations for organizing specified data by applying **reasoning informed by the contextual knowledge**	2
	PO 8	utilize linked lists to **implement** and perform operations for organizing specified data by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	utilize **Apply**linked lists to implement and perform operations for organizing specified data by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	utilize linked lists to implement and **perform** operations for organizing specified data by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	utilize**Apply** linked lists to implement and perform operations for organizing specified data by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	utilize**Apply** linked lists to implement and perform operations for organizing specified in **search engines**	2
	PSO 2	utilize**Apply** linked lists to implement and perform operations for organizing specified in **mobile and web applications development**	2
	PSO 3	utilize**Apply** linked lists to implement and perform operations for organizing specified **in shipping real world software, using industry standard tools**	2
CO 5	PO 1	Construct tree to perform different traversal techniques by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3

	PO 2	Construct tree to perform different traversal techniques by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3
	PO 3	Construct**Apply** tree to **perform** different traversal techniques by applying **Design/Development of Solutions**	3
	PO 4	**Construct** tree to perform different traversal techniques by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Construct tree to perform different traversal techniques by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search tools**	1
	PO 6	Construct tree to **perform** different traversal techniquesby applying **reasoning informed by the contextual knowledge**	2
	PO 8	ConstructApply tree to perform different traversal techniques by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	Construct tree to perform different traversal techniquesby applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of **people in an organization**	3
	PO 10	Construct tree to **perform** different traversal techniques by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	**Construct** tree to perform different traversal techniques by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	Construct tree to **perform** different traversal techniques in **search engines**	2
	PSO 2	Construct tree to **perform** different traversal techniques in **mobile and web applications development**	2
	PSO 3	Construct tree to **perform** different traversal techniques **in shipping real world software, using industry standard tools**	2
CO 6	PO 1	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying the **principles of Mathematics and Engineering** , **Scientific principles and methodology**,**engineering disciplines to integrate / support study**	3
	PO 2	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying Problem Analysis **Problem statement and system definition**,**Information and data collection**,**Solution development or experimentation / Implementation**	3

	PO 3	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying **Design/Development of Solutions**	3
	PO 4	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying **Conduct Investigations of Complex Problems**	2
	PO 5	Select Appropriate graph traversal techniques to visit the vertices of a graph by applying Computer software / simulation packages / diagnostic equipment / technical library resources / **literature search tools**	1
	PO 6	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying **reasoning informed by the contextual knowledge**	2
	PO 8	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying **ethical principles** and commit to professional **ethics and responsibilities** and norms of the Engineering practice	3
	PO 9	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by applying Function **effectively** as an individual, and as a member or leader to get Ability to work with all levels of people in an organization	3
	PO 10	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by **Communicate effectively** on **complex Engineering activities**	3
	PO 12	**Select** Appropriate graph traversal techniques to visit the vertices of a graph by **Keeping current in CSE and advanced engineering concepts**	3
	PSO 1	**Select** Appropriate graph traversal techniques to visit the vertices of a graph in **search engines**	2
	PSO 2	**Select** Appropriate graph traversal techniques to visit the vertices of a graph in **mobile and web applications development**	2
	PSO 3	**Select** Appropriate graph traversal techniques to visit the vertices of a graph **in shipping real world software, using industry standard tools**	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	**Program Outcomes/ No. of Key Competencies Matched**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	2	2	3	1	-	1	2	3	-	2	2	1	1
CO 2	1	2	2	2	3	1	-	2	3	3	-	2	1	1	1
CO 3	1	2	2	1	3	1	-	-	2	3	-	2	2	2	-

CO 4	1	2	1	1	3	1	-	-	2	3	-	2	2	1	1
CO 5	1	1	2	1	3	1	-	2	2	3	-	2	2	1	1
CO 6	1	1	2	1	3	1	-	1	3	3	-	2	2	1	1

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**SEARCHING TECHNIQUES**
	Write C programs for implementing the following searching techniques. a. Linear search. b. Binary search. c. Fibonacci search.
WEEK II	**SORTING TECHNIQUES**
	Write C programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Bubble sort. b. Insertion sort. c. Selection sort
WEEK III	**SORTING TECHNIQUES**
	Write C programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Quick sort. b. Merge sort
WEEK IV	**IMPLEMENTATION OF STACK AND QUEUE**
	Write C programs to a. Design and implement Stack and its operations using Arrays. b. Design and implement Queue and its operations using Arrays
WEEK V	**APPLICATIONS OF STACK**
	Write C programs for the following: a. Uses Stack operations to convert infix expression into postfix expression. b. Uses Stack operations for evaluating the postfix expression
WEEK VI	**IMPLEMENTATION OF SINGLE LINKED LIST**
	Write C programs for the following: a. Uses functions to perform the following operations on single linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal b. To store a polynomial expression in memory using linked list.
WEEK VII	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
	Write C programs for the following: Uses functions to perform the following operations on Circular linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal.

WEEK VIII	**IMPLEMENTATION OF DOUBLE LINKED LIST**
	Write C programs for the following: Uses functions to perform the following operations on double linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.
WEEK IX	**IMPLEMENTATION OF STACK USING LINKED LIST**
	Write C programs to implement stack using linked list
WEEK X	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
	Write C programs to implement queue using linked list
WEEK XI	**GRAPH TRAVERSAL TECHNIQUES**
	Write C programs to implement the following graph traversal algorithms: a. Depth first search. b. Breadth first search.
WEEK XII	**IMPLEMENTATION OF BINARY SEARCH TREE**
	Write a C program that uses functions to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.

TEXTBOOKS

1. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley Student Edition.
2. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt Publishers, 2017.

REFERENCE BOOKS:

1. S. Lipschutz, "Data Structures", Tata McGraw Hill Education, 1st Edition, 2008.
2. Samanta, "Classic Data Structures", PHI Learning, 2nd Edition, 2004.Gottfried Byron,
3. "Schaum's Outline of Programming with Python", Tata Mc Graw Hill, 1st Edition, 2010.
4. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley, John Wiley and Sons, INC., 2011.
5. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt Publishing Ltd., 2017.

WEB REFERENCES:

1. https://docs.python.org/3/tutorial/datastructures.html
2. http://interactivepython.org/runestone/static/pythonds/index.html
3. http://www.tutorialspoint.com/data-structures-algorithms
4. http://www.geeksforgeeks.org/data-structures/
5. http://www.studytonight.com/data-structures
6. http://www.coursera.org/specializations/data-structures-algorithms
7. http://cse01-iiith.vlabs.ac.in/

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Searching Techniques.	CO 1	T1
2	Sorting Techniques.	CO 2	T1
3	Sorting Techniques	CO 2	T1,T2
4	Implementation of Stack and Queue	CO 3	T1,T2
5	Applications of Stack.	CO 3	T1, W1
6	Implementation of Single Linked List	CO 4	T1,W2
7	Implementation of Circular Single Linked List.	CO 4	T1,W3
8	Implementation of Double Linked List	CO 4	T2,W3
9	Implementation of Stack Using Linked List.	CO 3,CO 4	T2,W2
10	Implementation of Queue Using Linked List	CO 3,CO 4	T2,W5
11	Graph Traversal Techniques.	CO 6	T2,W2
12	Implementation of Binary Search Tree	CO 5	T1,W5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Twin vortex formation:** Design a Data Structure SpecialStack that supports all the stack operations like push(), pop(), isEmpty(), isFull() and an additional operation getMin() which should return minimum element from the SpecialStack. All these operations of SpecialStack must be O(1). To implement SpecialStack, you should only use standard Stack data structure and no other data structure like arrays, list, . etc.
2	**Open channel:** In class, we studied binary search trees that do not allow us to insert duplicate elements. However, sometimes we do need to store duplicates. For example, a database of student marks might contain one record for every mark by every student; so if you've taken two courses, there will be two records with the same key (your student number) and different data (your two marks). To accomplish this, we might use a data structure called a "BST with duplicates", or BSTD
3	**Capillary action:** The variable tos in the Stack class is the index of the array element that would be filled the next time push() is called. Modify the code so that tos is the index of the top element actually in use. In other words, tos is to be the index of the top array element occupied by a value that has been "pushed" onto the stack. Write your changes on the code above. Don't forget to fix the comments. You do not need to add preconditions as in part-a.
4	**Buoyancy** Given an adjacency matrix representation of a graph, describe with pseudo code an algorithm that finds a single path, if one exists, between any two different vertices.

5	**Flow through pipes:** There is a garage where the access road can accommodate any number of trucks at one time. The garage is building such a way that only the last truck entered can be moved out. Each of the trucks is identified by a positive integer (a truck-id). Write a program to handle truck moves, allowing for the following commands: a) On-road (truck-id); b) Enter-garage (truck- id); c) Exit-garage (truck-id); d) Show-trucks (garage or road); If an attempt is made to get out a truck which is not the closest to the garage entry, the error message Truck x not near garage door
6	**Flow through pipes:** How many non-null links are there in a binary tree with N nodes?
7	**Flow through pipes:** How can we remove loops in a linked list? What are the functions of fast and slow pointers?

Signature of Course Coordinator **HOD,IT**
Ms. B.Rekha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE ENGINEERING
COURSE DESCRIPTION

Course Title	**ELECTRICAL AND ELECTRONICS ENGG LAB**				
Course Code	AEE101				
Program	B.Tech				
Semester	II	CSE/IT			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Mr.K Lingaswamy, Assistant Professor				

I COURSE OVERVIEW:

Electrical and electronics engineering laboratory is introduced to get the practical experience on with identification of all the electrical components. It also aims to get the knowledge of the different electronic devices like diodes, rectifiers, transistors and to measure the electrical quantities with different measuring devices and CRO.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS006	I	Engineering Physics
B.Tech	AHS002	I	Linear Algebra and Ordinary Differential Equations

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Electrical and Electronics Engineering Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

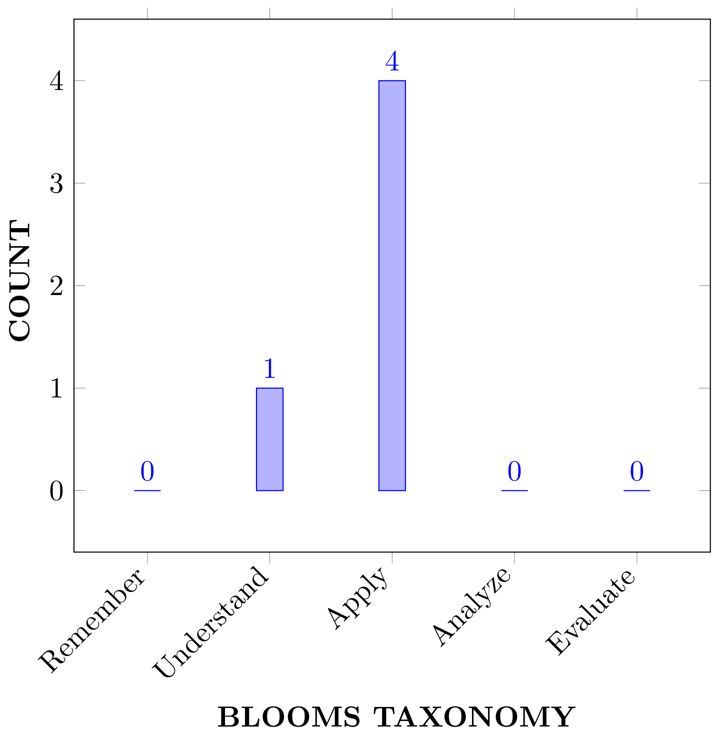
I	Analyze basic electrical circuits by implementing different circuits.
II	Apply circuit theorems to evaluate the behavior of electrical circuits.
III	Gain knowledge on semiconductor devices like diode and transistor..
IV	Interpret different transistor configurations.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Solve** the electrical circuit source resistance, currents, voltage and power by applying various network reduction techniques using hardware and software.	Apply
CO 2	**Apply** various network theorems to reduce complex network into simple equivalent network with DC excitation using hardware and software.	Apply
CO 3	**Acquire** basic knowledge on the working of PN-junction diode, Zener diode to plot their V-I characteristics.	Understand
CO 4	**Identify** transostor configuration and their working to deduce its working as switch and amplifier.	Apply
CO 5	**Explore** the knowledge and skills of employability to succeed in national and international level competitive examinations.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises

PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Lab Exercises
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	2	Lab Exercises
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	Lab Exercises
PO 9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Lab Exercises
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Lab Exercises
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Understand design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	1	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using **knowledge of mathematics, science and engineering fundamentals.** and various source transformation techniques are adopted for solving complex circuits.	3
	PO 5	Create,select and apply appropriate techniques,resources and modern engineering and IT tools **in solving the circuits**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in solving the circuits**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in solving the circuits**.	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in solving the circuits**.	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in solving the circuits**.	3
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts **by using computer programs.**	1
CO 2	PO 1	Demonstrate the various network theorems in order to determine the same **using principles of mathematics, science and engineering fundamentals.**	3
	PO 5	Create,select and apply appropriate techniques,resources and modern engineering and IT tools **in solving the complex circuits**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in solving complex circuits by using theroems**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in solving complex circuits by using theroems**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in solving complex circuits by using theroems**	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in solving the circuits by using theroems**	3

	PSO 1	Simplify complex electrical networks by applying various circuit theorems **by using computer programs.**	1
CO 3	PO 1	Understand the working of PN-junction diode,Zener diode by using principles of **mathematics and engineering science**	3
	PO 2	Acquire the knowledge on working of PN-junction diode **for its validity.**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **by understanding the working of PN-junction diode,Zener diode**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **by understanding the working of PN-junction diode,Zener diode**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **by understanding the working of PN-junction diode,Zener diode**	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **by understanding the working of PN-junction diode,Zener diode**.	3
CO 4	PO 1	Identify transistor configuration by using principles of **mathematics and engineering science**	3
	PO 2	Identify the different transistor configuration for its applications **for its validity.**	1
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **by identifying transistor configuration**	1
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **by identifying transistor configuration**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **by identifying transistor configuration**	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **by identifying transistor configuration**.	3
CO 5	PO 1	Demonstrate the knowledge of electrical circuits and semiconductor diodes **using principles of mathematics, science and engineering fundamentals.**	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in demonstration of electrical circuits and semiconductor diodes**	1

	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in demonstration of electrical circuits and semiconductor diodes**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in demonstration of electrical circuits and semiconductor diodes**	5
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in demonstration of electrical circuits and semiconductor diodes**	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE	PROGRAM OUTCOMES							PSO
OUTCOMES	PO 1	PO 2	PO 5	PO 8	PO 9	PO10	PO12	PSO1
CO 1	3		2	1	3	3	3	1
CO 2	3		2	1	3	3	3	1
CO 3	3			1	3	3	3	
CO 4	3			1	3	3	3	
CO 5	3			1	3	3	3	

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**KIRCHHOFF'S LAWS**
	Practical verification of Kirchhoff's current law and voltage law.
WEEK II	**SUPERPOSITION THEOREM**

	Illustration of superposition theorem.
WEEK III	**THEVENIN'S THEOREM**
	Obtain the equivalent circuit of the given electrical network using Thevenin's theorem.
WEEK IV	**NORTON'S THEOREM**
	Practical verification of Norton's theorem and obtain the equivalent circuit.
WEEK V	**MAXIMUM POWER TRANSFER THEOREM**
	Verification of maximum power transfer theorem.
WEEK VI	**KVL AND KCL**
	Verification of KVL and KCL using digital simulation.
WEEK VII	**DIGITAL SIMULATION OF THEOREMS**
	Superposition theorem and Thevenins theorem using digital simulation.
WEEK VIII	**NORTON'S AND MAXIMUM POWER TRANSFER THEOREMS**
	Norton's theorem and maximum power transfer theorem using digital simulation.
WEEK IX	**P-N JUNCTION DIODE**
	Volt Ampere characteristics of p-n junction diode.
WEEK X	**ZENER DIODE**
	Understand the zener diode characteristics.
WEEK XI	**RECTIFIERS**
	Build half wave and full wave rectifier circuits.
WEEK XII	**COMMON BASE TRANSISTOR**
	Understand transistor common base characteristics.
WEEK XIII	**COMMON EMITTER TRANSISTOR**
	Understand transistor common emitter characteristics.

TEXTBOOKS

1. C L Wadhwa "Electrical Circuit Analysis including Passive Network Synthesis", New Age International, 2nd Edition, 2009.

2. J P J Millman, C C Halkias, Satyabrata Jit, Millman's, "Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition, 1998.

REFERENCE BOOKS:

1. A Chakrabarti, "Electric Circuits", Dhanpat Rai Publications, 6th Edition, 2010.

2. William Hayt, Jack E Kemmerly S.M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7th Edition, 2010.

3. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1st Edition, 2013.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Apply Kirchhoff's current and voltage laws to linear electrical circuits using hardware.	CO 1	R1: 1.2
2	Verification of superposition theorem using hardware.	CO 2	R2: 3.5
3	Verification of Thevenin's theorem using hardware.	CO 2	R1: 3.4
4	Verification of Norton's theorem using hardware.	CO 2	R1: 2.2
5	Verification of maximum power transfer theorem using hardware.	CO 2	R1: 2.4
6	Apply Kirchhoff's current and voltage laws to linear electrical circuits using digital simulation.	CO 1	R3: 4.5
7	Superposition theorem and Thevenins theorem using digital simulation.	CO 2	R3: 4.6
8	Verification of Norton's theorem and maximum power transfer theorem using digital simulation.	CO 2	R2: 5.1
9	Understand the PN junction diode characteristics.	CO 3	R2: 5.2
10	Understand the zener diode characteristics.	CO 3	R1: 7.1
11	Build half wave and full wave rectifier circuits.	CO 3	R1:7.2
12	Understand transistor common base characteristics	CO 4	R1:7.3
13	Understand transistor common emitter characteristics	CO 4	R1:7.2

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Include more DC Electrical network theorems.

Signature of Course Coordinator **HOD,CSE**
Mr. K Lingaswamy, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**				
Course Title	**DESIGN AND ANALYSIS OF ALGORITHMS**				
Course Code	AIT001				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	3	2
Course Coordinator	Dr. B.V. Rao, Professor, IT				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS001	I	Computer Programming
B.Tech	ACS002	II	Data Structures

II COURSE OVERVIEW:

The primary objective of this course is to introduce the concept of algorithm as a precise mathematical concept, and study how to design algorithms, establish their correctness, study their efficiency and memory needs. The course consists of a strong mathematical component in addition to the design of various algorithms.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Design And Analysis Of Algorithms	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	✓	Seminars	✓	Quiz	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
70%	Understand
10%	Remember
20%	Apply
0%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz.

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

VI COURSE OBJECTIVES:

The students will try to learn:

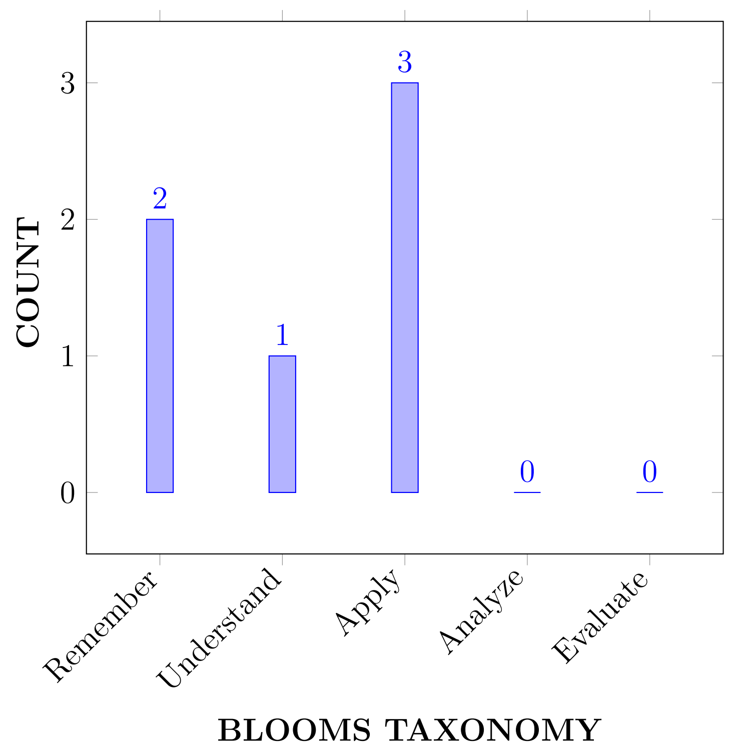
I	Calculate performance of algorithms with respect to time and space complexity.
II	Illustrate the graph traversals and tree traversals to solve the problems
III	Demonstrate the concepts greedy method and dynamic programming for several applications like knapsack problem, job sequencing with deadlines, and optimal binary search tree, TSP.
IV	Illustrating the methods of backtracking and branch bound techniques to solve the problems like n-queens problem, graph colouring and TSP respectively

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Find** the (worst case, randomized, amortized) running time and space complexity of given algorithms using techniques such as recurrences and properties of probability.	Remember
CO 2	**Apply** divide and conquer algorithms for solving sorting, searching and matrix multiplication.	Apply
CO 3	**Make Use of** appropriate tree traversal techniques for finding shortest path.	Apply
CO 4	**Identify** suitable problem solving techniques for a given problem and finding optimized solutions using Greedy and Dynamic Programming techniques	Remember
CO 5	**Utilize** backtracking and branch and bound techniques to deal with traceable and in-traceable problems.	Apply
CO 6	**Describe** the classes P, NP, NP-Hard, NP-complete for solving deterministic and non deterministic problems.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	SEE/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/SEE/AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools	2	SEE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		✓	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-	-
CO 5	✓	-	-	✓	-	-	-	-	-	-	-	✓	-	-	-
CO 6	✓	-	-	✓	-	-	-	-	-	-	-	✓	✓	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Analyze the running time and space complexity of given algorithms using techniques such as recurrences, potential functions, properties of probability by applying the **mathematical principles, engineering principles and scientific principles**	3
	PSO1	Understand the basic properties of asymptotic notations, probability analysis for designing **algorithms, system software and Networking.**	3
CO 2	PO 1	Apply divide and conquer algorithms for solving sorting, searching and matrix multiplication problems to integrate **mathematical principles, engineering Principles,** and **Scientific Principles.**	3
	PO 2	Understand the given **problem** and **develop the solution** for solving sorting, searching and matrix multiplication problems **complex engineering problems** and **Interpretation of results.**	4
	PSO1	Build divide and conquer algorithms for solving sorting, searching, **Big data** analysis and matrix multiplication problems through **system software.**	2
CO 3	PO 1	Utilize appropriate tree traversal techniques for solving graph problems to integrate **mathematical principles, scientific Methodology, and engineering principles.**	3
	PO 2	Understand the given **problem** traversal techniques to **develop the solution** for graph problems **complex engineering problems and interpretation of results.**	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 4	PO 1	Choose (Pick) greedy algorithms for finding solutions of minimization and maximization problems to support study of their own **engineering discipline and methodologies.**	2
	PO 2	Understand the given **problem** and **develop the solution** using greedy methods in reaching substantiated conclusions from the provided **problem identification, information, interpret of results, complex engineering problems** and **Experimental design.**	7
	PO 3	Select appropriate technique from the greedy techniques for given problem and **apply** chosen method for finding the solutions of given problem **define problem, Evaluate outcomes, innovative solutions, engineering activities** and**engineering processes**	7
	PO 12	make use of greedy and dynamic programming techniques for **beginning works on advances degree, current trends in computer science, efforts for personal continue education** ,personal development and **on going learning.**	4
CO 5	PO 1	Identify backtracking and branch and bound techniques to compact with traceable and in -traceable problems by applying the knowledge of **mathematics, Engineering fundamentals** and to find the solution of **complex engineering problems.**	3
	PO 4	Understand the given set of problems from the **provided information, to identify, classify** and describe the **performance of systems** approach and textbfengineering problems and principles.	6
	PO 12	Utilize branch and bound techniques to learn for solving problems in**current trends of computer science, on going learning, continuum education,** beginning works for **advance degree** and personal development.	4
CO 6	PO 1	Understanding the concepts of classes P, NP, NP-Hard, NP- complete for solving deterministic and non-deterministic problems in attainment of mathematical **principles, engineering methodologies and scientific principles.**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Identify the given complex problem and choose the deterministic algorithms for solving the given decision problems from the **provided information** in accomplishment of **engineering problems, performance of systems, to identify , classify and principles.**	6
	PO 12	Describe P,NP,NP-Hard, NP-complete for solving deterministic and non deterministic problems which are useful for **personal development**, on going learning ,**continuum education** and **current trends in computer science.**	3
	PSO 1	Understand the basic properties of deterministic algorithms in the areas related to **computer programs, Big data, Machine Learning and Networking.**	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	3	4	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	7	7	-		-	-	-	-	-	-	4	-	-	-
CO 5	3	-	-	6	-	-	-	-	-	-	-	4	-	-	-
CO 6	3	-	-	6	-	-	-	-	-	-	-	3	3	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	-	-	-	-	-	-	-	-	-		50.0	-	-
CO 2	100	40	-	-	-	-	-	-	-	-	-	-	33.33	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	70	70	-		-	-	-	-	-	-	50.0	100	100	-
CO 5	100	-	-	54.54	-	-	-	-	-	-	-	50.0	-	-	-
CO 6	100	-	-	54.54	-	-	-	-	-	-	-	37.5	50.0	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO 5	3	-	-	2	-	-	-	-	-	-	-	2	-	-	-
CO 6	3	-	-	2	-	-	-	-	-	-	-	1	2	-	-
TOTAL	18	7	3	4	-	-	-	-	-	-	-	5	5	-	-
AVERAGE	3.0	2.3	1.0	1.0	-	-	-	-	-	-	-	1.7	1.7	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1, PO 2, PO 3,PO 4	SEE Exams	PO 1, PO 2, PO 3,PO 4	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 4	Open Ended Experiments	-
Assignments	PO1				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

x	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Algorithm: Pseudo code for expressing algorithms; Performance analysis: Space complexity, time complexity; Asymptotic notations: Big O notation, omega notation, theta notation and little o notation, amortized complexity; Divide and Conquer: General method, binary search, quick sort, merge sort, Strassen's matrix multiplication.

MODULE II	**SEARCHING AND TRAVERSAL TECHNIQUES**
	Disjoint set operations, union and find algorithms; Efficient non recursive binary tree traversal algorithms, spanning trees; Graph traversals: Breadth first search, depth first search, connected components, bi-connected components.
MODULE III	**GREEDY METHOD AND DYNAMIC PROGRAMMING**
	Greedy method: The general method, job sequencing with deadlines, knapsack problem, minimum cost spanning trees, single source shortest paths. Dynamic programming: The general method, matrix chain multiplication optimal binary search trees, 0/1 knapsack problem, single source shortest paths, all pairs shortest paths problem, the travelling salesperson problem.
MODULE IV	**BACKTRACKING AND BRANCH AND BOUND**
	Backtracking: The general method, the 8 queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles; Branch and bound: The general method, 0/1 knapsack problem, least cost branch and bound solution, first in first out branch and bound solution, travelling salesperson problem.
MODULE V	**NP-HARD AND NP-COMPLETE PROBLEM**
	Basic concepts: Non-deterministic algorithms, the classes NP - Hard and NP, NP Hard problems, clique decision problem, chromatic number decision problem, Cook's theorem.

TEXTBOOKS

1. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekharan, —Fundamentals of Computer Algorithms, Universities Press, 2nd Edition, 2015.

2. Alfred V. Aho, John E. Hopcroft, Jeffrey D, —The Design And Analysis Of Computer Algorithms, Pearson India, 1st Edition, 2013.

REFERENCE BOOKS:

1. Levitin A, —Introduction to the Design and Analysis of Algorithms, Pearson Education, 3rd Edition, 2012.

2. Goodrich, M. T. R Tamassia, —Algorithm Design Foundations Analysis and Internet Examples, John Wileyn and Sons, 1st Edition, 2001.

3. Base Sara Allen Vangelder, —Computer Algorithms Introduction to Design and Analysis, Pearson, 3rd Edition, 1999.

WEB REFERENCES:

1. https://www.coursera.org/learn/algorithm-design-analysis

2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms

3. http://www.facweb.iitkgp.ernet.in/sourav/daa.html

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	
CONTENT DELIVERY (THEORY)			
2	Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis- Space complexity, Time complexity.	CO 1	T1:1.1-1.3.2
3	Asymptotic Notation-Big oh notation, Omega notation, Theta notation and Little oh notation	CO 1	T1:1.3.3
4	Amortized complexity.	CO 1	T2:2.3
5	Divide and conquer: General method.	CO 2	T1:3.1
6	Divide and conquer: Binary search, Quick sort	CO 2	T1:3.2-3.5
7	Divide and conquer: Merge sort, Strassen'smatrix multiplication.	CO 2	T1:3.4-3.7
8	Disjoint set operations.,	CO 3	T1:2.5
9	Union and find algorithms.	CO 1	T1:2.5.2
10	Non-recursive binary tree traversal algorithms,	CO 3	T1:6.1
11	Spanning tree.	CO 3	T1:6.3
12	Graph traversals: Breadth first search.	CO 3	T1:6.2.1
13	Graph traversals:Depth first search.	CO 3	T1:62.2
14	Connected components, Bi-connected components.	CO 3	T1:6.3-6.4
15	Greedy general method.	CO 4	T1:4.1
16	Greedy method: Job sequencing with deadlines.	CO 4	T1:4.4
17	Greedy method: 0/1 knapsack problem, Minimum cost spanning trees.	CO 4	T1:4.2-4.5
18	Greedy method: Single source shortest path problem	CO 4	T1:4.8
19	Dynamic Programming: General method.	CO 4	T1:5.1
20	Dynamic Programming: Matrix chain multiplication.	CO 4	T1:5.2
21	aDynamic Programming: Optimal binary search trees.	CO 4	T1:5.5
22	Dynamic Programming:0/1 knapsack problem.	CO 4	T1:5.7
23	Dynamic Programming:All pairs shortest path problem.	CO 4	T1:5.5
24	Dynamic Programming: Single source shortest path problem.	CO 4	T1:5.4
25	Dynamic Programming: Travelling sales person problem.	CO 4	T1:5.9
26	Backtracking: General method.	CO 5	T1:7.1
27	Backtracking: 8-queens problem.	CO 5	T1:7.2

28	Backtracking: Sum of subsets problem.,	CO 5	T1:7.3
29	Backtracking: Graph coloring	CO 5	T1:7.4
30	Backtracking :Hamiltonian cycles	CO 5	T1:7.5
31	Branch and Bound: General method.	CO 5	T1:8.1
32	Branch and Bound :0/1 knapsack problem	CO 5	T1:8.2
33	Branch and Bound: Least Cost Branch and Bound.	CO 5	T1:8.2.1
34	Branch and Bound: FIFO Branch and Bound.	CO 5	T1:8.2.2
35	Branch and Bound :Travelling sales person problem	CO 5	T1:8.3
36	NP-Hard and NP-Complete problems: Basic concepts.	CO 6	T1:11.1
37	Non-deterministic algorithms.	CO 6	T1:11.1.1
38	The classes NP -Hard and NP, NP Hard	CO 6	T1:11.1.2
39	Clique decision problem	CO 6	T1:11.3.1
40	Chromatic number decision problem.	CO 6	T1:11.3.3
41	Cook's theorem.	CO 6	T1:11.2
PROBLEM SOLVING/ CASE STUDIES			
42	Write a program to implement quick sort.	CO 2	T1:3.5
43	Write a program to implement Merge sort	CO 2	T1:3.4
44	Write a program to implement Warshall's algorithm	CO 3	t1:3.5.5
45	Write a program to implement Knapsack Problem	CO 4	T1:4.2
46	Write a program to implement Graph Traversals	CO 4	T1:6.2
47	Write a program to implement Shortest Paths Algorithm	CO 4	T1:5.3
47	Write a program to implement Minimum Cost Spanning Tree	CO 4	T1:4.5
48	Write a program to implement Tree Travesrsals	CO 4	T1:6.1
49	Write a program to implement Sum Of Sub Sets Problem	CO 5	T1:7.3
50	Write a program to implement Travelling Sales Person Problem	CO 5	T1:5.9
51	Write a program to implement Minimum Cost Spanning Tree	CO 5	T1:4.5
52	Write a program to implement All Pairs Shortest Paths	CO 5	T1:5.3
53	Write a program to implement N Queens Problem	CO 5	T1:7.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
54	Discuss definitions and terminology on introduction to algorithms, divide and conquer.	CO 1,2	T1:3.0
55	Discuss definitions and terminology on greedy method.	CO 1,2, 3	T:4.0
56	Discuss definitions and terminology on dynamic programming.	CO 4	T:5.0
57	Discuss definitions and terminology on bracktracking, branch and bound.	CO 5	T1:7-8
58	Discuss definitions and terminology on NP-Hard and NP-Complete.	CO 6	T1:11.0

DISCUSSION OF QUESTION BANK			
59	Discuss questions on introduction to algorithms, divide and conquer.	CO 1,2	T1:3.0
60	Discuss questions on greedy algorithm, dynamic programming.	CO 4	T1:3,4
61	Discuss questions on bracktracking, branch and bound and NP-hard and NP-Complete.	CO 5,6	T1:7,8,11

Signature of Course Coordinator **HOD,IT**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">COMPUTER SCIENCE AND ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">DIGITAL LOGIC DESIGN</td></tr>
<tr><td>Course Code</td><td colspan="5">AEC020</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">Third</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Regulation</td><td colspan="5">R-16</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td></td><td>3</td><td>1</td><td>-</td><td>4</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Ms.V.Bindusree,Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	-	-	-

II COURSE OVERVIEW:

This course intended to logic gates, various logic families. Design of digital circuits using logic gates, combinational circuits and sequential circuits. Apply op-amp characteristics to design analog to digital converters and digital to analog converters. Classification and characteristics of memories such as Read-only memory, Random access memory and programmable logic devices such as programmable logic array and programmable array logic.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Digital Logic Design	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
40%	Understand
40%	Apply
0%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

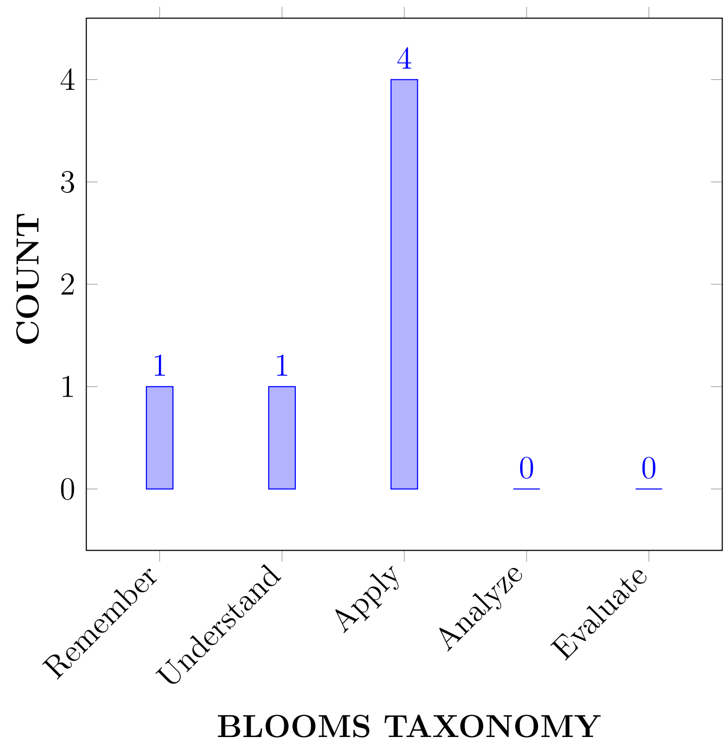
I	Simplification of the logic functions using boolean algebraic theorems and techniques.
II	Implementation of conventional combinational and sequential circuits including conversions of flip-flops
III	The exploration of the logic families and semiconductor memories.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Understand** the different forms of number representations and binary codes in digital logic circuits.	Understand
CO 2	**Make use of** Boolean postulates, theorems and k-map for obtaining minimized Boolean expressions.	Remember
CO 3	**Implement** the combinational logic circuits using the logic gates.	Apply
CO 4	**Utilize** the functionality and characteristics of flip-flops and latches for designing sequential circuits	Apply
CO 5	**Construct** the synchronous and asynchronous modules using flipflops used for memory storing applications.	Apply
CO 6	**Extend** the knowledge of memories and programmable logic devices for understanding the architectural blocks of FPGA.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/Quiz/AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1	Quiz

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 3	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	-	-	-
CO 4	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	-	-	-
CO 5	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	-	✓	-
CO 6	✓	-	✓	✓	-	-	-	-	-	✓	-	-	-	✓	

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand the number systems, Boolean operations, code conversion code by applying its own **engineering discipline**, science **principles and methodology.**	2
	PO 2	Understand the given**problem statement** and formulate the design (complex) **engineering problems** in detecting and correcting errors in the received data in reaching substantiated conclusions by the **interpretation** of results.	4
	PO 10	Demonstrate the ability to communicate effectively **writing** design documentation and make effective presentation	1
CO 2	PO 1	Demonstrate the design procedures of half and full Adders, subtractors, serial and parallel adders, BCD Adder for fundamental block realization in any processor **complex engineering problems** by applying **mathematical principles**	2
	PO 2	Illustrate the minimization techniques for **validation** of Boolean expressions apply for basic theorems and properties	1
	PO 10	Demonstrate the ability to communicate effectively **writing** design documentation and make effective presentation	1
CO 3	PO 1	Demonstrate the design procedures of half and full Adders, subtractors, serial and parallel adders, BCD Adder for fundamental block realization in any processor **complex engineering problems** by applying **mathematical principles**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Identify the importance of SOP and POS canonical forms in the **optimization** of conventional Boolean formulas in general and digital circuits	1
	PO 3	Understand the customer needs, use **creativity** and **manage design process** in realization of combinational circuits using logic gates and evaluate outcomes	2
	PO 4	Design various combinational circuits which are basic requirement of various systems using **design** of experiments, **analysis** and **interpretation** of data	3
	PO 10	Demonstrate the ability to communicate effectively **writing** design documentation and make effective presentation	1
CO 4	PO 1	Demonstrate the design procedures of various adder circuits with own **engineering discipline**, science **principles and methodology**	2
	PO 2	Understand the given **problem statement** and formulate the design (complex) **engineering problems** of shift registers, translate the information into hardware circuit programming from provided information and data, develop solutions based on the simulation result, **validate** the results reaching substantiated conclusions by the interpretation of results.	4
	PO 3	Design of a clocked flip-flop conversion from one type of flip-flop to another, registers and counters **mathematics, science** and **engineering fundamentals**	3
	PO 4	Design various combinational circuits which are basic requirement of various systems using **design** of experiments, **analysis** and **interpretation** of data	2
	PO 10	Demonstrate the ability to communicate effectively **writing** design documentation and make effective presentation	1
CO 5	PO 1	Explain the synchronous counters using procedure of sequential circuit and excitation tables of flip–flops for clock tree based circuits using own **engineering discipline**, science **principles and methodology.**	3
	PO 2	Identify and analyze fidelity criteria, shift registers implement using **engineering science,** design system components from counters and **model translation** using **principal of mathematics**.	3
	PO 3	Design of a clocked flip-flop conversion from one type of flip-flop to another, registers and counters **mathematics, science** and **engineering fundamentals**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Use **research-based knowledge** on design of asynchronous counters analysis and **interpretation of data**	2
	PO 10	Demonstrate the ability to communicate effectively **writing** design documentation and make effective presentation	1
	PSO 2	Utilize the **software reliability** for designing the cpmbinational and sequential circuits	2
CO 6	PO 1	Explore the concept of programmable logic devices for understanding architectural blocks of FPGA using the own **engineering discipline**, science **principles and methodology.**	2
	PO 3	Design the different **memory techniques** of memories.	1
	PO 4	Use **research-based knowledge** on design of asynchronous counters analysis and **interpretation of data**	2
	PO 10	Demonstrate the ability to communicate effectively **writing** design documentation and make effective presentation	1
	PSO 2	Utilize the **software reliability** for designing the cpmbinational and sequential circuits	2

Note: For Key Attributes refer **Annexure - I**

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO / PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	2	4	-	-	-	-	-	-	-	1	-		-	-	-
CO 2	2	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	2	1	2	3	-	-	-	-	-	1	-	-	-	-	-
CO 4	2	4	3	2	-	-	-	-	-	1	-		-	-	-
CO 5	3	3	-	2	-	-	-	-	-	1	-	-	-	2	-
CO 6	2	-	1	2	-	-	-	-	-	1	-	-	-	2	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO / PSO:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	66.6	40	-	-	-	-	-	-	-	10	-		-	-	-
CO 2	66.6	10	-	-	-	-	-	-	-	10	-	-	-	-	-
CO 3	66.6	10	66.7	27	-	-	-	-	-	10	-	-	-	-	-
CO 4	66.6	40	100	18		-	-	-	-	10	-	-	-	-	-
CO 5	33.3	30	-	18	-	-	-	-	-	10	-	-	-	100	-
CO 6	100	-	10	18	-	-	-	-	-	10	-	-	-	100	-

XV COURSE ARTICULATION MATRIX PO / PSO MAPPING:

CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - 0$\leq$ C$\leq$ 5% – No correlation

1- 5<C$\leq$ 40% – Low/ Slight

2-40 <C$\leq$ 60% – Moderate.

3-60 <C$\leq$ 100% –Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	1	-	-	-	-	
CO 2	3	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 3	3	1	3	1	-	-	-	-	-	1	-	-	-	-	-
CO 4	3	1	3	1	-	-	-	-	-	1	-	-	-	-	-
CO 5	1	1	-	1	-	-	-	-	-	1	-	-	-	3	-
CO 6	1	-	1	1	-	-	-	-	-	1	-	-	-	3	-
TOTAL	14	5	7	4	-	-	-	-	-	6	-	-	-	6	-
AVERAGE	2.3	1	2.3	1	-	-	-	-	-	1	-	-	-	3	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**NUMBERS SYSTEMS AND CODES**
	Review of number systems, number base conversion; Binary arithmetic: Binary weighted and nonweighted codes; Complements: Signed binary numbers; Error detection and correcting codes; Binary logic.
MODULE II	**BOOLEAN ALGEBRA AND GATE LEVEL MINIMIZATION**
	Postulates and theorems; representation of switching functions; SOP and POS forms; Canonical forms; Digital logic gates; Karnaugh Maps: Minimization using three variable; four variable; five variable KMaps; Don't Care Conditions; NAND and NOR implementation; Other Two-level implementation; Exclusive –OR function.
MODULE III	**DESIGN OF COMBINATIONAL CIRCUITS**
	Combinational circuits: Analysis and design procedure; Binary adder and subtractors; Carry look-ahead adder; Binary multiplier. Magnitude comparator; BCD adder; Decoders; Encoders; Multiplexers; Demultiplexer.
MODULE IV	**DESIGN OF SEQUENTIAL CIRCUITS**
	Combinational vs sequential circuits ; Latches, flip flops: RS flip flop, JK flip flop, T flip flop, D flip flop, Master-Slave flip flop, flip flops excitation functions; Conversion of one flip flop to another flip flop; Shift registers; Design of asynchronous and synchronous circuits; State table, state diagram, state reduction and state assignment for mealy and moore machines.
MODULE V	**MEMORY**
	Random access memory; Types of ROM; Memory decoding; Address and data bus; Sequential memory; Cache memory; Programmable logic arrays; Memory hierarchy in terms of capacity and access time.

TEXTBOOKS

1. P Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M M Mano, "Digital logic and Computer design", Pearson Education India, 2016.

REFERENCE BOOKS:

1. A Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

COURSE WEB PAGE:

https://lms.iare.ac.in/index?route=course/details&course_id=184

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
	OBE DISCUSSION		
1	Course description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https://lms.iare.ac.in/index?route=course/details&course_id=184
CONTENT DELIVERY (THEORY)			
1-5	Understand the need for digital systems, review of number systems, number base conversion	CO 1	T2:1.1-1.8, 2.2
6-7	Complements of numbers, codes-binary codes, BCD code and its Properties.	CO 1	T2:1.10,
8	Unit distance code, alphanumeric codes, and error detecting and correcting codes	CO 1	T2:2.7
9-10	Design and analyze the combinational circuits using TTL/CMOS logic	CO 1	T2:2.8
11-12	Design and analyze the sequential circuits using TTL/CMOS logic.	CO 1	T2:2.8
15-16	SIdentify basic building blocks of digital systems and Minimization using three variables; four variables; five variable K-Maps; Don't Care Conditions.	CO 2	T2:3.1-3.2
17-18	Design functions using universal gates. NAND and NOR Implementation; Other Two-Level Implementation; Exclusive –OR function. .	CO 2	T2:3.3-3.7
19-21	Combinational design, arithmetic circuits- adders, subtractors.	CO 2	T2:4.2,7.1-7.4
22-25	Design different combinational logic circuits comparators Multiplexers,	CO 2	T2: 7.6 7.7, 8.9-8.10
26-27	Demultiplexer, Decoder	CO 3	T3:1.1 R3:1.1-1.4
28-30	Understand the elementary ALU design	CO 3	T3:1.1-1.2 R3:1.5-1.7
31-32	popular MSI chips	CO 4	T3:1.3 R3:1.7,7.4

33-35	Combinational and sequential circuits, the binary cell, the Fundamentals of sequential machine operation.	CO 4	T3:3.1-3.4 R3:2.1-2.4
36-37	Flip-flop	CO 5	T3:3.3-3.5 R3:2.6
38-39	D-Latch Flip-flop.	CO 5	T3:5.1-5.3 R3:2.8,3.7-3.8
40-43	Clocked T Flip-flop.	CO 5	T4:5.1.-5.10 R3:3.6
44-45	Clocked JK Flip-flop.	CO 6	T3:4.4-4.6 T4: 5.11 R3:3.10
46-47	Shift Registers	CO 6	T4:6.1,6.4 R3:4.1-4.5
48-49	Synchronous, Asynchronous Counters	CO 7	T4:6.2-6.3,6.7 R3:4.8,4.11
50-51	Excitation tables of Flip-flops	CO 7	T4:6.3,6.10 R3:4.9-4.10
52-54	Discuss the classifications of data converters	CO 8	R2:7.5
55	Discuss and Analyze DAC techniques and characteristics.	CO 9	T4:7.1 R3:5.2-5.3
56-58	Discuss and Analyze ADC techniques and characteristics	CO 9	T4:7.2-7.6 R3:5.4-5.5
59-60	classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM),	CO 10	T4:7.7-7.10 R3:5.5
61	Discuss and analyze PLA, PAL, PLD	CO 11	T4:8.1-8.3 R3:6.1-6.2 R3:5.5
62	FPGA	CO 12	T4:8.4-8.7 R3:6.3-6.5

PROBLEM SOLVING/ CASE STUDIES			
9	Problems on number conversions	CO 1	T1: 1.1
10	Problems on Hamming code	CO 1	R3: 1.7
18	Derive the Boolean theorems and properties.	CO 1	T1: 2.1-2.6
19	Problems on 3 and 4 variable k-maps.	CO 2	T1: 6.1-6.6
30	Design the Decoder,Encoder.	CO 2	T1: 2.7-2.12
31	Design the multplexer and demultiplexer.	CO 2	T1: 2.7-2.12
32	Construct the registers using flipflops	CO 3	T1: 3.7-3.12
42	Design and construct the counters using flipflops.	CO 4	T1: 7.7-7.12
43	Design the analog to digital and digital analog converter	CO 5	T3: 1.7
44	Derive the specifications of analog to digital.	CO 5	T3: 1.7
51	Design the programmable logic devices using memories	CO 6	R4: 4.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
56	Hamming code	CO 1	T1:4.1
57	Multiplexer and demultiplexer	CO 2	T2:4.1
58	Twisted ring counter	CO 3	T3:2.1
59	Analog to digital converter specifications.	CO 4	R4: 4.2
60	Programmable logic devices.	CO 5	T2:6.1
DISCUSSION OF QUESTION BANK			
61	Solve the given 8bit data word 01011011, generate the 12-bit composite word for the hamming code that corrects and detects single errors.	CO 1	T1:4.1
62	implify the following 3 variable expression using Boolean algebra Y = M(3, 5, 7)	CO 2	T2:4.1
63	Explain the working of 2 to 4 decoder and also implement a 2 to 4 decoder using 1 to 2 decoders.	CO 3	T3:2.1
64	Design a synchronous counter using JKFF to count the following sequence 0, 2, 5, 6 undesired states 1,3,4,7must go to 0 on the next clock pulse.	CO 5	R4: 4.2
65	Compare logic families of CMOS,TTL and ECL with their specifications.	CO 6	T2:6.1

Signature of Course Coordinator **HOD,ECE**
Ms.V.Bindusree,Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	COMPUTER SCIENCE AND ENGINEERING				
Course Title	DATABASE MANAGEMENT SYSTEMS				
Course Code	ACS005				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	3	2
Course Coordinator	Dr K Suvarchala,Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS001	I	Computer Programming
B.Tech	ACS002	II	Data Structures

II COURSE OVERVIEW:

Database management system is intended to provide a clear understanding of fundamentals with emphasis on their applications to create and manage large data sets. It emphasizes on technical overview of database software to retrieve data from database. This includes database design principles, normalization, concurrent transaction processing, security, recovery and file organization techniques. This will provide adequate knowledge to understand future evolutions of data technologies.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Database Managment Systems	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	White Board	✓	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
50%	Understand
50%	Apply
0%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course

is given in table.

Five Minutes Video	METE	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

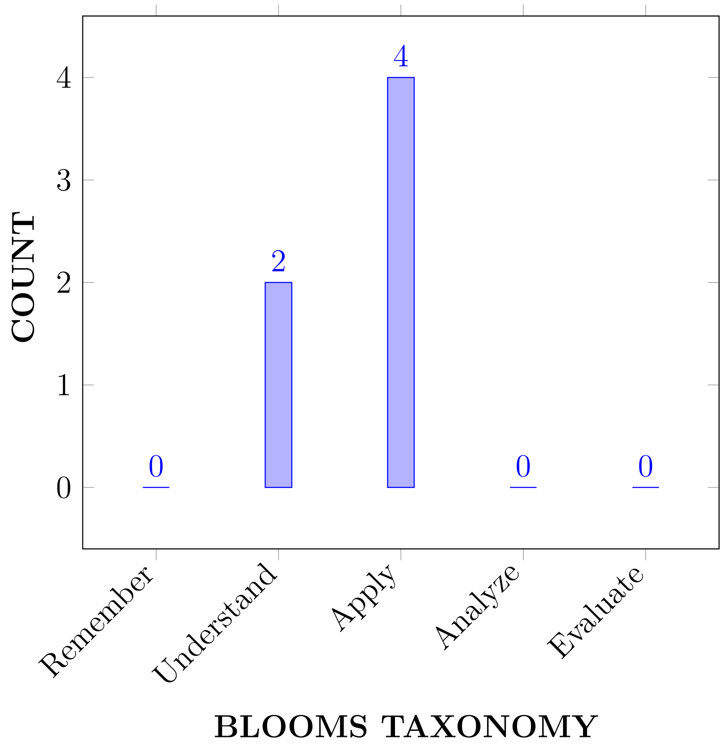
I	Efficient ways of designing database by encapsulating data requirements for business and organizational scenarios
II	Analysing and developing sophisticated queries in database language SQL for extracting information from large datasets
III	Enhancing skills in developing and managing data efficiently in related engineering problems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Outline** the importance of database system, RDBMS and its functionalities for voluminous data storage and management..	Understand
CO 2	**Model** the real world database systems using Entity Relationship Diagrams from the requirement specification.	Apply
CO 3	**Construct** queries in Relational Algebra, Relational Calculus and SQL to retrieve desired information.	Apply
CO 4	**Identify** appropriate normalization technique using dependencies for controlling the redundancy of data in database.	Apply
CO 5	**Demonstrate** ACID properties of Transaction processing, currency control protocols and recovery to preserve the database in a consistent state.	Understand
CO 6	**Organize** data storage and file organization techniques using tree and hash indices for effective query processing..	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2.6	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2.16	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE / CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1.5	SEE / CIE / AAT

PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	SEE / CIE / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	**Understand, design and analyze** computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	1.33	Quiz/AAT
PSO 2	**F**ocus on improving software reliability, network security / information retrieval systems.	2.5	Quiz/AAT
PSO 3	**Make use of** modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	1.6	Quiz/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	-	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	✓	✓
CO 5	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	-	-	✓
CO 6	✓	✓	✓	-	-	-	-	-	-	✓	-	-	-	✓	✓

XII JUSTIFICATIONS FOR CO – PO / PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Demonstrate basics of databases, functions of database management system and types of users to describe large sets of data with knowledge of mathematics, Science and Engineering Fundamentals.	3
	PO 2	Define the relational data model, constraints and keys to maintain integrity of data with the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation	3
	PO 10	Understand and Outline fundamental concepts of databases with clarity .	1
CO 2	PO 2	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	5
	PO 3	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation.	5
	PO 4	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation.	6
	PO 10	Develop logical model for real time applications to get clarity on requirements.	1
	PO 12	Choose appropriate techniques to model Database project using advanced concepts of CSE to meet industry trends..	3
	PSO 1	Model the real world database systems using Entity Relationship Diagrams from the requirement specification by using sequence of steps.	2
	PSO 2	Design ER model for efficient any data retrieval to develop database projects	2
	PSO 3	Develop a model for real time database application for any Enterprise.	1
CO 3	PO 1	Outline the use of relational algebra, relational calculus and SQL for creation and management of database with knowledge on fundamentals of mathematics such as set theory and engineering basics.	2

	PO 2	Build queries in Relational Algebra , Relational Calculus and SQL to retrieve desired information with detail Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation and validation	5
	PO 3	Illustrate the use of Relational Algebra , Relational Calculus and SQL for database creation and querying with the help of Investigate and define a problem , Identify constraints ,find creative solution , Manage the design process and evaluate outcomes	7
	PO 4	Develop RA, RC and SQL queries for database creation and maintenance by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , appropriate codes of practice , industry standards and apply system approach to output qualitative output	6
	PO 5	Select appropriate techniques to retrieve information using modern tools such as SQL	1
	PO 10	Develop queries in SQL , RA and RC for retrieving information in real time applications with clear understanding of needs	1
	PO 12	Choose appropriate techniques to model Database project using advanced concepts of CSE to meet industry trends..	3
	PSO 1	Demonstrate RA, RC and SQL queries for database creation and maintenance by using a set of instructions.	2
	PSO 2	Identify clauses and verbs of SQL for retrieving Information from database	2
	PSO 3	Selectl for real time database application for any Enterprise.	1
CO 4	PO 1	Illustrate the definition of Functional Dependencies, Inference rules and minimal sets of FD's to maintain data integrity basic fundamentals of mathematics and engineering fundamentals.	2
	PO 2	Illustrate the definition of Functional Dependencies, Inference rules and minimal sets of FD's to maintain data integrity with the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation.	7
	PO 3	Make use of normalization techniques for reducing redundancy of database to Investigate and define a problem and identify constraints ,Understand customer and user needs, for creating and Managing the design process and evaluate outcomes.	5

	PO 4	Apply normalization techniques to normalize a database by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of practice and industry standards.	2
	PO 10	Develop efficient logical model of database using normalization for real time database applications with clear understanding of enterprise needs.	1
	PSO 1	Make use of normalization to identify the need of constraints and design appropriate techniques to develop data centric applications .	3
	PSO 2	Apply normalization to design efficient information retrieval system .	1
	PSO 3	Apply dependencies for normalization and extend the study for advanced frameworks and platforms of data storage.	1
CO 5	PO 1	Demonstrate the concepts of transaction ACID properties and recovery techniques in data manipulation with basic engineering fundamentals.	1
	PO 2	Outline concurrent transaction processing, recovery techniques in transaction failure by formulating and stating the problem with constraints using Information management and data collection .	5
	PO 3	Make use of concurrency control protocols to preserve the database in a consistent state by Investigate and define a problem and identify constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes	3
	PO 4	Utilize concurrency control protocols to preserve the database in a consistent state by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature.	2
	PO 10	Build a database which will always in a consistent state during concurrent transaction processing with reference to security and integrity.	1
	PSO 3	Extend concurrent transactions and recovery processing to manage large data sets by using innovative technical tools and advanced frameworks	1
CO 6	PO 1	Describe disk storage devices, file organization to select efficient data storage with basic fundamentals of mathematics and engineering fundamentals	2
	PO 2	Apply indexing ,hashing techniques to access the records from the file effectively through problem statement and formulation with data collection and validation in designing experiment and developing effective data retrieval system	7

	PO 3	Apply indexing techniques to access the records from the file effectively by Investigate and define a problem and identify constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes,.	5
	PO 10	Make use of efficient data storage devices to implement effective retrieval techniques with clear understanding of data structures	1
	PSO 2	Outline the indexing and hashing techniques for efficient and secure retrieval of data in query processing .	2
	PSO 3	Extend storage devices characteristics and organization of data with innovative technical tools and advanced frameworks	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO / PSO MAPPING:

COURSE	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	-	-	-	-	-	-	-	1	-	-	-	-	
- CO 2	-	5	5	6	-	-	-	-	-	1	-	2	2	2	1
CO 3	2	5	7	6	-	-	-	-	-	1	-	2	2	2	1
CO 4	2	7	5	2	-	-	-	-	-	1	-	-	3	1	1
- CO 5	1	5	3	2	-	-	-	-	-	1	-	-	-	-	1
CO 6	2	7	5	-	-	-	-	-	-	1	-	-	-	1	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO / PSO:

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	100	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
CO 2	0.0	50.0	50.0	54.5	0.0	0.0	0.0	0.0	0.0	20.0	0.0	37.5	33.3	100	50.0
CO 3	66.7	50.0	70.0	54.5	100	0.0	0.0	0.0	0.0	20.0	0.0	25.5	33.3	100	50.0
CO 4	66.7	70.0	50.0	27.3	0.0	0.0	0.0	0.0	0.0	20.0	0.0	00.0	50.0	50.0	50.0
CO 5	33.3	50.0	30.0	27.3	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	50.0
CO 6	66.7	70.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	50.0	50.0

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0$\leq$ C$\leq$ 5% – No correlation
2 - 40 % <C < 60% –Moderate
1-5 <C$\leq$ 40% – Low/ Slight
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	0	2	2	2	-	-	-	-	-	1	-	1	1	3	2
CO 3	3	2	3	2	3	-	-	-	-	1	-	1	1	3	2
CO 4	3	3	2	1	-	-	-	-	-	1	-	-	2	2	2
CO 5	1	2	1	1	-	-	-	-	-	1	-	-	-	-	2
CO 6	3	3	2	-	-	-	-	-	-	1	-	-	-	2	2
TOTAL	13	13	10	6	3	-	-	-	-	6	-	2	4	10	8
AVERAGE	2.6	2.16	2	3	-	-	-	-	-	1	-	1	1.33	2.5	1.6

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assign-ments	✓
Laboratory Practices	-	Student Viva	-	Certifica-tion	-
Term Paper	-	5 Minutes Video	✓	Open Ended Ex-periments	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**CONCEPTUAL MODELING INTRODUCTION**
	Introduction to Data bases: Purpose of Database Systems, View of Data, Data Models, Database Languages, Database Users, Various Components of overall DBS architecture, Various Concepts of ER Model, Basics of Relational Model. .
MODULE II	**RELATIONAL APPROACH**

	Relational algebra and calculus: Relational algebra, selection and projection, set operations, renaming, joins,division, examples of algebra queries, relational calculus: Tuple relational calculus, Domain relationalcalculus, expressive power of algebra and calculus.
MODULE III	**SQL QUERY - BASICS, RDBMS - NORMALIZATION**
	SQL – Data Definition commands, Queries with various options, Mata manipulation commands, Views,Joins, views, integrity and security; Relational database design: Pitfalls of RDBD, Lossless joindecomposition, Functional dependencies , Armstrong Axioms, Normalization for relational databases 1st 2nd and 3rd normal forms, Basic definitions of MVDs and JDs, 4th and 5th normal forms Theory of games: Introduction, terminology, solution of games with saddle points and without saddle points, 2 x 2 games, dominance principle, m x 2 and 2 x n games, graphical method.
MODULE IV	**TRANSACTION MANAGEMENT**
	Transaction processing: Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability. Concurrency Control: Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols,Multiple Granularity, Multiversion Schemes, Deadlock Handling. Recovery: Failure Classification, Storage Structure ,Recovery and Atomicity, Log-Based Recovery, Shadow Paging, Recovery With Concurrent Transactions Buffer Management .
MODULE V	**DATA STORAGE AND QUERY PROCESSING**
	Data storage: Overview of Physical Storage Media, Magnetic Disks, Storage Access, File Organization, Organization of Records in Files. Indexing and Hashing: Basic Concepts: Ordered Indices, B+-Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing.Query Processing: Overview, Measures of Query Cost.

TEXT BOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, ”Database System Concepts”, McGraw-Hill 6th Edition, 2017.

2. Ramez Elmasri, Shamkant B. Navathe, ”Fundamental Database Systems”, Pearson Education, 6th Edition, 2014. 2. Raghu Ramakrishnan, ”Database Management System”, Tata McGraw

REFERENCE BOOKS:

1. Raghu Ramakrishnan, ”Database Management System”, Tata McGraw-Hill Publishing Company, 3rd Edition, 2007.

2. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, ”Database System Implementation”, Pearson Education, United States, 1st Edition, 2000.

3. Peter Rob, Corlos Coronel, ”Database System, Design, Implementation and Management”, Thompson Learning Course Technology, 5th Edition, 2003.

.

COURSE WEB PAGE:

https://nptel.ac.in/courses/112105171/1

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	CD based on OBE for DBMS course		
CONTENT DELIVERY (THEORY)			
1	Introduction to Databases	CO 1	T2:1.1-1.5
2	File System vs. Database system	CO 1	T2: 1.6-1.8 T1.2.1
3	Data Models and Levels of Abstraction	CO 1	T2:1.1 - 1.5
4	Database users and Database languages, DBS architecture	CO 1	T1:1.5, 1.4.2,1.4.3
5	Basics of ER Model	CO 2	T1:2.2
6	Extended ER Model	CO 2	T1:3.1
7	Basics of Relational Model	CO 1	T1:3.1,3.2 R1:6.2-6.8
8	Logical Database design.	CO 1	T1: 3.1
9	Relational database languages	CO 3	T1:4.1
10	Basic operations of Relational algebra	CO 3	T1:4.1
11	Derived operations of Relational algebra, Extended operations of Relational algebra	CO 3	T1: 4.1
12	Queries in Relational algebra	CO 3	T1:4.1,4.2.2
13	Tuple Relational Calculus	CO 3	T1:4.3
14	Domain Relational calculus	CO 3	T1:4.3
15	Intiegrity constraints – RDB Design	CO 4	T1: 3.1
16	Pitfalls of RDBD	CO 4	T1:3.1
17	Lossless join decomposition	CO 4	T1: 9.1,19.1.3
18	Functional dependencies Armstrong Axioms	CO 4	T2: 19.4
19	Closure of set of FDs and Attribute Closure, Canonical Cover	CO 4	T2: 19.4
20	Purpose of Normalization – RDBD.	CO 4	T1: 9.1
21	1st, and 2nd normal forms.	CO 4	T1: 9.1
22	3rd and BCNF normal forms.	CO 4	T1: 9.1
23	4NF, 5NF Normal forms and Other Dependencies.	CO 4	T2: 19.8-19..9
24	Transaction Concept, Transaction State	CO 4	T2:15.1
25	Implementation of Atomicity and Durability.	CO 5	T2:15.1
26	Serial Vs. Nonserial Transactions.	CO 5	T2:15.1
27	Serializability – Conflict Serializability.	CO 5	T2: 16.1

28	View Serializability.	CO 5	T2: 16.3
29	Lock-Based Protocols.	CO 5	T2: 16.1
30	Deadlock Handling – Concurrent Transactions	CO 5	T2: 16.3
31	Implementation of locks and Multiple Granularity.	CO 5	T2: 16.1
32	Timestamp-Based and Validation-Based Protocols	CO 5	T2: 16.3
33	Transaction Recovery and LogBbased Recovery techniques	CO 5	T2:17.1
34	Recovery Algorithms – Buffer Management	CO 5	T2:17.1
35	Physical Storage Media	CO 6	T1: 8.1
36	Data Access and File Organization Techniques	CO 6	T1: 8.1
37	B+ Tree index File Organization	CO 6	T1: 8.3- 8.4
38	B-Tree and Bit Index File Organization	CO 6	T1: 10 10.2
39	Static and Dynamic Hashing Techniques	CO 6	T1: 8.3- 8.4
40	Query Processing : Overview	CO 6	T1: 10 10.2
PROBLEM SOLVING/ CASE STUDIES			
1	SQL – DDL Statements	CO 3	R1.5
2	SQL – DML Statements.	CO 3	R1.5.1
3	SQL – Builtn funcions	CO 3	R1.5.2
4	SQL – SELECT Statement	CO 3	R1.5.3
5	SQL - Join operation .	CO 3	R1.5.4
6	SQL – Subqueries.	CO 3	R1.5.5
7	SQl – Views	CO 3	R1.5.6
8	SQL – Stored Programs and stored Functions	CO 3	R1.5.7
9	SQL - Triggers	CO 3	R1.5.8
10	Problems on Rlational algebra and Relational Calculus	CO 3	R1.4
11	Problems on ER Model	CO 2	R1.2
12	Problems on Concurrent Transactions and Recovery	CO 5	R1.3
13	Problems on Normalization.	CO 4	R1.3
14	Problems on Functional dependencies.	CO 4	R1.3
15	Problems on B-trees and hashing	CO 6	R1.9, R1.10
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Data, Information, Database,DBMS, basics of ER modelling, FMS	CO 1, CO 2	T1.1, R1.1,2
2	Relation, keys, relational algebric operators, relational calculus	CO 3	R1.4

3	SQL basics, normal forms , dependencies	CO 3,CO 4	R1.5
4	Transaction, ACID properties, Concurrency control, Recovery management	CO 5	R1.18, 19,20
5	Storage devices, Data Organization Techniques, B trees, Hashing	CO 6	R1.7, 8, 9,10
DISCUSSION ON QUESTION BANK			
1	ER diagrams, Logical design of database	CO 1, CO 2	T1.1, R1.1,2
2	Quering in Relational algebra , relational calculus	CO 3	R1.4
3	SQL queries, Normal forms, Key identification, FDs	CO 3,CO 4	R1.5
4	Serializability problems, concurrent transactions, lock based protocols, Recovery problems	CO 5	R1.18, 19,20
5	File Organization Techniques, B trees, Hashing Techniques, Query optimization techniques	CO 6	R1.7, 8, 9,10

Course Coordinator **HOD,CSE**
Dr K.Suvarchala, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

Department	INFORMATION TECHNOLOGY				
Course Title	COMPUTER ORGANIZATION AND ARCHITECTURE				
Course Code	ACS004				
Program	B.Tech				
Semester	III				
Course Type	CORE				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	-	-	-
Course Coordinator	Dr. PL SRINIVASA MURTHY, Associate Professor.				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AAEB08	II	Programming for Problem Solving
B.Tech	AAEB10	III	Digital System Design

II COURSE OVERVIEW:

This course intended to provide the structure, internal working and implementation of a computer system. The fundamentals of various functional units of computer, computer instructions, addressing modes, computer arithmetic and logic unit, registers, data transfer, memory and input output system. It focuses on analysis of computer performance and functioning in modern computers.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Architecture	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
70 %	Understand
20 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

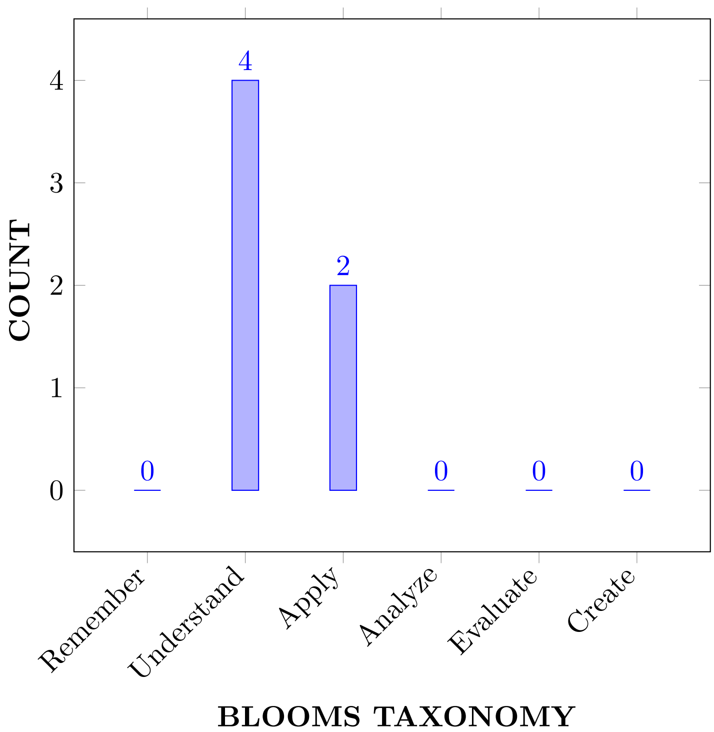
I	The basic concepts of the various functional units and characteristics of computer systems.
II	The concepts of central processing unit design and perform basic operations with signedand unsigned integers in decimal and binary number systems.
III	The function of each element of a memory hierarchy and compare the different methods for computer input and output.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** interaction of components in a computer system with functional units and levels of programming languages.	Understand
CO 2	**Demonstrate** the implementation of micro-operations with the help of register transfer language and electronic circuits.	Understand
CO 3	**Identify** appropriate addressing modes for specifying the location of an operand.	Apply
CO 4	**Make use of** number system for data representation and binary arithmetic in digital computers.	Apply
CO 5	**Interpret** the design of hardwired and micro-programmed control unit for execution of micro programs.	Understand
CO 6	**Summarize** the concepts of pipelining and inter process communication for advanced processor design..	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Program Outcomes	
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz

PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,and the cultural, societal, and Environmental considerations	3	CIE/Quiz
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Assignments/ SEE /CIE, QUIZ
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Assignments
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	CIE/Quiz
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges	2	CIE/Quiz
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in it industry	3	CIE/Quiz

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	-	-	-	-	-	-	-	-		✓	✓	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	✓	-
CO 3	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	✓	-	✓	✓	-	-
CO 5	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	✓	-	✓	✓	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	**Demostrate** interaction of components in a computer system with functional units using **knowledge of mathematics, science, engineering fundamentals, and to the solution of complex engineering problems**.	1
	PO 2	**IIustrate** interaction of components in a computer system with functional units and levels of programming languages by **Identifying complex engineering problems of mathematics, natural sciences, and engineering sciences**	2
	PO 3	**Understand** the interaction of components in a computer system with respect to various functional units **Design solutions for complex Engineering problems that meet the specified needs with appropriate consideration** for the public health and safety,and the cultural, societal, and Environmental considerations	4
	PSO 1	**Make use** components in a computer system in designing next-generation computer systems, **networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools**	1
	PSO 2	**Exibit** interaction of components which enables **Focus on mobile and web applications development and learn the emerging technologies and frameworks** in demand with contemporary challenges.	1
CO 2	PO 1	**Demonstrate** the implementation of micro-operations by using knowledge of mathematics, science, engineering fundamentals, and **provide solution to complex engineering problems**	2
	PSO 1	**Illustrate** the implementation of micro-operations in Designing next-generation computer systems, **networking devices, search engines, soft computing and intelligent systems**, web browsers, and knowledge discovery tools.	1
	PSO 2	**Compare** the implementation of micro-operations with the help of register **transfer language and electronic circuits in development of emerging technologies** and frameworks.	2
CO 3	PO 1	**Explain** various appropriate addressing modes for specifying the location of an operand which uses of **knowledge of mathematics, science, engineering fundamentals, and an engineering specialization** to the solution of complex engineering problems.	2
	PO 2	**Describe** modes for specifying the location of an operand which **analyze complex engineering problems reaching principles of mathematics, natural sciences, and engineering sciences**	2

	PO 3	**Recognize** addressing modes for complex Engineering problems and design system components or processes that meet the specified needs with **appropriate consideration for the public health and safety**,and the cultural, societal, and Environmental consideration.	1
	PO 4	**Summarize** modes for specifying the location of an operand in analysis and interpretation of data, and **synthesis of the information to provide valid conclusions**.	3
	PO 10	**Describe** Addressing modes in effective activities with the engineering community and with society at large, and **make effective presentations, and give and receive clear instructions**	2
	PSO 1	**Define** appropriate addressing modes which are capable for next-generation computer systems, **soft computing and intelligent systems**, web browsers, and knowledge discovery tools.	1
CO 4	PO 1	**Make** use of number system for data representation and binary arithmetic in digital computers by **using knowledge of mathematics, science, engineering fundamentals**, to the solution of complex engineering problems.	3
	PO 12	**Identification** of effective data representation and **binary arithmetic in independent computers and life-long learning** in the broadest context of technological change .	1
	PSO 1	**Explain** number system for data representation next-generation computer systems, **networking devices, search engines, soft computing and intelligent systems**, web browsers, and knowledge discovery tools.	1
CO 5	PO 1	**IIIustrate** the design of hardwired and micro-programmed control unit for mathematics, science, **engineering fundamentals, to provide solutions** to complex engineering problems	3
	PO 10	**Design** of hardwired and micro-programmed control unit for execution of micro **programs engineering community in writing effective reports and design documentation, make effective presentations**, and give and receive clear instructions.	2
	PO 12	**Recognize** the need for having the preparation and ability to design of hardwired and micro-programmed control unit for **execution of micro programs which are independent** and life-long learning in the broadest context of technological change	2
	PSO 1	**IIIustrate**thedesign of next-generation computer systems, networking devices, search engines,soft computing and intelligent systems, web browsers, and knowledge discovery tools	2
CO 6	PO 1	**Apply** the knowledge of mathematics, science, engineering fundamentals, and an **engineering specialization to the solution of complex engineering problems**	2

	PO 2	**Focus** on mobile and web applications development and learn the emerging technologies and **frameworks in demand with employers and contemporary challenges**	2
	PO 10	**Communicate** effectively on complex engineering activities with the engineering community and with society at large, such as, **being able to comprehend and write effective reports and design documentation, make effective presentations**, and give and receive clear instructions.	2
	PO 12	**Recognize** the need for and having the preparation and ability to engage in**independent and life-long learning in the broadest context** of technological change	2
	PSO 1	**Design** next-generation computer systems, networking devices, search engines, **soft computing and intelligent systems, web browsers, and knowledge discovery tools**	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	1	2	4	-	-	-	-	-	-	-	-	-	1	1	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	1	2	-
CO 3	2	2	1	3	-	-	-	-	-	2	-	2	1	-	-
CO 4	3	6	-	4	-	-	-	-	-	2	-	3	1	-	-
CO 5	1	2	3	3	-	-	-	-	-	2	-	4	1	-	1
CO 6	2	-	-	-	-	-	-	-	-	2	-	4	1	-	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	33.4	20	40	-	-	-	-	-	-	-	-	-	16.6	50 -	-
CO 2	66.6	-	-	-	-	-	-	-	-	-	-	-	16.6	100	-
CO 3	66.6	20	10	27.3	-	-	-	-	-	20	-	16.67	16.6	-	-
CO 4	100	60	-	36.4	-	-	-	-	-	20	-	25	16.6	-	-
CO 5	33.4	20	30	27.3	-	-	-	-	-	20	-	33.4	16.6	-	50
CO 6	66.6	-	-	-	-	-	-	-	-	20	-	33.4	16.6	-	50

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0≤ C≤ 5% – No correlation
2 - 40 % <C < 60% –Moderate
1-5 <C≤ 40% – Low/ Slight
3 - 60% ≤ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	2	-	-	-	-	-	-	-	-	-	1	3	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	1	3	-
CO 3	3	1	1	1	-	-	-	-	-	1	-	1	1	-	-
CO 4	3	3	-	1	-	-	-	-	-	1	-	1	3	-	-
CO 5	1	1	1	1	-	-	-	-	-	1	-	1	1	-	3
CO 6	3	-	-	-	-	-	-	-	-	1	-	1	1	-	3
TOTAL	14	6	4	3	-	-	-	-	-	4	-	4	7	6	6
AVERAGE	2.3	1.5	2.6	1	-	-	-	-	-	1	-	1	1.17	3	3

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1,PO 2	SEE Exams	PO 1,PO 2	Seminars	PO 1, PO 2, PO5
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	PO 1, PO 2, PO5	5 Minutes Video	PO 10	Open Ended Experiments	-
Assignments	PO 1, PO 2				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO COMPUTER ORGANIZATION**
	Basic computer organization, CPU organization, memory subsystem organization and interfacing, input or output subsystem organization and interfacing, simple computer levels of programming languages, assembly language instructions and a simple instruction set architecture.

MODULE II	**ORGANIZATION OF A COMPUTER**
	Register transfer: Register transfer language, register transfer, bus and memory transfers, arithmetic micro operations, logic micro operations and shift micro operations; Control memory.
MODULE III	**CPU AND COMPUTER ARITHMETIC**
	CPU design: Instruction cycle, data representation, memory reference instructions, input- output, and interrupt, addressing modes, data transfer and manipulation, program control. Computer arithmetic: Addition and subtraction, floating point arithmetic operations, decimal arithmetic unit.
MODULE IV	**INPUT-OUTPUT ORGANIZATION AND MEMORY ORGANIZATION**
	Memory organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory; Input or output organization: Input or output Interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access.
MODULE V	**MULTIPROCESSORS**
	Pipeline: Parallel processing, pipelining-arithmetic pipeline, instruction pipeline; Multiprocessors: Characteristics of multiprocessors, inter connection structures, inter processor arbitration, inter processor communication and synchronization.

TEXTBOOKS

1. M. Morris Mano,Computer Systems Architecture, Pearson, 3rd Edition, 2015.
2. Patterson, Hennessy, Computer Organization and Design- The Hardware Software Interface, Morgan Kaufmann, 5th Edition, 2013.

REFERENCE BOOKS:

1. John. P. Hayes, Computer System Architecture, McGraw-Hill, 3rd Edition, 1998.
2. Carl Hamacher, Zvonko G Vranesic, Safwat G Zaky, Computer Organization, McGraw-Hill, 5th Edition, 2002.
3. William Stallings,Computer Organization and Architecture, Pearson Edition, 8th Edition,2010.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
	OBE DISCUSSION		
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
	CONTENT DELIVERY (THEORY)		
1	Outline the basic computer organization	CO 1	R1:1.1
2	Understand the CPU organization, memory subsystem organization and interfacing	CO 1	R1:1.1
3	Analyze the input or output subsystem organization and interfacing	CO 2	T1:1.2

4	Understand a simple computer levels of programming languages	CO 2	T1:1.2
5	Explain assembly language instructions	CO 3	T1:1.3
6	Determine the simple instruction set architecture	CO 3	T1:1.3
7	Understand the register transfer language, register transfer	CO 4	R1:1.5
8	Analyze bus and memory transfers	CO 4	R1:1.5
9	Explain the arithmetic micro-operations, logic micro-operations, shift micro-operations	CO 4	R1:1.5
10	Understand the control memory	CO 5	T1:3.2
11	Explain the instruction cycle	CO 5	T1:3.2
12	Outline the data representation, memory reference instructions	CO 3	T1:3.5
13	Analyze input-output, and interrupt, addressing modes	CO 3	T1:3.5
14	Discuss the data transfer and manipulation, program control	CO 3	T1:4.3
15	Determine the Addition and subtraction, floating point arithmetic operations, decimal arithmetic unit	CO 3	T1:4.3
16	Need of Input or output organization	CO 8	T1:5.2
17	Discuss the Input or output Interface	CO 3	T1:5.2
18	Understand the asynchronous data transfer, modes of transfer	CO 3	T1:5.2
19	Analyze the priority interrupt, direct memory access	CO 3	T1:5.2
20	internal commerce, supply chain management	CO 3	T1:5.2
21	Understand the memory organization	CO 4	T1:6.2
22	Discuss Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory	CO 4	T1:6.2
23	Understand the Pipeline: Parallel processing, Instruction pipeline	CO 6	T1:6.5
24	Characteristics of multiprocessors	CO6	T1:6.5
25	Inter connection structures	CO 5	T1:10.2
26	Inter processor arbitration	CO 5	T1:10.2
27	Inter processor communication and synchronization	CO 2	T1:10.2
28	auxiliary memory	CO 2	T1:10.2
29	associative memory	CO 3	T1:10.4
30	cache memory	CO 3	T1:10.4
31	modes of transfer	CO 3	T1:10.4
32	Instruction pipeline	CO 3	T1:10.4
PROBLEM SOLVING/ CASE STUDIES			
1	Perform of particle in cell methods on highly concurrent computational architectures	CO 1	R1:1.5
2	Computer architecture fundamentals and principles of computer design	CO 1	R1:1.5
3	Programmable architecture for quantum computing	CO 1	R1:1.5
4	The new landscape of parallel computer architecture	CO 1	T1:3.2
5	A task-based parallelism and vectorized approach to 3D method of characteristics (MOC) reactor simulation for high performance computing architecture	CO 4	T1:3.2
6	A Heterogeneous Quantum Computer Architecture.	CO 4	T1:3.2
7	Computer aid in solar architecture	CO 4	T1:4.3

8	Electromagnetic physics models for parallel computing architecture.	CO 5	T1:4.3
9	Layered architecture for quantum computing	CO 1	T1:4.3
10	Fault Tolerant Computer Architecture	CO 3	T1:6.2
11	Spatial computing in interactive architecture	CO 1	T1:6.2
12	Self-timed circuitry for global clocking	CO 1	T1:6.2
13	Globally-Asynchronous Locally-Synchronous (GALS) systems	CO 5	T1:6.5
14	Asynchronous circuit and processor design	CO 5	T1:6.5
15	The new landscape of parallel computer architecture	CO 5	T1:6.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define computer.and Define register transfer language.	CO 1	R1:1.5
2	What is data representation?	CO 2	T1:3.2
3	What are second generation computers?	CO 3	T1:5.2
4	What are the characteristics of a system bus?	CO 4,5	T1:6.2,6.5
5	Define the data Processing instruction.	CO 5,6	T1:10.2,4
DISCUSSION OF QUESTION BANK			
1	Define data moment instructions.	CO 1	R1:1.5
2	Explain the micro program control with diagram and give with an example	CO 2	T1:3.2
3	Explain the rules in arithmetic operation on floating point numbers.	CO3	T1:5.2
4	How the mapping process in address sequencing	CO 4,5	T1:6.2,6.5
5	What is data hazard? Explain the methods for dealing with data hazard?	CO 5,6	T1:10.2,4

Signature of Course Coordinator **HOD,IT**

Dr. PL SRINIVASA MURTHY, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY
COURSE DESCRIPTION

Course Title	**DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**				
Course Code	AIT101				
Program	B.Tech				
Semester	III	IT			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Dr. B.V. Rao, Professor, IT				

I COURSE OVERVIEW:

Design and analysis of algorithm lab provides hands on experience in implementing different algorithmic paradigms and develops competence in choosing appropriate data structure to improve efficiency of technique used. This laboratory implements sorting techniques using divide and conquer strategy, shortest distance algorithms based on Greedy, Dynamic programming techniques, Minimum spanning tree construction and applications of Back tracking , Branch and Bound. This is essential for developing software in areas Information storage and retrieval, Transportation through networks, Graph theory and Optimization problems.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming for Problem Solving
B.Tech	ACSB03	IV	Data Structures

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Design And Analysis Of Algorithms Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	The selection of Algorithmic technique and Data structures required for efficient development of technical and engineering applications.
II	The algorithmic design paradigms and methods for identifying solutions of optimization problems..

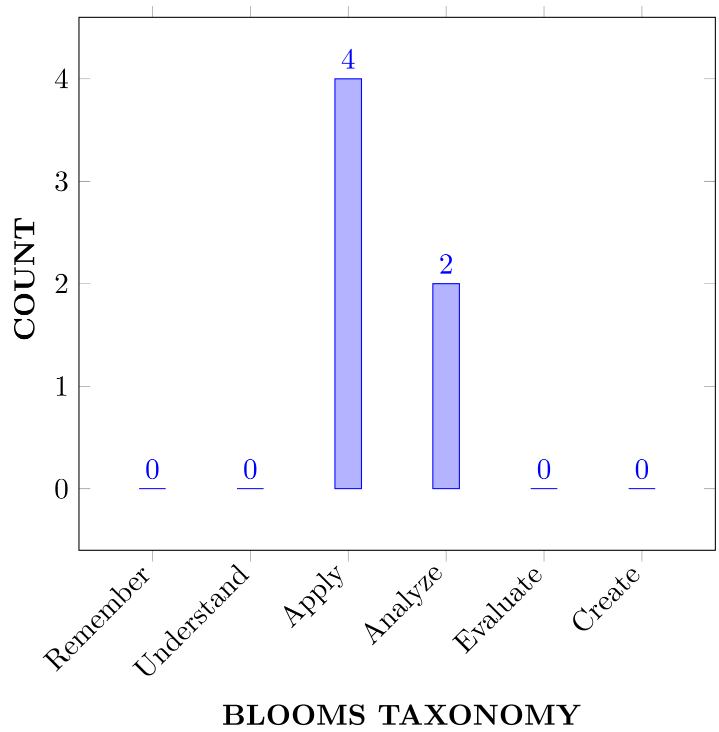
III	Implementation of different algorithms for the similar problems to compare their performance.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Apply** Divide and conquer strategy to organize the data in ascending or descending order. .	Apply
CO 2	**Make use of** Algorithmic Design paradigms to determine shortest distance and transitive closure of Directed or Undirected Graphs.	Apply
CO 3	**Utilize** Greedy Technique or principle of Optimality for finding solutions to optimization problems.	Analyze
CO 4	**Compare** the efficiencies of traversal problems using different Tree and Graph traversal algorithms.	Apply
CO 5	**Utilize** Backtracking method for solving Puzzles involving building solutions incrementally.	Analyze
CO 6	**Examine** Branch and Bound Approach for solving Combinatorial optimization problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab Exercises,CIE,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	2	Lab Exercises,CIE,SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises,CIE,SEE
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	3	Lab Exercises,CIE,SEE
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	Lab Exercises,CIE,SEE
PO 8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	Lab Exercises,CIE,SEE
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	Lab Exercises,CIE,SEE
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Lab Exercises,CIE,SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	Lab Exercises
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	3	Lab Exercises
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 2	Demonstrate the use of divide and conquer strategy for arranging data in sorted order with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation and interpret the results.	4
	PO 3	Demonstrate the use of sorting techniques and analyze time and space complexities with the help of Investigate and define a problem and identify constraints Manage the design process and evaluate outcomes and use in engineering application.	1
	PO 5	Translate the algorithm into python code by using its Libraries and modules	1
	PO 6	Apply Divide and conquer strategy to organize the data in ascending or descending order,Knowledge and understanding of commercial and economic context of engineering processes	1
	PO 7	Apply Divide and conquer strategy to organize the data in ascending or descending order,impact of the professional Engineering solutions	1
	PO 8	Apply Divide and conquer strategy to organize the data in ascending or descending order,evaluates the ethical dimensions of professional practice,	1

	PO 10	Apply Divide and conquer strategy to organize the data in ascending or descending order	1
	PO 12	Apply Divide and conquer strategy to organize the data in ascending or descending order	1
	PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools	2
CO 2	PO 2	Make Use of Dynamic programming for solving shortest distance problems with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation and solution development.	4
	PO 3	Make Use of Dynamic Programming for shortest distance problems and substructure generation with the help of Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes and find innovative solutions	4
	PO 5	Make Use of DP for implementing Shortest distance algorithms and optimal substructure identifications by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	1
	PO 6	Make use of Algorithmic Design paradigms to determine shortest distance and transitive closure of Directed or Undirected Graphs,Knowledge and understanding of commercial	1
	PO 7	Make use of Algorithmic Design paradigms to determine shortest distance and transitive closure of Directed or Undirected Graphs,Impact of the professional Engineering solutions	1
	PO 8	Make use of Algorithmic Design paradigms to determine shortest distance and transitive closure of Directed or Undirected Graphs, knowledge of professional codes of ethics	1
	PO 10	Build strong foundation on Dynamic Programming for career building by communicating effectively with engineering community about optimal solutions.	4
	PO 12	Make use of Algorithmic Design paradigms to determine shortest distance and transitive closure of Directed or Undirected Graphs,Personal continuing education efforts,Continued personal development.	3
	PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools	3

CO 3	PO 2	Make Use Greedy Technique or principle of Optimality for for finding solutions to optimization problems with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation and solution development.	4
	PO 3	Make Use of Greedy Technique or principle of Optimality for for finding solutions to optimization problems with the help of Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes and find innovative solutions	7
	PO 4	Utilize Greedy Technique,technical uncertainty, industry standards, principle of Optimality for finding solutions to optimization problems,Understanding of appropriate codes	6
	PO 5	Make Use of Greedy Technique or principle of Optimality for for finding solutions to optimization problem identifications by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	1
	PO 6	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems,knowledge and understanding of commercial	1
	PO 7	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems,impact of the professional Engineering solutions	1
	PO 8	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems,knowledge of professional codes of ethics	1
	PO 10	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems,Clarity,Grammar,Subject Matter,References	4
	PO 12	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems,Personal continuing education ,efforts Ongoing learning,Continued personal development.	3
	PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools	4
	PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	1
	PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	2

CO 4	PO 2	Make Use of recursive and non recursive algorithms for comparing traversal techniques of graph and tree with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation and solution development.	4
	PO 3	Make Use recursive and non recursive algorithms for comparing tree and graph traversal techniques with the help of Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes and find innovative solutions	7
	PO 5	Compare the efficiencies of traversal problems using different Tree and Graph traversal algorithms	1
	PO 6	Compare the efficiencies of traversal problems using different Tree and Graph traversal algorithms	1
	PO 7	Compare the efficiencies of traversal problems using different Tree and Graph traversal algorithms	1
	PO 8	Compare the efficiencies of traversal problems using different Tree and Graph traversal algorithms	1
	PO 10	Compare the efficiencies of traversal problems using different Tree and Graph traversal algorithms	4
	PO 12	Compare the efficiencies of traversal problems using different Tree and Graph traversal algorithms	3
	PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers,and knowledge discovery tools	3
	PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	1
CO 5	PO 2	Apply Back Tracking for developing solutions to puzzles with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation and solution development.	4
	PO 3	Apply Back Tracking for developing solutions to puzzles with the help of Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes and find innovative solutions	7
	PO 4	Utilize Backtracking method,technical uncertainty, industry standards, principle of Optimality involving building solutions incrementally to optimization problems,Understanding of appropriate codes	6
	PO 5	Apply Back Tracking for developing solutions to puzzles by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	1

	PO 6	Utilize Backtracking method for solving Puzzles involving building solutions incrementally,Knowledge and understanding of commercial	1
	PO 7	Utilize Backtracking method for solving Puzzles involving building solutions incrementally,impact of the professional Engineering solutions	1
	PO 8	Utilize Backtracking method for solving Puzzles involving building solutions incrementally, evaluates the ethical dimensions of professional practice	1
	PO 10	Build strong foundation on Back tracking for by communicating effectively with engineering community about games development.	4
	PO 12	Build strong foundation on Back tracking for career building in software development for games and puzzles	3
	PSO1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers,and knowledge discovery tools	4
	PSO2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	1
	PSO3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	2
CO 6	PO 2	Make Use of Branch and Bound for solving Optimal problems with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation and solution development.	4
	PO 3	Make Use of Branch and Bound for solving Optimal problems with the help of Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes and find innovative solutions	7
	PO 4	Examine Branch and Bound Approach,technical uncertainty, industry standards, principle of Optimality for finding solutions to optimization problems,Understanding of appropriate codes	6
	PO 5	Make Use of Branch and Bound for solving Optimal problems by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	1
	PO 6	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems,Knowledge and understanding of commercial	1
	PO 7	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems	1

	PO 8	Utilize Greedy Technique or principle of Optimality for finding solutions to optimization problems, evaluates the ethical dimensions of professional practice	1
	PO 10	Build strong foundation on Branch and bound for career building by communicating effectively with engineering community about optimal solutions related to state space.	4
	PO 12	Utilize Greedy Technique for career building in software development for games and puzzles and optimal solutions	3
	PSO1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers,and knowledge discovery tools	4
	PSO3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	2	1	-	1	1	2	2	-	3	-	2	1	-	-
CO 2	-	2	2	-	2	1	2	2	-	3	-	2	2	-	-
CO 3	-	2	3	2	3	1	2	2	-	3	-	2	3	2	2
CO 4	-	2	3	-	2	1	2	2	-	3	-	2	2	2	-
CO 5	-	2	3	2	3	1	2	2	-	3	-	2	3	2	2
CO 6	-	2	3	2	3	1	2	2	-	3	-	2	3	-	1

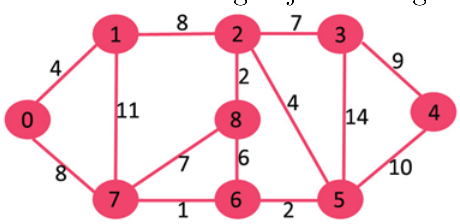
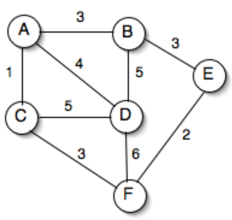
XII ASSESSMENT METHODOLOGY DIRECT:

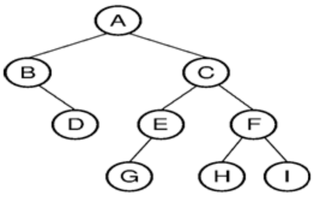
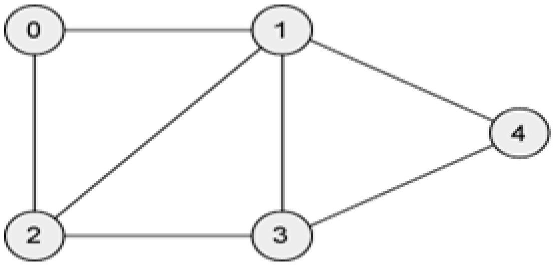
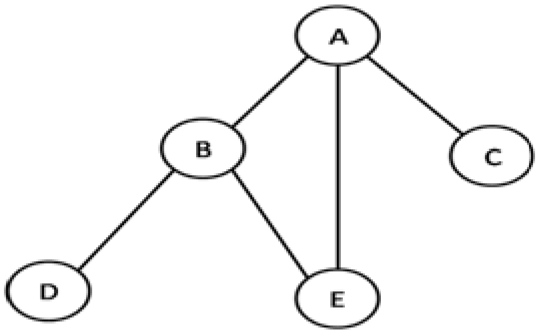
CIE Exams	PO 2, PO 3, PO 5	SEE Exams	PO 2,PO 3, PO 5	Seminars	-
Laboratory Practices	PO 2,PO 3, PO 5	Student Viva	PO 2, PO 3	Certification	-
Assignments	-				

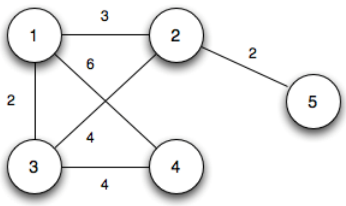
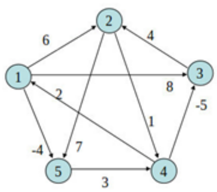
XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**QUICK SORT**
	Sort a given set of elements using the quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the 1st to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
WEEK II	**MERGE SORT**
	Implement merge sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
WEEK III	**KNAPSACK PROBLEM**
	Implement 0/1 Knapsack problem using Dynamic Programming
WEEK IV	**SHORTEST PATHS ALGORITHM**
	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm. 2. 
WEEK V	**MINIMUM COST SPANNING TREE**
	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm. 
WEEK VI	**TREE TRAVESRSALS**

	Perform various tree traversal algorithms for a given tree 
WEEK VII	**GRAPH TRAVERSALS**
	a. Print all the nodes reachable from a given starting node in a digraph using BFS method.  b. Check whether a given graph is connected or not using DFS method 
WEEK VIII	**SUM OF SUB SETS PROBLEM**
	Find a subset of a given set S = sl, s2,.....,sn of n positive integers whose sum is equal to a given positive integer d. For example, if S= 1, 2, 5, 6, 8 and d = 9 there are two solutions 1, 2, 6 and 1,8.A suitable message is to be displayed if the given problem instance doesn't have a solution.

<table>
<tr><td>WEEK IX</td><td>TRAVELLING SALES PERSON PROBLEM</td></tr>
<tr><td></td><td>Implement any scheme to find the optimal solution for the Traveling Sales Person problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.</td></tr>
<tr><td>WEEK X</td><td>MINIMUM COST SPANNING TREE</td></tr>
<tr><td></td><td>Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm

</td></tr>
<tr><td>WEEK XI</td><td>ALL PAIRS SHORTEST PATHS</td></tr>
<tr><td></td><td>Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.


<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>1</td><td>0</td><td>6</td><td>8</td><td>∞</td><td>-4</td></tr>
<tr><td>2</td><td>∞</td><td>0</td><td>∞</td><td>1</td><td>7</td></tr>
<tr><td>3</td><td>∞</td><td>4</td><td>0</td><td>∞</td><td>∞</td></tr>
<tr><td>4</td><td>2</td><td>∞</td><td>-5</td><td>0</td><td>∞</td></tr>
<tr><td>5</td><td>∞</td><td>∞</td><td>∞</td><td>3</td><td>0</td></tr>
</table></td></tr>
<tr><td>WEEK XII</td><td>N QUEENS PROBLEM</td></tr>
<tr><td></td><td>Implement N Queen's problem using Back Tracking.</td></tr>
</table>

REFERENCE BOOKS

1. 1. Levitin A, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 2008.
2. Goodrich, M.T. R Tomassia, "Algorithm Design foundations Analysis and Internet Examples", John Wiley and Sons, 2006.
3. Base Sara, Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson, 3rd Edition, 1999

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Out-comes	Reference
1. 1	Quick Sort	CO 1	T1:4.1, T2:1.1
2. 2	Merge Sort	CO 1	T1:4.9,4.11, T2:7
3.	KnapSack Problems	CO 3	T1:6.6, T2:12
4.	Shortest distance using Dijkstra's algorithm	CO 3	T1:4.4, T2:10
5.	Minimum spanning tree using Kruskal's algorithm	CO 3	T1:4.6, T2:10
6.	Tree Traversal Techniques using Non recursive techniques	CO 4	T2:15
7.	Graph Traversal Techniques	CO 4	T2:18
8.	Sum of Subsets using DP	CO 3	T2:18
9.	Travelling salesman Problem	CO 3	T2:18
10.	Minimum spanning tree using Prims algorithm	CO 3	T2:10
11.	All Pairs Shortest Paths – Floyd Algorithms	CO 6	T1:2, T2:1
12.	N Queen Problem	CO 5	T1:2, T2:1

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Implementation of Optimization problems using Branch and Bound.
2	Practical Implementation of Games and Puzzles using Back Tracking

Signature of Course Coordinator **HOD,IT**
Dr. B.V. Rao, Professor, IT

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY
COURSE DESCRIPTION

Course Title	**DATABASE MANAGEMENT SYSTEMS LABORATORY**				
Course Code	ACS104				
Program	B.Tech				
Semester	III	IT			
Course Type	Theory				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. K Laxmi Narayanamma, Assistant Professor				

I COURSE OVERVIEW:

This Laboratory course introduces the query language for design and development of a database by using various software's such as SQL, ORACLE, and MS – Access etc. It provides practice on built-in SQL functions using languages like DDL, DCL, DML and TCL to create and manage database systems and perform Set operations, Sub Queries, Joins; and PL/SQL programs to implement Exceptions, Cursors, Stored Functions, Views, Sequences, Locks and Triggers. This is essential for mobile and web application development for business, scientific and engineering applications.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS002	III	Data Structures

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Database Management Systems Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

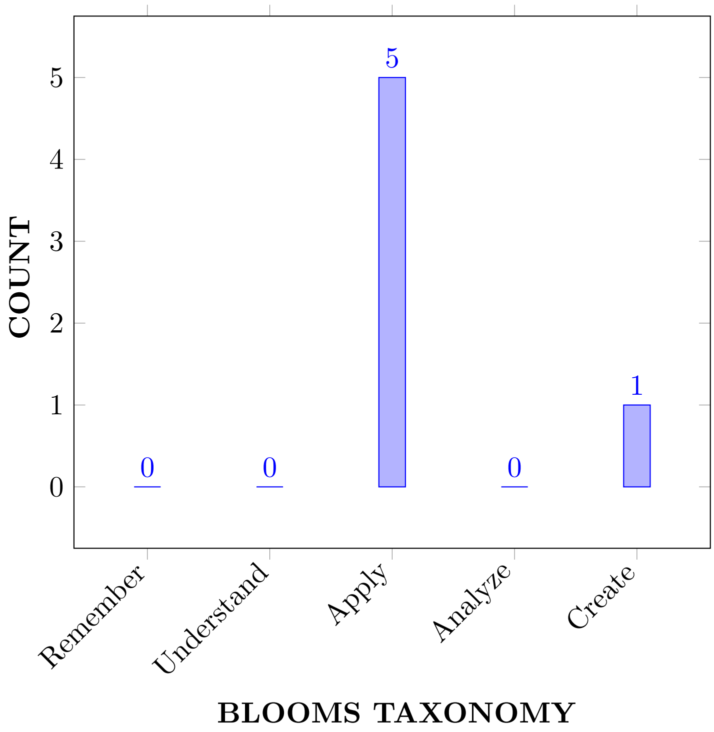
I	The SQL commands for data definition, manipulation, control and perform transactions in database systems.
II	The procedural language for implementation of functions, procedures, cursors and triggers using PL/SQL programs.
III	The logical design of a real time database system with the help of Entity Relationship diagrams.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** database creation and manipulation concepts with the help of SQL queries. .	Apply
CO 2	**Make use of** inbuilt functions of SQL queries to perform data aggregations, subqueries, embedded queries and views	Apply
CO 3	**Apply** key constraints on database for maintaining integrity and quality of data.	Apply
CO 4	**Demonstrate** normalization by using referential key constraint.	Apply
CO 5	**Implement** PL/SQL programs on procedures, cursors and triggers for enhancing the features of database system to handle exceptions.	Apply
CO 6	**Design** database model with the help of Entity Relationship diagrams for a real time system or scenario.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab Exercises,CIE,SEE

PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3	Lab Exercises,CIE,SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises,CIE,SEE
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,and give and receive clear instructions.	3	Lab Exercises,CIE,SEE
PO 12	**Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2	Lab Exercises,CIE,SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 2	Demonstrate the use of SQL for database creation and maintenance with **the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	3
	PO 3	Demonstrate the use of SQL for database creation and maintenance with the help **of Investigate and define a problem and identify constraints Manage the design process and evaluate outcomes**	4

	PSO 5	Demonstrate the use of SQL for database creation and maintenance by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of **practice and industry standards**.	3
CO 2	PSO 2	Demonstrate the use of SQL for database creation and maintenance **by using a set of instructions.**	1
	PO 2	Make Use of SQL queries for data aggregation,calculations, views, sub-queries, embedded queries manipulation **with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	4
	PO 3	Make Use of SQL queries for data aggregation,calculations, views, sub-queries, embedded queries manipulation with the help of Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes.	3
	PO 5	Make Use of SQL queries for data aggregation, calculations,views, sub-queries, embedded queries manipulation **by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards**	3
	PO 10	Build strong foundation on SQL queries for career building **by communicating effectively with engineering community**.	2
	PSO 2	Make Use of SQL queries for data aggregation,calculations, views, sub-queries, embedded queries manipulation **by using a set of steps**	3
CO 3	PO 2	Define the relational data model, its constraints and keys to maintain integrity of data with **the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	4
	PO 10	Build strong foundation on relational model and keys **for career building by communicating effectively with engineering community**.	
CO 4	PO 2	Apply normalization techniques to normalize a database with the Problem statement and system definition, **Problem formulation and abstraction, Information and data collection, Model translation**	4
	PO 3	Apply normalization techniques to normalize a database Investigate and define a problem and identify constraints, understand customer and user needs, Manage the design process and evaluate outcomes, **Investigate and define a problem and identify constraints, understand customer and user needsManage the design process and evaluate outcomes**	4

	PO 5	Apply normalization techniques to normalize a database by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	3
	PSO 2	Apply normalization techniques to normalize a database by using sequence of steps	1
CO 5	PO 2	Define PL/SQL programs on procedures, cursors and triggers for enhancing the features of database system to handle exceptions. with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	4
CO 6	PO 2	Model the real-world database systems using Entity Relationship Diagrams from the requirement specification **with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	4
	PO 3	Model the real-world database systems using Entity Relationship Diagrams from the requirement specification through **Investigate and define a problem and identify constraints, Understand customer and user needs, Manage the design process and evaluate outcomes.**	4
	PO 5	Model the real- world database systems using Entity Relationship Diagrams from the requirement specification **Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.**	3
	PO 12	Build strong foundation on SQL and ER diagrams **for career building by communicating effectively with engineering community**	2
	PSO 2	Model the real-world database systems using Entity Relationship Diagrams from the requirement specification by using sequence of steps	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1		2	3		3									3	
CO 2		2	3		3					2				3	
CO 3		2								3					
CO 4		2	3		3									2	

CO 5		2													
CO 6		2	3		3							2		3	

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 2, PO 3, PSO 3	SEE Exams	PO 2,PO 3, PO 5, PO 10,PO12	Seminars	-
Laboratory Practices	PO 1,PO 3, PO 5	Student Viva	PO 2, PO 3,PO10	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**CREATION OF TABLES**

1. Create a table called Employee with the following structure.
Name Type
Emp no Number
E name Varchar2(20)
Job Varchar2(20)
Mgr Number
Sal Number
• Add a column commission with domain to the Employee table
• Insert any five records into the table.
• Update the column details of job
• Rename the column of Employ table using alter command.
• Delete the employee whose empno is19.
2.Create department table with the following structure.
Name Type
Dept no Number
Dept name Varchar2(20)
location Varchar2(20)
• Add column designation to the department table.
• Insert values into the table.
• List the records of emp table grouped by dept no. Update the record where dept no is 9.
• Delete any column data from the table.
3. Create a table called Customer table
Name Type
Cust Name Varchar2(20)
Cust city Varchar2(20)
Cust city Varchar2(20)
• Insert records into the table.
• Add salary column to the table.
• Alter the table column domain.
• Drop salary column of the customer table.
• Delete the rows of customer table whose cust city is hyd.
4. Create a table called branch table.
Name Type
Branch Name Varchar2(20)
Branch city Varchar2(20)
Asserts Number
• Increase the size of data type for asserts to the branch.
• Add and drop a column to the branch table.
• Insert values to the table.
• Update the branch name column
• Delete any two columns from the table
5. Create a table called sailor table
Name Type
S Name Varchar2(20)
Rating Varchar2(20)
Sid Number
• Add column age to the sailor table.
• Insert values into the sailor table.
• Delete the row with rating¿8.
• Update the column details of sailor.
• Insert null values into the table.
6. Create a table called reserves table.
Name Type
Boat Id Number
Day Number
Sid Number

WEEK II	**QUERIES USING DDL AND DML**
	1. a. Create a user and grant all permissions to the user. b. Insert the any three records in the employee table and use rollback. Check the result. c. Add primary key constraint and not null constraint to the employee table. d. Insert null values to the employee table and verify the result. 2. a. Create a user and grant all permissions to the user. b. Insert values in the department table and use commit. c. Add constraints like unique and not null to the department table. d. Insert repeated values and null values into the table. 3. a. Create a user and grant all permissions to the user. b. Insert values into the table and use commit. c. Delete any three records in the department table and use rollback. d. Add constraint primary key and foreign key to the table. 4. a. Create a user and grant all permissions to the user. b. Insert records in the sailor table and use commit. c. Add save point after insertion of records and verify savepoint. d. Add constraints not null and primary key to the sailor table. 5. a. Create a user and grant all permissions to the user. b. Use revoke command to remove user permissions. c. Change password of the user created. d. Add constraint foreign key and not null. 6. a. Create a user and grant all permissions to the user. b. Update the table reserves and use savepoint and rollback. c. Add constraint primary key , foreign key and not null to the reserves table
WEEK III	**QUERIES USING AGGREGATE FUNCTIONS**

	1. a. By using the group by clause, display the enames who belongs to deptno 10 , whose salary is same as respective departments average salary. b. Display lowest paid employee details under each department. c. Display number of employees working in each department and their department number. d. Using builtin functions, display number of employees working in each department and their department name from dept table. Insert deptname to dept table and insert deptname for each row, do the required thing specified above. e. List all employees which start with either B or C. f. Display only these ename of employees where the maximum salary is greater than or equal to 5000. 2. a. Calculate the average salary for each different job. b. Show the average salary of each job excluding manager. c. Show the average salary for all departments employing more than three people. d. Display employees who earn more than the lowest salary in department 30 e. Show that value returned by sign (n)function. f. How many days between day of birth to current date. 3. a. Show that two substring as single string. b. List all employee names, salary and 15 c. Display lowest paid emp details under each manager d. Display the average monthly salary bill for each deptno. e. Show the average salary for all departments employing more than two people. f. By using the group by clause, display the eid who belongs to deptno 05 along with average salary. 4. a. Count the number of employees in department20 b. Find the minimum salary earned by clerk. c. Find minimum, maximum, average salary of all employees. d. List the minimum and maximum salaries for each job type. e. List the employee names in descending order. f. List the employee id, names in ascending order by empid. 5. a. Find the sids ,names of sailors who have reserved all boats called “INTERLAKE Find the age of youngest sailor who is eligible to vote for each rating level with at least two such sailors. b. Find the sname , bid and reservation date for each reservation. c. Find the ages of sailors whose name begin and end with B and has at least 3 characters. d. List in alphabetic order all sailors who have reserved red boat. e. Find the age of youngest sailor for each rating level. 6. a. List the Vendors who have delivered products within 6 months from order date. b. Display the Vendor details who have supplied both Assembled and Subparts. c. Display the Sub parts by grouping the Vendor type (Local or NonLocal). d. Display the Vendor details in ascending order.
WEEK IV	**PROGRAMS ON PL/SQL**

	1. a. Write a PL/SQL program to swap two numbers. b. Write a PL/SQL program to find the largest of three numbers. 2. a. Write a PL/SQL program to find the total and average of 6 subjects and display the grade. b. Write a PL/SQL program to find the sum of digits in a given number. 3. a. Write a PL/SQL program to display the number in reverse order. b. Write a PL / SQL program to check whether the given number is prime or not. 4. a. Write a PL/SQL program to find the factorial of a given number. b. Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 3 to 7. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns radius and area. 5. a. Write a PL/SQL program to accept a string and remove the vowels from the string. b. Write a PL/SQL program to accept a number and a divisor. Make sure the divisor is less than or equal to 10. Else display an error message. Otherwise Display the remainder in words.
WEEK V	**PROCEDURES AND FUNCTIONS**
	1. Write a function to accept employee number as parameter and return Basic +HRA together as single column. 2. Accept year as parameter and write a Function to return the total net salary spent for a given year. 3. Create a function to find the factorial of a given number and hence find NCR. 4. Write a PL/SQL block o pint prime Fibonacci series using local functions. 5. Create a procedure to find the lucky number of a given birthdate. 6. Create function to the reverse of given number.
WEEK VI	**TRIGGERS**
	1. Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old values and new values: CUSTOMERS table. 2. Creation of insert trigger, delete trigger, update trigger practice triggers using the passenger database. Passenger (Passport id INTEGER PRIMARY KEY, Name VARCHAR (50) Not NULL, Age Integer Not NULL, Sex Char, Address VARCHAR (50) Not NULL); 3. Insert row in employee table using Triggers. Every trigger is created with name any trigger have same name must be replaced by new name. These triggers can raised before insert, update or delete rows on data base. The main difference between a trigger and a stored procedure is that the former is attached to a table and is only fired when an INSERT, UPDATE or DELETE occurs. 4. Convert employee name into uppercase whenever an employee record is inserted or updated. Trigger to fire before the insert or update. 5. Trigger before deleting a record from emp table. Trigger will insert the row to be deleted into table called delete emp and also record user who has deleted the record and date and time of delete. 6. Create a transparent audit system for a table CUST MSTR. The system must keep track of the records that are being deleted or updated

WEEK VII	**PROCEDURES**
	1. Create the procedure for palindrome of given number. 2. Create the procedure for GCD: Program should load two registers with two Numbers and then apply the logic for GCD of two numbers. GCD of two numbers is performed by dividing the greater number by the smaller number till the remainder is zero. If it is zero, the divisor is the GCD if not the remainder and the divisors of the previous division are the new set of two numbers. The process is repeated by dividing greater of the two numbers by the smaller number till the remainder is zero and GCD is found. 3. Write the PL/SQL programs to create the procedure for factorial of given number. 4. Write the PL/SQL programs to create the procedure to find sum of N natural number. 5. Write the PL/SQL programs to create the procedure to find Fibonacci series. 6. Write the PL/SQL programs to create the procedure to check the given number is perfect or not.
WEEK VIII	**CURSORS**
	1. Write a PL/SQL block that will display the name, dept no,salary of fist highest paid employees. 2. Update the balance stock in the item master table each time a transaction takes place in the item transaction table. The change in item master table depends on the item id is already present in the item master then update operation is performed to decrease the balance stock by the quantity specified in the item transaction in case the item id is not present in the item master table then the record is inserted in the item master table. 3. Write a PL/SQL block that will display the employee details along with salary using cursors. 4. To write a Cursor to display the list of employees who are working as a Managers or Analyst.
WEEK IX	**CASE STUDY: BOOK PUBLISHING COMPANY**
	A publishing company produces scientific books on various subjects. The books are written by authors who specialize in one particular subject. The company employs editors who, not necessarily being specialists in a particular area, each take sole responsibility for editing one or more publications. A publication covers essentially one of the specialist subjects and is normally written by a single author. When writing a particular book, each author works with on editor, but may submit another work for publication to be supervised by other editors. To improve their competitiveness, the company tries to employ a variety of authors,more than one author being a specialist in a particular subject for the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes. Create the logical data model using E-R diagram
WEEK X	**CASE STUDY GENERAL HOSPITAL**

	A General Hospital consists of a number of specialized wards (such as Maternity, Pediatric, Oncology, etc). Each ward hosts a number of patients, who were admitted on the recommendation of their own GP and confirmed by a consultant employed by the Hospital.On admission, the personal details of every patient are recorded. A separate register is to be held to store the information of the tests undertaken and the results of a prescribed treatment. A number of tests may be conducted for each patient. Each patient is assigned to one leading consultant but may be examined by another doctor, if required. Doctors are specialists in some branch of medicine and may be leading consultants for a number of patients, not necessarily from the same ward. For the above case study, do the following. 1. Analyze the data required. 2. Normalize the attributes. 3. Create the logical data model using E-R diagrams.
WEEK XI	**CASE STUDY: CAR RENTAL COMPANY**
	A database is to be designed for a car rental company. The information required includes a description of cars, subcontractors (i.e. garages), company expenditures, company revenues and customers. Cars are to be described by such data as: make, model, year of production, engine size, fuel type, number of passengers, registration number, purchase price, purchase date, rent price and insurance details. It is the company policy not to keep any car for a period exceeding one year. All major repairs and maintenance are done by subcontractors (i.e. franchised garages), with whom CRC has long-term agreements. Therefore the data about garagesto be kept in the database includes garage names, addresses, range of services and the like. Some garages require payments immediately after a repair has been made; with others CRC has made arrangements for credit facilities. Company expenditures are to be registered for all outgoings connected with purchases, repairs, maintenance, insurance etc. Similarly the cash inflow coming from all sources: Car hire, car sales, insurance claims must be kept of file. CRC maintains a reasonably stable client base. For this privileged category of customers special credit card facilities are provided. These customers may also book in advance a particular car. These reservations can be made for any period of time up to one month. Casual customers must pay a deposit for an estimated time of rental, unless they wish to pay by credit card. All major credit cards are accepted. Personal details such as name, address,telephone number, driving license, number about each customer are kept in the database. For the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes.
WEEK XII	**CASE STUDY: STUDENT PROGRESS MONITORING SYSTEM**

	A database is to be designed for a college to monitor students' progress throughout their course of study. The students are reading for a degree (such as BA, BA (Hons) M.Sc., etc) within the framework of the modular system. The college provides a number of modules, each being characterized by its code, title, credit value, module leader, teaching staff and the department they come from. A module is coordinated by a module leader who shares teaching duties with one or more lecturers. A lecturer may teach (and be a module leader for) more than one module. Students are free to choose any module they wish but the following rules must be observed: Some modules require pre- requisites modules and some degree programme have compulsory modules. The database is also to contain some information about students including their numbers, names, addresses, degrees they read for, and their past performance i.e. modules taken and examination results. For the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes. 3. Create the logical data model i.e., ER diagrams. 4. Comprehend the data given in the case study by creating respective tables with primary keys and foreign keys wherever required. 5. Insert values into the tables created (Be vigilant about Master- Slave tables). 6. Display the Students who have taken M.Sc course. 7. Display the Module code and Number of Modules taught by each Lecturer. 8. Retrieve the Lecturer names who are not Module Leaders. 9. Display the Department name which offers "English" module. 10. Retrieve the Prerequisite Courses offered by every Department(with department names). 11. Present the Lecturer ID and Name who teaches Mathematics. 12. Discover the number of years a Module is taught. 13. List out all the Faculties who work for Statistics Department. 14. List out the number of Modules taught by each Module Leader. 15. List out the number of Modules taught by a particular Lecturer. 16. Create a view which contains the fields of both Department and Module tables. (Hint The fields like Module code, title, credit, Department code and its name). 17. Update the credits of all the prerequisite courses to 5. Delete the Module History from the Module table.

TEXTBOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Mc raw-Hill, 4th Edition,2002.
2. Ivan Bayross, "SQL, PL/SQL The programming language of oracle", BPB publications, 4th Revised Edition, 2010.

REFERENCE BOOKS:

1. Ramez Elmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.
2. Peter Rob, Carles Coronel, "Database System Concepts", Cengage Learning, 7th Edition, 2008.
3. M L Gillenson, "Introduction to Database Management", Wiley Student Edition,2012.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Introduction to database management system environments.	CO 1	T1:4.1, T2:1.1
2	Creation of tables using DDL and DML commands.	CO 2	T1:4.9,4.11, T2:7
3	Working with integrity constraints	CO 3,CO4	T1:3, T2:8
4	Working with DCL and TCL commands	CO1,CO 4	T1:6.6, T2:12
5	Queries using aggregate functions.	CO 3	T1:4.4, T2:10
6	Nested queries using comparison keywords and logical operators	CO 3	T1:4.6, T2:10
7	Working with Programs on pl/sql.	CO 6	T2:15
8	Working with Procedures.	CO 3,CO 6	T2:18
9	Working with Triggers.	CO 6	T2:18
10	Working with functions.	CO 5	T2:18
11	Working with Cursors.	CO 6	T2:10
12	Case study	CO 7	T1:2, T2:1

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Implementation of views using SQL.
2	Practical Implementation of assertions using PL/SQL.

Signature of Course Coordinator **HOD,IT**
Ms. K Laxmi Narayanamma, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">COMPUTER SCIENCE AND ENGINEERING</td></tr>
<tr><td>Course Title</td><td colspan="5">OPERATING SYSTEMS</td></tr>
<tr><td>Course Code</td><td colspan="5">ACS007</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Regulation</td><td colspan="5">R-16</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>1</td><td>4</td><td>3</td><td>2</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr. Laxman Kumar, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS002	II	Data Structures
B.Tech	AIT001	III	Design and Analysis of Algorithms

II COURSE OVERVIEW:

This course emphasizes on basic knowledge of various types of operating systems, effective resource utilization by using systems and applications software. It is designed to provide in-depth critique on the problems of resource management, scheduling, concurrency, synchronization, memory management, file management, protection and security of used system. Learned knowledge will be implemented in design and development of hybrid operating systems, command control systems, and in real time environments.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Operating Systems	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

<table>
<tr><td>✓</td><td>Power Point Presentations</td><td>✓</td><td>Chalk & Talk</td><td>✓</td><td>Assignments</td><td>x</td><td>MOOC</td></tr>
<tr><td>x</td><td>Open Ended Experiments</td><td>x</td><td>Seminars</td><td>x</td><td>Mini Project</td><td>x</td><td>Videos</td></tr>
<tr><td>x</td><td colspan="7">Others</td></tr>
</table>

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
45%	Understand
18%	Apply
27%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

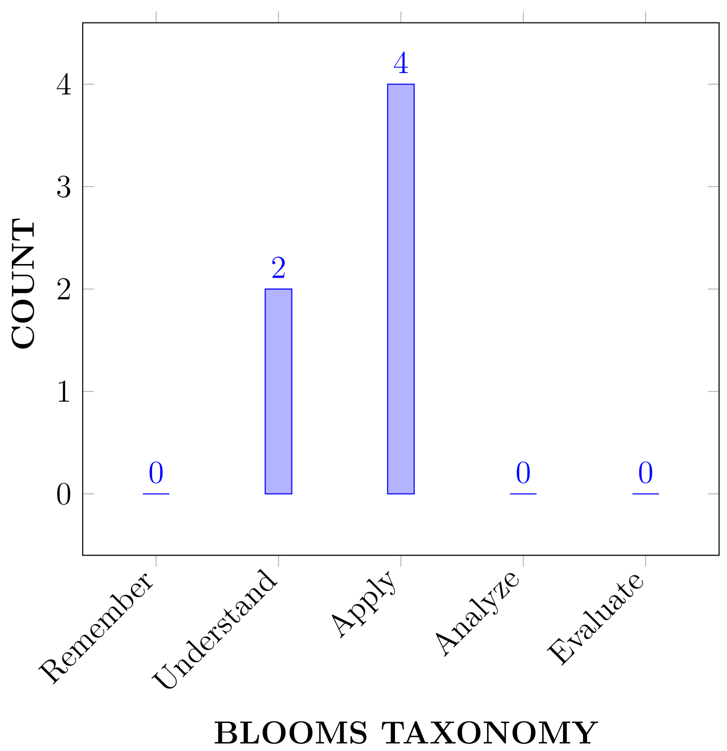
I	The principles of operating systems, services and functionalities with its evolution.
II	The structures, functions and components of modern operating systems
III	The conventional hardware at different OS abstraction levels.
IV	The essential skills to examine issues and methods employed in design of operating systems with identification of various functionalities.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** different architectures used in design of modern operating systems.	Understand
CO 2	**Solve** problems related to process scheduling, synchronization and deadlock handling in uni and multi-processing systems.	Apply
CO 3	**Choose** memory allocation algorithms for effective utilization of resources.	Apply
CO 4	**Select** various page replacement algorithms applied for allocation of frames.	Apply
CO 5	**Make use of** different file allocation and disk scheduling algorithms applied for efficient utilization of storage.	Apply
CO 6	**Outline** mechanisms used in protection of resources in real time environment	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE / CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	SEE / CIE / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	2	QUIZ
PSO 2	Focus on improving software reliability, network security / information retrieval systems.	3	QUIZ
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	3	QUIZ

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 2	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	✓	-
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	-	-
CO 5	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 6	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand the structure and evolution of operating system by understanding fundamentals of Computer engineering specialization and mathematical and scientific principles.	3
	PO 10	Communicate effectively on evolution of operating systems including deep subject knowledge.	1
	PO 12	By understanding different operating system architectures, one can personally continue understanding of different operating systems developed by the companies to stay up with new technology and for personal development.	2
	PSO 1	Identify the need, key issues and applications of the operating system in various real time environments.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	By understanding different operating system architectures, one can acquire knowledge on advanced operating systems for engineering practice and higher education and even can extend the knowledge to become an entrepreneur.	2
CO 2	PO 1	Understand the concept of Process, process scheduling, issues and their solutions related to process synchronization by using mathematical principles, fundamental of Computer engineering specialization and scientific principles.	3
	PO 2	Identify synchronization problem and understand the problem statement of classical synchronization problems collect the data needed for solving the problem then analyze different models of solutions for classical synchronization problems by semaphores and monitors and interpret the solutions	6
	PO 3	Define the process synchronization problem, understand the user needs then identify the resources required next manage the design process using banker's algorithm and evaluate outcomes.	4
	PO 4	By having the knowledge of characteristics of process and understanding the context in classical synchronization problems and the solutions provided using the technical constructs like semaphores and monitors with their working strategies, these can be applied for understanding of other synchronization problems.	5
	PO 10	Communicate effectively on process communication using process communication techniques and explaining each technique.	2
	PO 12	By understanding process management, one can personally continue understanding internal functioning of operating systems developed by the companies to stay up with new technology and for personal development.	2
	PSO 1	Identify the need for process scheduling and apply appropriate algorithms for scheduling of process arriving at various time intervals.	4
	PSO 2	By acquiring knowledge of process management one can design software applications with reliability and applications with fast information retrieval.	2
CO 3	PO 1	Describe the need and various techniques for memory management by understanding the limits of contiguous memory allocation through applying mathematical principles, fundamental of Computer engineering specialization and scientific principles	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Identify problem of memory management and understand the problem statement of contiguous memory management then analyze different models of non-contiguous memory management.	3
	PO 3	Define the problem related to contiguous memory management, understand the user needs then identify the memory requirements of each process next manage the design process by using non-contiguous memory management techniques and evaluate outcomes.	4
	PO 10	Communicate effectively on memory management techniques with clarity on contiguous and varied strategies and explaining each technique with appropriate terminology.	2
‘	PSO 1	Identify the need of efficient utilization of main memory and apply various contiguous and non-contiguous memory allocation techniques of memory management.	4
CO 4	PO 1	Understand the concept of virtual memory and various algorithms for effective usage of memory by applying the knowledge of computer engineering fundamentals, mathematical and scientific principles.	3
	PO 2	Identify the need for page replacement, understand the problem statement of allocation of pages to frames, then collect the data related to available pages and frames then analyze various models for solving problem based on the given sequence of pages and interpret their results accordingly.	6
	PO 3	Define the problem of mapping of large virtual memory to the existing physical memory, understand the user needs then manage the design process using page replacement algorithms and evaluate outcomes by identifying the number of page faults incurred.	4
	PO 4	By understanding characteristics of process, understanding the context in virtual memory management using demand paging and segmentation, this knowledge can be applied for virtualizing engineering process.	4
	PO 10	Communicate on utilization of main memory using pictorial representation of demand paging and segmentation and explaining them in detail.	2
	PSO 1	Identify the need of separation of logical memory from physical memory and apply appropriate algorithms for allocating given sequence of pages to frames.	4
CO 5	PO 1	Understand the concept of file system and analyze various file allocation methods by using the knowledge of computer engineering fundamentals, mathematical and scientific principles.	3

Course Outcomes	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of Key competencies matched.**
	PO 2	Identify the need for disk scheduling, understand the problem statement of disk scheduling, then collect the data related to location of data to be accessed in the disk structure then analyze different scheduling algorithm models used for solving problems related to finding total head movements and interpret their results.	6
	PO 3	Define the problem of file allocation to disk block, understand the user needs then identify the free disk space available next manage the design process by using appropriate file allocation methods.	4
	PO 10	Communicate on effective utilization of mass storage structures clearly using pictorial representation of disk structure.	2
	PO 12	By understanding mass storage structure, one can personally continue understanding of different storage devices developed by the companies to stay up with new technology.	2
	PSO 1	Identify the need of scheduling the service of disk I/O requests and apply appropriate algorithms for processing I/O requests.	4
CO 6	PO 1	Explain the importance of protection of objects and the protection provided for them by using domain concept in terms of access matrix implementation by applying knowledge of computer science fundamentals.	1
	PO 10	Communicate on protection of computer system components using protection strategies in detail.	1
	PO 12	By understanding the concept of protection, one can study and analyze various protection mechanisms developed recently for personal development.	2
	PSO 1	Identify the need of protection provided to the hardware and software components of the computer system and analyze the techniques provided for their protection.	1
	PSO 2	By acquiring knowledge of protection one can design software applications with high security and reliability.	1
	PSO 3	By understanding the concept of protection, one can acquire knowledge on advanced protection mechanisms for engineering practice and higher education and even can extend the knowledge to become an entrepreneur.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	1	-	2	1	-	2
CO 2	3	6	4	5	-	-	-	-	-	2	-	2	4	2	-
CO 3	3	3	4	-	-	-	-	-	-	2	-	-	4	-	-
CO 4	3	6	4	4	-	-	-	-	-	2	-	-	4	-	-
CO 5	3	6	4	-	-	-	-	-	-	2	-	2	4	-	-
CO 6	1	-	-	-	-	-	-	-	-	1	-	2	1	1	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	-	-	-	-	-	-	-	20	-	25	17		100
CO 2	100	60	40	45	-	-	-	-	-	40	-	25	67	100	-
CO 3	100	30	40	-	-	-	-	-	-	40	-	-	67	-	-
CO 4	100	60	40	36	-	-	-	-	-	40	-	-	67	-	-
CO 5	100	60	40	-	-	-	-	-	-	40	-	25	67	-	-
CO 6	33	-	-	-	-	-	-	-	-	20	-	25	17	50	100

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -5 $< C \leq 40\%$ – Low/ Slight

2 - 40 % $< C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	1	-	1	1	-	3
CO 2	3	3	2	2	-	-	-	-	-	2	-	1	3	3	-
CO 3	3	1	2	-	-	-	-	-	-	2	-	-	3	-	-
CO 4	3	3	2	2	-	-	-	-	-	2	-	-	3	-	-
CO 5	3	3	2	-	-	-	-	-	-	2	-	1	3	-	-
CO 6	1	-	-	-	-	-	-	-	-	1	-	1	1	2	3
TOTAL	16	10	8	4	-	-	-	-	-	10	-	4	14	5	6
AVERAGE	2.7	2.5	2	2	-	-	-	-	-	1.7	-	1	2.3	2.5	3

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Operating systems objectives and functions: Computer system architecture, operating systems structure, operating systems operations; Evolution of operating systems: Simple batch, multi programmed, time shared, personal computer, parallel distributed systems, real time systems, special purpose systems, operating system services, user operating systems interface; Systems calls: Types of systems calls, system programs, protection and security, operating system design and implementation, operating systems structure, virtual machines.
MODULE II	**PROCESS AND CPU SCHEDULING, PROCESS COORDINATION**
	Process concepts: The process, process state, process control block, threads; Process scheduling: Scheduling queues, schedulers, context switch, preemptive scheduling, dispatcher, scheduling criteria, scheduling algorithms, multiple processor scheduling; Real time scheduling; Thread scheduling; Case studies Linux windows; Process synchronization, the critical section problem; Peterson‘s solution, synchronization hardware, semaphores and classic problems of synchronization, monitors.
MODULE III	**MEMORY MANAGEMENT AND VIRTUAL MEMORY**
	Logical and physical address space: Swapping, contiguous memory allocation, paging, structure of page table. Segmentation: Segmentation with paging, virtual memory, demand paging; Performance of demand paging: Page replacement, page replacement algorithms, allocation of frames, thrashing
MODULE IV	**FILE SYSTEM INTERFACE, MASS-STORAGE STRUCTURE**
	The concept of a file, access methods, directory structure, file system mounting, file sharing, protection, file system structure, file system implementation, allocation methods, free space management, directory implementation, efficiency and performance; Overview of mass storage structure: Disk structure, disk attachment, disk scheduling, disk management, swap space management; Dynamic memory allocation: Basic concepts; Library functions.

MODULE V	**DEADLOCKS, PROTECTION**
	System model: Deadlock characterization, methods of handling deadlocks, deadlock prevention, dead lock avoidance, dead lock detection and recovery form deadlock system protection, goals of protection, principles of protection, domain of protection, access matrix, implementation of access matrix, access control, revocation of access rights, capability based systems, language based protection.

TEXTBOOKS

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Principles‖, Wiley Student Edition, 8th Edition, 2010.

2. . William Stallings, Operating System- Internals and Design Principles‖, Pearson Education, 6th Edition, 2002.

REFERENCE BOOKS:

1. Andrew S Tanenbaum, Modern Operating Systems‖, PHI, 3rd Edition, 2007.

2. D. M. Dhamdhere, Operating Systems a Concept based Approach, Tata McGraw-Hill, 2nd Edition, 2006.

WEB REFERENCES:

1. www.smartzworld.com/notes/operatingsystems

2. www.scoopworld.in

3. www.sxecw.edu.in

4. www.technofest2u.blogspot.com

COURSE WEB PAGE:

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Computer system architecture, operating systems structure	CO 1	T1:1.1-1.4
3	operating systems operations	CO 1	T1:1.5
4	Evolution of operating systems: Simple batch, multi programmed, time shared, personal computer	CO 1	T2:2.2
5	parallel distributed systems, real time systems, special purpose systems,	CO 1	T2:2.2

6	operating system services, user operating systems interface	CO 1	T2:2.1-2.2
7	Systems calls: Types of systems calls, system programs	CO 1	T2:2.3-2.5
8	protection and security, operating system design and implementation	CO 1	T1:2.6
9	operating systems structure, virtual machines.	CO 1	T1:2.7-2.8
10	Process concepts: The process, process state	CO 2	T1:3.1-3.2
11	process control block, threads;	CO 2	T1:3.2-3.4
12	Process scheduling: Scheduling queues, schedulers, context switch	CO 2	T1:5.2
13	preemptive scheduling, dispatcher, scheduling criteria	CO 2	T1:5.3
14	scheduling algorithms	CO 2	T1:5.3
15	multiple processor scheduling	CO 2	T1:5.3
17	Real time scheduling; Thread scheduling;	CO 2	T1:5.4-5.5
18	Case studies Linux windows	CO 2	T1:5.6, 21.4
19	Process synchronization, the critical section problem	CO 2	T1:6.1
20	Peterson‘s solution	CO 2	T1:6.2-6.3
21	synchronization hardware	CO 2	T1:6.4
22	semaphores	CO 2	T1:6.5
23	classic problems of synchronization, monitors.	CO 2	T1:6.6-6.7
24	Logical and physical address space: Swapping, contiguous memory allocation	CO 3	T1:8.1
26	paging, structure of page table	CO 3	T1:8.2
27	Segmentation: Segmentation with paging	CO 3	T1:8.3
29	virtual memory, demand paging	CO 3	T1:8.4-8.5
30	Performance of demand paging	CO 3	T1:8.6
31	Page replacement, page replacement algorithms,	CO 4	T1:8.6
33	allocation of frames	CO 4	T1:9.5
34	Thrashing	CO 4	T1:9.6
35	The concept of a file, access methods	CO 4	T1:10.1-10.2
36	directory structure	CO 4	T1:10.3
37	file system mounting	CO 4	T1:10.5
38	file sharing, protection	CO 4	T1:10.6
39	file system structure	CO 4	T1:10.6
40	file system implementation	CO 4	T1:11.3
41	allocation methods	CO 4	T1:11.4

43	free space management	CO 4	T1:11.5
44	directory implementation, efficiency and performance	CO 4	T1:11.6
45	Overview of mass storage structure: Disk structure, disk attachment	CO 5	T1:12.1-12.3
46	disk scheduling, disk management, swap space management	CO 5	T1:12.4-12.6
48	Dynamic memory allocation: Basic concepts; Library functions.	CO 5	T1:12.7-12.8
49	System model: Deadlock characterization, methods of handling deadlocks	CO 2	T1:7.1-7.2
50	deadlock prevention	CO 2	T1:8.1
51	deadlock avoidance	CO 2	T1:8.2
52	dead lock detection and recovery form deadlock system protection	CO 2	T1:8.3
55	goals of protection, principles of protection, domain of protection	CO 6	T2:27.8
56	access matrix, implementation of access matrix, access control, revocation of access rights	CO 6	T2:27.9
57	capability based systems, language based protection	CO 6	T1:8.2-8.3
PROBLEM SOLVING/ CASE STUDIES			
16	Problems on CPU scheduling algorithms	CO 2	T1:5.3-5.3
25	Problems on contiguous memory allocation	CO 3	T1:8.1-8.3
28	Problems on paging and segmentation	CO 3	T1:8.4-8.6 T1:9.1-9.2
32	Problems on page replacement algorithms	CO 4	T1:9.4-9.6
42	Problems on file allocation methods	CO 5	T1:11.3-11.6
47	Problems on disk scheduling	CO 5	T1:12.1-12.6
53	Problems on deadlock avoidance	CO 2	T1:8.1-8.3
54	Problems on recovery from deadlocks	CO 2	T1:8.1-8.3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
58	Definitions on operating systems fundamentals	CO 1	T1:1.2
59	Definitions on process, CPU scheduling and process coordination	CO 2	T1:1.5
60	Definitions on memory management and virtual memory	CO 3, CO 4	T1:8,9

61	Definitions on file system interface and mass storage structure	CO 5	T1:10,11
62	Definitions on deadlocks and protection	CO 2, CO 6	T1:9.1
DISCUSSION OF QUESTION BANK			
1	Introduction	CO 1	T1:1.2
2	Process and CPU Scheduling, Process Coordination	CO 2	T1:1.5
3	Memory Management and Virtual Memory	CO 3,4	T1:8,9
4	File System Interface, Mass Storage Structure	CO 5	T1:10,11
5	Deadlocks, Protection	CO 2,6	T1: 9.1

Signature of Course Coordinator **HOD, CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**SOFTWARE ENGINEERING**				
Course Code	ACSB26				
Program	B.Tech				
Semester	VI	CSE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms .B Shashirekha, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	-	-	Basic knowledge of computer Hardware and Software

II COURSE OVERVIEW:

This course concentrates on developing basic understanding about various activities that are involved in a software development. This course enables the student to develop necessary skills for developing a product or applications. The course focuses on all activities involved in software development (communication, planning, modeling, construction, deployment).In this course; students will gain a broad understanding of the discipline of software engineering and its application to the development and management of software systems. Student can implement and get knowledge about development of the software and gains knowledge of basic engineering methods and practices, and their appropriate application.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
SOFTWARE ENGINEERING	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
60 %	Understand
20 %	Apply
20 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

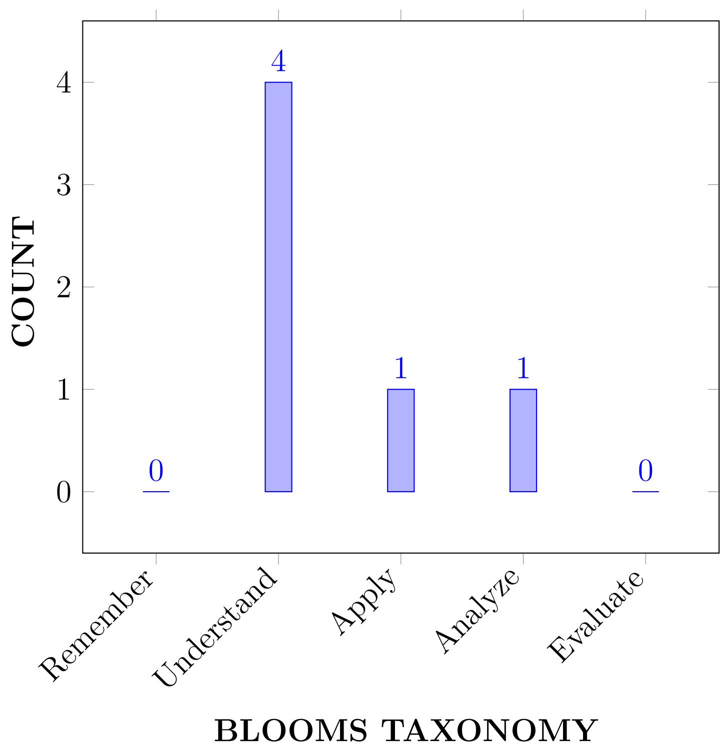
I	Learn how to elicitate requirements and develop software life cycles.
II	Understand the design considerations for enterprise integration and deployment.
III	Analyze quality assurance techniques and testing methodologies.
IV	Prepare a project plan for a software project that includes estimates of size and effort, a schedule, resource allocation, configuration control, and project risk.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Describe** process models, approaches and techniques for managing a software development process.	Understand
CO 2	**Recognize** the importance project planning activities that accurately help in selection and initiation of individual projects and of portfolios of projects in the enterprise.	Understand
CO 3	**Explain** software model and behavior of a software system.	Understand
CO 4	**Develop** the approaches to verification and validation including static analysis and reviews.	Apply
CO 5	**Demonstrate** the concept of risk management through risk identification, risk measurement and mitigation.	Understand
CO 6	**Make use of** earned value analysis and project metric for scheduling and improving the quality of software.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes

PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 10	**Project management and finance:**Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	CIE / Quiz / AAT
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE / Quiz / AAT
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	CIE / Quiz / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyse computer programs in the areas related to Algorithms, System Software, Web design, Bigdata, Artificial Intelligence, Machine Learning and Networking.	3	CIE / Quiz / AAT
PSO 2	Focus on improving software reliability, network security and information retrieval systems.	2	CIE / Quiz / AAT
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	✓	-	-	-	-	-	-	✓	-		✓	-	-
CO 5	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Explain the evolution of software and its characteristics and challenges **by applying computer science methodologies**	1
CO 2	PO 1	Compare process models, approaches and techniques to manage a given software development process by using the **mathematical principles and computer science methodologies.**	3
	PSO 1	Understand the differences between analysis and analytics in the areas related to **Algorithms, Bigdata, Artificial Intelligence, Machine Learning and Networking.**	4
CO 3	PO 1	Understand the concept of Earned Value Analysis (EVA) to measure the projects progress at any given point in time by applying **mathematical principles and computer science methodologies**	2

	PO 2	Understand the key issues in **problems identification and formulation, data collection, model translation, validation, interpretation of results and documentatio**n in optimizing business decisions.	6
	PO 3	Classify the key issues in terms of **defining various problems, customer and user needs, cost effective and creative solutions, design process, economic context and management techniques.**	7
CO 4	PO 1	Explain the concept of data dictionary process and querying the software by applying **mathematical principles and computer science methodologies**	2
	PO 2	Understand the **problem and develop solutions using different data technologies and document the results for interpretation**	4
	PO 3	Identify the appropriate technology like black box testing and white box testing. suitable for various problems, by understanding **customer and user needs, with cost effective and creative solutions by managing the design process, knowledge on economic context, management techniques.**	7
	PO 10	Communicate effectively in orally and written by comprehend and write effective **reports and design documentation with the**	5
	PO 12	Recognize the need for **advanced concepts** testing technologies for developing applications through **continuing education efforts with ongoing learning** – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change.	5
	PSO 1	Explain the technologies used to process and querying the data in the areas related to **Algorithms, Bigdata, Artificial Intelligence, Machine Learning and Networking.**	4
CO 5	PO 1	Select appropriate process modelcomponent for finding model the structure and behavior of a software system. using **computer science methodologies**.	1
	PO 2	Make use of Hadoop components on huge volume of **information and data collected from various sources and perform model translation and validation**	3
	PO 4	Make use of Hadoop components for developing applications based on **technical literature and quality issues. Identify, classify and describe the performance of systems through analytical methods and techniques.**	3

	PO 10	Communicate in written and orally by comprehending and writing effective reports and design documentation and presentations on Hadoop components for developing applications with the engineering community by having major focus on clarity on content, **Grammar/Punctuation with appropriate References, good Speaking style and depth in subject matter.**	5
	PSO 1	Make use of Hadoop components on huge volume data used to develop analytical solutions related to **Bigdata, Artificial Intelligence, Machine Learning and Networking.**	4
CO 6	PO 1	Translate the data from traditional file system to HDFS for analyzing big data in Hadoop ecosystem using the **mathematical principles and computer science methodologies**	2
	PO 2	Translation of data structure from traditional to HDFS includes volume of **information and data, file structure translation methods, validation and solution development with proper documentation.**	6
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation on HDFS file system applications with the engineering community by having major focus on clarity on content, **Grammar/Punctuation with appropriate References, good Speaking style and depth in subject matter.**	5

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 2	6	7	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	4	7	-	1	-	-	-	-	-	5	-	-	4	-
CO 5	1	3	3	-	-	-	-	-	-	5	-	-	-	-	-
CO 6	2	6	-	-	-	-	-	-	-	3	-		-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	66.7	-	-

CO 3	66.7	60.0	70.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	40.0	70.0	-	-	-	-	-	-	100	-	60.0	66.7	-	-
CO 5	33.3	30.0	30.0	-	-	-	-	-	-	100	-	-	-	-	-
CO 6	66.7	60.0	-	-	-	-	-	-	-	60.0	-		66.7	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - 40 % $<C < 60\%$ –Moderate

1-5 $<C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	3	-	-	-	-	-	-	3	-		-	-	-
CO 5	1	1	1	-	-	-	-	-	-	3	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	3	-		-	-	-
TOTAL	23	18	16	11	9	-	-	-	-	3	-	-	1.5	1.5	1.5
AVERAGE	2.5	2.5	2.6	2.7	3.0	-	-	-	-	2.6	-	3	3..0	2.5	3.0

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**SOFTWARE PROCESS AND PROJECT MANAGEMENT**
	Software process and project management: Introduction to software engineering, software process, perspective and specialized process models; Software project management: Estimation: LOC and FP based estimation, COCOMO model; Project scheduling: Scheduling, earned value analysis, risk management.
MODULE II	**REQUIREMENT ANALYSIS AND SPECIFICATION**
	Requirement Analysis and Specification: Software requirements: Functional and nonfunctional, user requirements, system requirements, software requirements document; Requirement engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management; Classical analysis: Structured system analysis, petri nets, data dictionary.
MODULE III	**SOFTWARE DESIGN**
	Software Design: Design process: Design concepts, design model, design heuristic, architectural design, architectural styles, accessing alternative architectural designs, and architectural mapping using data flow. User interface design: Interface analysis, interface design; Component level design: Designing class based components, traditional components.
MODULE IV	**TESTING AND IMPLEMENTATION**
	Testing and Implementation : Software testing fundamentals: Internal and external views of testing, white box testing, basis path testing, control structure testing, black box testing, regression testing, unit testing, integration testing, validation testing, system testing and debugging; Software implementation techniques: Coding practices, refactoring.
MODULE V	**PROJECT MANAGEMENT**
	Project Management: Estimation: FP based, LOC based, make/buy decision; COCOMO II: Planning, project plan, planning process, RFP risk management, identification, projection; RMMM: Scheduling and tracking, relationship between people and effort, task set and network, scheduling; EVA: Process and project metrics.

TEXTBOOKS

1. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, McGraw-Hill International Edition, 7th Edition, 2010.

2. Ian Somerville, “Software Engineering”, Pearson Education Asia, 9th Edition, 2011.

REFERENCE BOOKS:

1. Rajib Mall, “Fundamentals of Software Engineering”, PHI Learning Private Limited, 3rd Edition, 2009.

2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 1st Edition, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students, Parents, Industry Personnel and Recruiters. OBE is all about feedback and outcomes. In this we will discuss about the course outcomes and program outcomes and their attainment		
CONTENT DELIVERY (THEORY)			
1-2	Introduction to Software Engineering	CO1	T2: 1.1-1.3
2-5	Software processes	CO2	T1: 2.2-2.3
6-9	Process models	CO4	T1: 2.1,2-3-2.6
11-12	Software Project Management	CO3	R2: 3.4-3.9
11-12	LOC and FP based estimation COCOMO model	CO5	R2: 4.1-4.3
12-13	Project Scheduling, EVA	CO5	T1: 27.1
14	Risk management	CO5	T1: 28.1
15-17	Software Requirements	CO4	T2: 4.1-4.3
18-19	Requirements Engineering process	CO6, 5	T1: 4.4-4.7
20-21	Classical Analysis	CO2	R1: 1.1-1.4
22-24	Design process	CO2	T1 8.1-8.4
25-28	Architectural design	CO3, CO1	T1:9.1, 9.3,9.4,9.6
29-33	User interface design	CO4	T1:11.3-11.4
34-37	Component level design	CO3	T1:10.2, 10.5
38-44	Software Testing fundamentals	CO2	T1:17.3,17.6-17.8
45-47	Software implementation techniques	CO1	T1:10.1-1.3
48-51	Project management	CO1	T1: 26.2, 26.6.4,
52-55	COCOMO II	CO1, 2	T1:26.1-26.3 28.1- 28.7
56-59	Project Scheduling	CO3, 4	T1:27.1-27.6
60-62	Project Metrics	CO2	T1:25.1-25.6
CASE STUDIES			

1	Develop a set of actions for the communication activity. Select one action and define a task set for it.	CO 6	T1:11.2.1
2	Developing software in which quality is “good enough”	CO 6	T1:11.2.2
3	Explain why systems developed as prototypes should not normally be used as production systems.	CO 6	T1:11.2.18
4	Software myth	CO 6	T1:11.2.25
5	layered technology of software engineering.	CO 6	T1:11.4.1
6	Software myth.	CO 6	T1:11.4.2
7	Evolutionary process models	CO 6	R2:7.5
8	Spiral model	CO 6	R2:7.5
4	concurrent development model (or) concurrent engineering model.	CO 6	R2:7.5
10	layers of software engineering.	CO 6	R2:7.5
11	COCOMO model.	CO 6	T1:11.4.1
12	component level design and deployment level design elements.	CO 6	T1:11.4.2
13	software architecture	CO 6	T1:11.5.1
14	system representation in architectural context	CO 6	T1:11.5.2
15	Coupling and Cohesion in designing class based components. s	CO 6	T2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definations of Software Process and Poject Management	CO 1	R1:2.1-2.11
2	Definations of Requirement Analysis and Specification	CO 2, 3	R1:4.2-4.11
3	Definations of Software Design	CO 4	R2:5.6-5.9
4	Definations of Testing and Implementation	CO 5	R4:8.1-8.9
5	Definations of Project Management	CO 6	R2:12.1-12.16
DISCUSSION OF QUESTION BANK			
1	Software Process and Poject Management	CO 1,	R1:2.1-2.11
2	Requirement Analysis and Specification	CO 2, 3	R1:4.2-4.11
3	Software Design	CO 4	R2:5.6-5.9
4	Testing and Implementation	CO 5	R4:8.1-8.9
5	Project Management	CO 6	R2:12.1-12.16

Signature of Course Coordinator **HOD,CSE**
Ms .B Shashirekha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**					
Course Title	**THEORY OF COMPUTATION**					
Course Code	AIT002					
Program	B.Tech					
Semester	IV					
Course Type	Core					
Regulation	R-16					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	-	3	-	-	
Course Coordinator	Dr. K Srinivasa Reddy, Professor					

I COURSE PRE-REQUISITES:

UG	AHSC010	II	Probability and Statistics.
UG	ACS002	II	Data Structures
UG	AHS013	III	Discrete Mathematical Structures

II COURSE OVERVIEW:

This course focuses on infinite languages in finite ways, and classifies machines by their power to recognize. It includes finite automata, regular grammar, push down automata, context free grammars, and Turing machines It is applicable in designing phrasing and lexical analysis of a compiler, genetic programming and recursively enumerable languages

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
THEORY OF COMPUTATION	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
60 %	Understand
20%	Apply
10%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

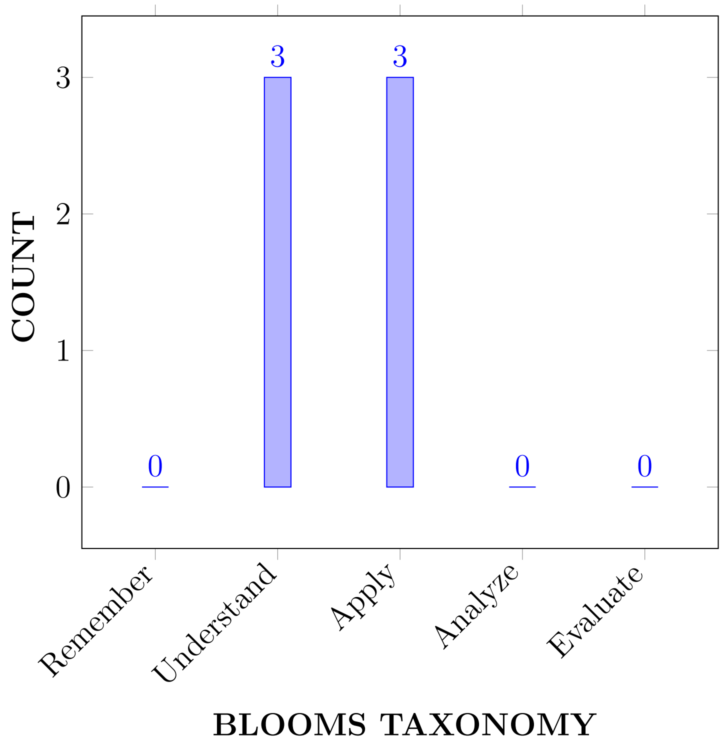
I	The fundamental knowledge of automata theory which is used to solve computational problems
II	The reorganization of context free language for processing infinite information using push down automata.
III	The computer based algorithms with the help of an abstract machine to solve recursively Enumerable problems

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Make use of** deterministic finite automata and non deterministic finite automata for modeling lexical analysis and text editors.	Apply
CO 2	**Extend** regular expressions and regular grammars for parsing and designing programming languages.	Understand
CO 3	**Illusrate** the pumping lemma on regular and context free languages for perform negative test .	Understand
CO 4	**Demonstarte** context free grammars, normal forms for generating patterns of strings and minimize the ambiguity in parsing the given strings.	Understand
CO 5	**Construct** push down automata for context free languages for developing parsing phase of a compiler.	Apply
CO 6	**Apply** Turing machines and Linear bounded automata for recognizing the languages,complex problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations

Program Outcomes	
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2.5	AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2.5	SEE / AAT

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2.3	Group discussion/ Short term courses
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	2.0	Research papers/ Industry exposure

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	✓
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓
CO 6	✓	✓	✓	✓		-	-	-	-	-	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Solve the lexical analysis and text editor's using deterministic finite automata and non- deterministic finite automata using the principles of mathematical principles and scientific principles.	2
	PSO 3	Demonstrate the basic text editors in real world software, using industry standard tools and collaboration techniques in the field of computational programming.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 1	Understand the basics of regular expressions and regular grammars, its types and properties for applying mathematical principles and scientific principles.	2
	PSO 1	Make use of the concept of regular expressions and regular grammars for developing algorithms of machine learning and networking concepts.	3
CO 3	PO 1	Find an optimized solution for the given problem using pumping lemma by applying the knowledge of mathematical principles and computer engineering methodologies.	2
	PO 2	Understand the given problem and develop the solution using pumping lemma from the provided information and interpret of results for validation.	5
	PO 3	Explain and demonstrate the pumping lemma, by investigate and define a problem and identify constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes.	5
CO 4	PO 1	Describe the role of Ambiguity in construction of context free grammars by understanding mathematical principles and scientific principles.	2
	PO 2	Understand the given problem and analyze the grammar and eliminate ambiguity using derivation trees by model,design,document the results for interpretation.	6
	PSO 1	Understand the normalization techniques in the area related to parsing desire for higher studies in field of compiler design, machine Learning and data science.	3
CO 5	PO 1	Describe acceptance of context free language by final state and by empty stack problems by understanding mathematical principles, engineering methodologies and scientific principles.	3
	PO 2	Understand equivalence of context free language and pushdown automata for validation , model, design of inter conversion for solving the given problem related to engineering from the provided information , data and documentation.	6
	PSO 3	Understand the principle of languages , grammars for computational programming to achieve engineering objectives.	1
CO 6	PO 1	Describe the recursively enumerable languages and churchs hypothesis using mathematical principles and scientific principles.	3
	PO 2	Understand the given problem statement and formulate the (complex) engineering problems in the Design and Model of Turing machine in reaching substantiated conclusions by the interpretation of results.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Make Use of Turing machines to develop programs (define problem)for identify the solution (innovative) of complex engineering problems which satisfy the user constraints.	6
	PO 4	Ability to identify ,classify and describe the performance of turing machine by using analytical methods and modeling techniques.	4
	PSO 1	Analyze computable functions in the areas related to simulation of Turing machine, software testing, high performance computing, machine learning, software engineering and computer networks	6

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-		-	-	1
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	2	5	5	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	6	-	-		-	-	-	-	-	-	-	3	-	-
CO 5	3	6	-	-	-	-	-	-	-	-	-	-	-	-	1
CO 6	3	5	6	5	-	-	-	-	-	-	-		6	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO / PSO:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	-	-	-	-	-	-	-	-	-	-		-	-	50.0
CO 2	66.7	-	-	-	-	-	-	-	-	-	-	-	50.0	-	-
CO 3	66.7	50.0	50.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	60.0	-	-		-	-	-	-	-	-	-	50.0	-	-
CO 5	100.0	60.0	-	-	-	-	-	-	-	-	-	-	-	-	50.0
CO 6	100.0	50.0	60.0	55.0		-	-	-	-	-	-		100.0	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - 40 % $< C < 60\%$ –Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO 6	3	2	3	2	-	-	-	-	-	-	-	-	3	-	-
TOTAL	18	10	5	2	-	-	-	-	-	-	-	-	7	-	4
AVERAGE	3.0	2.5	2.5	2.0	-	-	-	-	-	-	-	-	2.3	0	2.0

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

UNIT I	**FINITE AUTOMATA**
	Fundamentals: Alphabet, strings, language, operations; Introduction to finite automata: The central concepts of automata theory, deterministic finite automata, nondeterministic finite automata, an application of finite automata, finite automata with and without epsilon transitions, Conversion of NFA to DFA Machines.
UNIT II	**REGULAR LANGUAGES**
	Regular sets, regular expressions, identity rules, constructing finite automata for a given regular expressions, conversion of finite automata to regular expressions, pumping lemma of regular sets, closure properties of regular sets (proofs not required), regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and finite automata, inter conversion.
UNIT III	**CONTEXT FREE GRAMMARS**
	Context free grammars and languages: Context free grammar, derivation trees, sentential forms, right most and leftmost derivation of strings, applications. Ambiguity in context free grammars, minimization of context free grammars, Chomsky normal form, Greibach normal form, pumping lemma for context free languages, enumeration of properties of context free language (proofs omitted)
UNIT IV	**PUSHDOWN AUTOMATA**

	Pushdown automata, definition, model, acceptance of context free language, acceptance by final state and acceptance by empty stack and its equivalence, equivalence of context free language and pushdown automata, inter conversion;(Proofs not required); Introduction to deterministic context free languages and deterministic pushdown automata.
UNIT V	**TURING MACHINE**
	Turing machine: Turing machine, definition, model, design of Turing machine, computable functions, recursivey enumerable languages, Church's hypothesis, counter machine, types of Turing machines (proofs not required), linear bounded automata and context sensitive language, Chomsky hierarchy of languages.

TEXT BOOKS

1. John E. Hopcroft , Rajeev Motwani, Jeffrey D. Ullman, —Introduction to Automata, Theory, Languages and Computation, Pearson Education, 3rd Edition, 2007.

REFERENCE BOOKS:

1. John C Martin, —Introduction to Languages and Automata Theory, Tata McGraw Hill, 3rd Edition, 2017
2. Daniel I.A. Cohen, Introduction to Computer Theory, John Wiley Sons, 2nd Edition, 2004.

COURSE WEB PAGE:

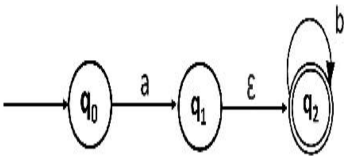
https://nptel.ac.in/courses/106103070

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
	OBE DISCUSSION		
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
	CONTENT DELIVERY (THEORY)		
1	Alphabet, strings, language and operations	CO1	T1:1.5-1.6
2	finite automata and concepts of automata theory	CO1	T1:2.1-2.2, R2:38-64
3	Demonstrate the behavior of deterministic finite automata	CO 1	T1:2.2-2.3
4-6	Understand the functionality of non-deterministic finite automata and Finite automata with epsilon transitions.	CO 1	T1:2.3-2.4, R1:3.1-3.3, R2:142-148
7	application of finite automata,Conversion of NFA to DFA, Moore and Melay Machines.	CO 1	T1:2.3-2.4, R1:3.1-3.3, R2:142-148

8-10	understand the Regular sets, regular expressions, identity rules	CO 2	T1: 3.1-3.2
11-13	finite automata for a given regular expressions, finite automata to regular expressions	CO 2	T1: 3.1-3.2
14-15	find the pumping lemma of regular sets, regular grammars, right linear and left linear grammars	CO 3	T1: 4.1-4.2
16-19	Regular grammars-right linear and left linear grammars	CO 4	T1: 4.4-4.5
20-22	regular linear grammar and finite automata, inter conversion.	CO 2	T1: 4.4-4.5
23-24	Apply Context free grammar on derivation trees	CO 4	T1: 5.1-5.5, R1:4.2-4.4
25-27	sentential forms, right most and leftmost derivation of strings	CO 4	T1: 5.1-5.5, R1:4.2-4.4
28-29	Ambiguity in context free grammars	CO 4	T1: 5.1-5.5, R1:4.2-4.4
30-32	Understand Minimization of context free grammars, Chomsky normal form, Greibach normal form	CO 4	T1: 7.4-7.5, R1:6.1-6.2
33-34	Pumping lemma for context free languages, properties	CO 3	T1: 7.4-7.5, R1:6.1-6.2
35-37	Apply the push down automata for acceptance of context free Languages	CO 5	T1: 6.1-6.2, R1:5.2-5.4
38-41	push down automata for given context free languages	CO 5	T1: 6.1-6.2, R1:5.2-5.4
42-43	acceptance by empty stack and its Equivalence.	CO 5	T1: 6.1-6.2, R1:5.2-5.4
44-45	Describe Equivalence of context free language and pushdown automata	CO 5	T1: 6.3-6.4
46-47	inter conversion, deterministic push down automata.	CO 5	T1: 6.3-6.4
48-53	Describe Turing machine, definition, model, computable functions	CO 6	T1: 8.1-8.2, R1:7.2-7.4
54-56	Apply Recursively enumerable languages	CO 6	T1: 8.2-8.6, R1:7.5-7.6
57-58	Types of Turing machines and Church's hypothesis.	CO 6	T1: 8.2-8.6, R1:7.5-7.6
59-60	Linear bounded automata and context sensitive language.	CO 6	T1:9.1-9.8, R2:551-560
61-62	Chomsky hierarchy of languages.	CO 6	T1:9.1-9.8, R2:551-560
PROBLEM SOLVING/ CASE STUDIES			
1	Describe a DFA for the following language L={w/|w | mod5=0,w belongs to (a,b)*} L={w/|w | mod5=1,w belongs to (a,b)*}	CO 1	T1:2.3-2.4, R1:3.1-3.3

2	Convert NFA with ϵ to equivalent NFA M=({q0,q1,q2},{0,1,2}, δ, q0, {q2}) where δ is given by [δ (q0,0)={q0}, δ (q0,1)=ϕ, δ (q0,2)=ϕ, δ(q0, ϵ)=q1] [δ (q1,0)=ϕ, δ (q1,1)=q1 , δ (q1,2)=ϕ ,δ (q1, ϵ)=q2] [δ (q2,0)=ϕ, δ (q2,1)= ϕ , δ (q2,2)= {q2},δ (q2, ϵ)= ϕ]	CO1	T1:2.3-2.4, R1:3.1-3.3
3	Convert NFA with ϵ to equivalent DFA 	CO 1	T1:2.3-2.4, R1:3.1-3.3
4	Describe Pumping Lemma for Regular Languages. Prove that the language L = {a^n/ n is a n^5} is not regular	CO 3	T1: 7.4-7.5, R1:6.1-6.2
5	Convert the following automata into Regular expression M=({q1,q2,q3},{0,1}, δ, q1, {q2,q3}) where δ is given by [δ (q1,0)={q2}, δ (q1,1)={q3}] [δ (q2,0)={q1}, δ (q2,1)={q3}] [δ (q3,0)={q2}, δ (q3,1)= {q2}]	CO 2	T1: 3.1-3.2
6	Describe the DFA Transition diagram for equivalent Regular expression (ab+a) *(aa+b)	CO 1	T1:3.1-3.2
7	Convert the following grammar into GNF S→ABA/AB/BA/AA/B A→aA/a, B→bB/b	CO 4	T1: 7.4-7.5, R1:6.1-6.2
8	Describe the context free grammars in the four tuple form.(V,T,P,S) for the given languages on $\sum$={a,b} i. All strings having at least two a's ii. All possible strings not containing triple b's	CO 4	T1: 7.4-7.5, R1:6.1-6.2
9	Describe the steps to show the following is not CFG. { $a^m b^n c^p$ | m< n or n< p}	CO 4	T1: 7.4-7.5, R1:6.1-6.2
10	Construct PDA for equal number of x's and y's. eg: xyyxxy	CO 5	T1: 6.1-6.2, R1:5.2-5.4
11	Construct NDPDA for L = { W$\neq$ W^R /W$\in$ $(X+Y)^*$}	CO 5	T1: 6.1-6.2, R1:5.2-5.4
12	Construct DPDA for L = { W$\neq$ W^R /W$\in$ $(X+Y)^*$}	CO 5	T1: 6.1-6.2, R1:5.2-5.4
13	Construct a Turing Machine that accepts the language L = { $a^{2n}b^n$ |n$\geq$0}.Give the transition diagram for the Turing Machine obtained.	CO 6	T1: 8.2-8.6, R1:7.5-7.6

14	Construct a Turing Machine to accept the following languages L = $\{w^n x^n y^n z^n \mid n \geq 1\}$	CO 6	T1:8.2-8.6, R1:7.5-7.6
15	Design a Turing Machine that accepts the language denoted by regular expression (000)*	CO 6	T1:8.2-8.6, R1:7.5-7.6
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Alphabet, strings, language and operations	CO 1	T1:1.5-1.6
2	understand the Regular sets, regular expressions, identity rules	CO 2	T1:3.1-3.2
3	Understand Minimization of context free grammars, Chomsky normal form, Greibach normal form	CO 4	T1:7.4-7.5, R1:6.1-6.2
4	push down automata for given context free languages	CO 5	T1:6.1-6.2, R1:5.2-5.4
5	Types of Turing machines and Church's hypothesis.	CO 6	T1:8.2-8.6, R1:7.5-7.6
DISCUSSION ON QUESTION BANK			
1	Describe the DFA with the set of strings having "aaa as a substring over an alphabet $\sum = \{a,b\}$.	CO 1	T1:1.5-1.6
2	Convert Regular Expression (11+0)*(00+1)* to Finite Automata.	CO 2	T1:3.1-3.2
3	Describe a CFG for the languages L=$\{a^i b^j \mid i \leq 2j\}$	CO 4	T1:7.4-7.5, R1:6.1-6.2
4	Define the NPDA(Nondeterministic PDA) and DPDA(deterministic PDA) equivalent? Illustrate with an example.	CO 5	T1:6.1-6.2, R1:5.2-5.4
5	Describe a Turing Machine. With a neat diagram explain the working of a Turing Machine.	CO 6	T1: 8.2-8.6, R1:7.5-7.6

Signature of Course Coordinator **HOD,IT**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY
COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**				
Course Title	**COMPUTER NETWORKS**				
Course Code	AIT003				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. S Vinod Kumar , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB07	III	Computer Organization and Architecture

II COURSE OVERVIEW:

The main emphasis of this course is on the organization and management of local area networks (LANs) wide area networks (WANs). The course includes learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks. Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, and web and email protocols. The applications of this course are to design, implement and maintain a basic computer networks.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Networks	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
50 %	Understand
30 %	Analyze
20 %	Evaluate

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

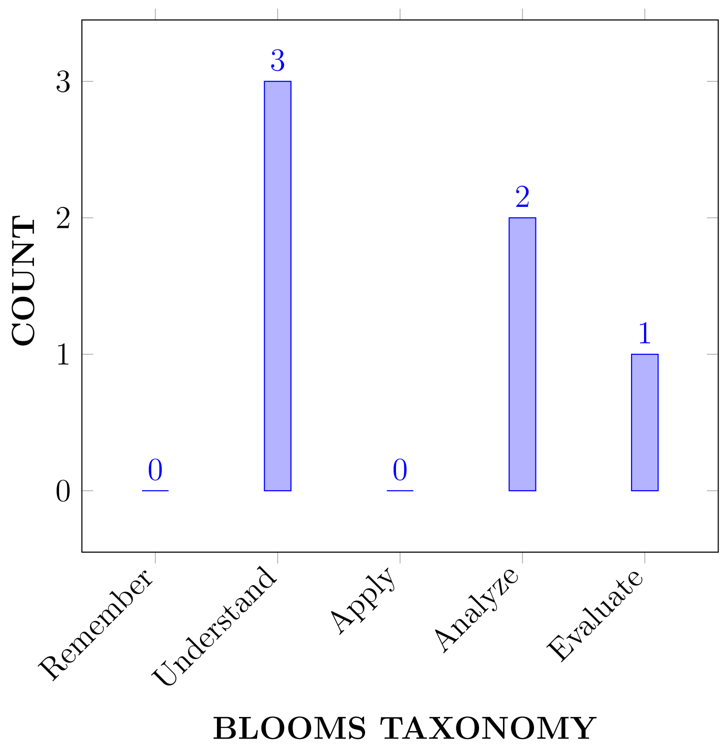
I	How computer network hardware and software operate
II	Investigate the fundamental issues driving network design
III	The data transmission through protocols across the network in wired and wireless using routing algorithms.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Describe** the functions of each layer in OSI and TCP/IP model use to communicate over a network.	Understand
CO 2	**Make use of** all various Techniques of Data-link layer for implementation of point-to-point flow and error control mechanism.	Understand
CO 3	**Identify** the various network layer techniques for designing subnets and supernets and analyse packet flow on basis of routing algorithms.	Understand
CO 4	**Discuss** Internetworking principles and Internet protocols (IP, IPv6 and OSPF) for connecting computers to form a computer network	Analyze
CO 5	**Make** use of common transport layer metrics used to measure network performanceinclude latency, bandwidth, and throughput	Analyze
CO 6	**Select** client-server programming model and various application layer protocols (HTTP, SMTP, FTP and DNS) (OSI, TCP/IP) in terms of design parameters and communication modes.for communicate with servers and other applications.	Evaluate

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/Quiz/AAT
PO 10	**Communication:** Communicate effectively on complex Engineering activities with the Engineering .community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions..	2	Discussion on Innovations / Presentation
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Short term courses

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2	Research papers / Group discussion / Short term courses

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	1	Research papers / Industry exposure

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	✓	-	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	-	✓	✓	-	-	-	-	-	✓	-		✓	-	✓
CO 5	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-	✓
CO 6	✓	-	✓	-	-	-	-	-	-	-	-		-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand the importance of network types, suitable transmission medium, devices and the Internet in supporting business communications and everyday activities by understanding **fundamentals of Computer engineering specialization** and **scientific principles.**	1
CO 2	PO 1	Understand the importance of network types, suitable transmission medium, devices and the Internet in supporting business communications and everyday activities by understanding **fundamentals of Computer engineering specialization** and **scientific principles.**	2
	PO 2	Understand the **problem** statement and **choose appropriate techniques** by **analyzing** the importance of data hiding **interpretation of results.**	4
	PO 10	Recognize the importance of error detection and correction techniques for optimizing the efficiency of the networks by **communicating effectively** with **engineering community.**	2
	PO 12	Build strong foundation of the performance of a single link, logical process-to-process (end-to-end) channel, and a network as a whole (latency, bandwidth, and throughput) for career **building** by **communicating effectively** with **engineering community.**	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 1	Explain the concept of Hamming distance, and the significance of the minimum Hamming Distance and its relationship to errors by **understanding mathematical principles** and **scientific principles.**	3
	PO 2	Understand the **problem** statement and **choose appropriate techniques** by **analyzing**the importance of data hiding **interpretation of results.**	4
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3
	PO 10	Recognize the importance of error detection and correction techniques for optimizing the efficiency of the networks by **communicating effectively** with **engineering community.**	2
	PSO 1	Design **next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers,** and **knowledge discovery tools.**	6
CO 4	PO 1	Describe the relationship between data and signals, their types, behavior, properties, characterization and transmission through the physical layer by **understanding mathematical principles** and **scientific principles.**	2
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3
	PO 4	Evaluate the performance of a single link, logical process-to-process (end-to-end) channel, a and **a network as a whole (latency, bandwidth, and throughput).**	2
	PO 10	Recognize the importance of error detection and correction techniques for optimizing the efficiency of the networks by **communicating effectively with engineering community.**	2
	PSO 1	Design **next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers,** and **knowledge discovery tools.**	6
	PSO 3	Practical experience in **shipping real world software,using industry standard tools** and **collaboration techniques** will equip to secure and succeed in first job upon graduation in IT industry.	3
CO 5	PO 1	Understand the basic design problems of data communications including the checksum, flow control, error control, reliability by apply the **knowledge of computer engineering fundamentals and mathematical principles.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Understand the **problem** statement and **choose appropriate techniques by analyzing**analyzing the importance of data hiding **interpretation of results.**	3
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3
	PO 12	Build strong foundation of the performance of a single link, logical process-to-process (end-to-end) channel, and a network as a whole (latency, bandwidth, and throughput) for career **building by communicating effectively with engineering community.**	2
	PSO 1	Design **next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers,** and **knowledge discovery tools.**	6
	PSO 3	Practical experience in **shipping real world software,using industry standard tools** and **collaboration techniques** will equip to secure and succeed in first job upon graduation in IT industry.	3
CO 6	PO 1	Describe the reliable inter-node transmission of chunks and congestion control methods for reliable data transmission across the network by apply the**knowledge of computer engineering fundamentals and mathematical principles.**	2
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	4	-	-	-	-	-	-	-	2	-	4	-	-	-
CO 3	3	4	3	-	-	-	-	-	-	2	-	-	6	-	-
CO 4	2	-	3	2	-	-	-	-	-	2	-	-	6	-	3
CO 5	2	3	3	-	-	-	-	-	-	-	-	2	6	-	3
CO 6	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	-	-	-	-	-	-	-		-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 2	66.7	40	-	-	-	-	-	-	-	40	-	33.3	-	-	-
CO 3	100	40	30	-	-	-	-	-	-	40	-	-	100	-	-
CO 4	66.7	-	30	18	-	-	-	-	-	40	-	-	100	100	-
CO 5	66.7	30	30	-	-	-	-	-	-	-	-	17	100	100	-
CO 6	66.7	30	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq$ C$\leq 5\%$ – No correlation

1 -5 <C$\leq 40\%$ – Low/ Slight

2 - 40 % <C < 60% –Moderate

3 - $60\% \leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	2	-	1	-	-	-
CO 3	3	2	1	-	-	-	-	-	-	1	-	-	3	-	-
CO 4	3	-	1	1	-	-	-	-	-	1	-	-	3	3	-
CO 5	3	1	1	-	-	-	-	-	-	-	-	1	3	-	3
CO 6	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	15	5	4	1	-	-	-	-	-	4	-	2	9	3	3
AVERAGE	2.5	1.6	1.3	1.0	-	-	-	-	-	1.3	-	1.0	3.0	1.0	1.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1,PO 2, PO 3, PO 10, PO 12	SEE Exams	PO 1,PO 2, PO 3, PO 10, PO 12	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO8	Open Ended Experiments	PO10
Assignments	PO 1				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

X	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO PHYSICAL LAYER**
	Introduction: Networks, network types, internet history, standards and administration; Network models: Protocol layering, TCP/IP protocol suite, the OSI model; Introduction to physical layer: Data and signals, transmission impairment, data rate limits, performance; Transmission media: Introduction, guided media, unguided media; Switching: Introduction, circuit switched networks, packet switching.
MODULE II	**INTRODUCTION TO DATA LINK LAYER**
	Introduction: Link layer addressing, error detection and correction: Cyclic codes, checksum, forward error correction: Data link control: DLC services, data link layer protocols, HDLC, point to point protocol, media access control: Random access, controlled access, channelization, connecting devices and virtual LAN: Connecting devices, virtual LAN.
MODULE III	**THE NETWORK LAYER**
	Network layer design issues, routing algorithms, congestion control algorithms, quality of service, and internetworking. The network layer in the internet: IPv4 addresses, IPv6, internet control protocols, OSPF (Open Shortest Path First), BGP (Border Gateway Protocol), IP, (Internet Protocol), ICMP (internet control message protocol.
MODULE IV	**TRANSPORT LAYER**
	The transport service, elements of transport protocols, congestion control; The internet transport protocols: UDP (User Datagram Protocol), TCP (Transport Control Protocol), performance problems in computer networks, network performance measurement.
MODULE V	**APPLICATION LAYER**
	Introduction, client server programming, WWW (World Wide Web) and HTTP (Hyper Text Transfer Protocol), FTP (File Transfer Protocol), E-mail, telnet, DNS (Domain Naming System), SNMP (Simple Network Management Protocol).

TEXTBOOKS

1. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill, 5th Edition, 2012.
2. Andrew S. Tanenbaum, David.j.Wetherall, ”Computer Networks”, Prentice-Hall, 5th Edition, 2010.

REFERENCE BOOKS:

1. Douglas E. Comer, “Internetworking with TCP/IP”, Prentice-Hall, 5th Edition, 2011
2. Peterson, Davie, Elsevier, “Computer Networks”, 5th Edition,2011
3. Comer, “Computer Networks and Internets with Internet Applications”, 4th Edition, 2004.
4. Chwan-Hwa Wu, Irwin, “Introduction to Computer Networks and Cyber Security”, CRC publications, 2014.

WEB REFERENCES:

1. https://www.geeksforgeeks.org/computer-network-tutorials/

2. http://computer.howstuffworks.com/computer-networking-channel.htm
3. http://www.ietf.org
4. http://www.rfc-editor.org/

COURSE WEB PAGE:

1. https://www.mooc-list.com/course/networking-introduction-computer-networking-stanford-university
2. https://lagunita.stanford.edu/courses/Engineering/Networking/Winter2014/about.
3. https://technet.microsoft.com/en-us/network/default.aspx

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
1	Introduction: Networks, network types	CO1	T1: 1.1
2	Internet history	CO1	T1:1.2
3	Standards and administration	CO1	T1: 1.3
4	Network models: Protocol layering	CO1	T1:1.4
5	TCP/IP protocol suite	CO1	T1: 1.5
6	The OSI model Transmission media: guided media, unguided media	CO1	T1:7.1
7	Switching	CO1	T1: 2.14
8	Circuit switched networks	CO1	T1: 8.1
9	Packet switching	CO1	T1: 8.2
10	Link layer addressing	CO2	T1: 10.0
11	Error detection and correction	CO2	T1: 10.1
12	Cyclic codes	CO2	T1: 10.1
13	Checksum	CO2	T1: 10.2
14	Forward error correction	CO2	T1: 10.2
15	Data link control: DLC services	CO2	T1: 11.1
16	Data link layer protocols	CO2	T1: 11.2
17	Media access control: Random access	CO2	T1: 11.3
18	Virtual LAN	CO2	T1:15.3
19	Network layer design issues	CO3	T1:19.1
20	Routing algorithms	CO3	T1: T1:19.1

21	Congestion control algorithms	CO3	T1:19.1
22	Quality of service and Internetworking	CO3	T1:19.1
23	The network layer in the internet: IPv4 addresses	CO3	T1:19.1
24	IPv6, internet control protocols	CO3	T1:19.2
25	OSPF (Open Shortest Path First)	CO3	T1:19.2
26	IP (Internet Protocol)	CO4	T1:19.1
27	The transport service	CO4	T1:23.0
28	Elements of transport protocols	CO4	T1:23.1
29	Congestion control	CO4	T1:23.1
30	The internet transport protocols: UDP (User Datagram Protocol)	CO4	T1:23.2
31	TCP (Transport Control Protocol)	CO4	T1:23.3
32	Performance problems in computer networks	CO4	T1:23.3
33	Network performance measurement	CO4	T1:23.3
34	Client server programming	CO5	T1:25.1
35	WWW (World Wide Web)	CO5	T1:25.2
36	HTTP (Hyper Text Transfer Protocol)	CO5	T1:25.3
37	FTP (File Transfer Protocol)	CO5	T1:25.4
38	E-mail, telnet	CO5	T1:25.5
39	DNS (Domain Naming System)	CO5	T1:25.6
40	SNMP (Simple Network Management Protocol)	CO5	T1:25.7
PROBLEM SOLVING/ CASE STUDIES			
41	With a network with bandwidth of 10 Mbps can pass only an average of 12,000 frames per minute with each frame carrying an average of 10,000 bits. What is the throughput of this network?	CO 1	T2:18.3.4, 18.3, 4.17
42	Demonstrate the Laplace transform of the message delay in FDMA in which every message contains a random number of packets. Compare the expected message delay with that of TDMA	CO 2	T2:24.2,28.4
43	Why are we running out of IPv4 addresses? How does IPv6 solve this problem?	CO 3	T1: 276-296
44	Discuss in detail about the connection establishment and release in TCP.	CO 4	T2:24.3.6, 24.3.9
45	Discuss about application layer and client server programming	CO 5	T2:25.1, 25.1.2
46	Interpret the following sequences of characters (In Hexadecimals) received by a TELNET client or server. a. FFFB01 c. FFF4 FFFE01 d. FFF9	CO 5	T2:26.1.2, 26.2, 26.3, 26.4,26.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Discuss in detail about Introduction to Physical Layer	CO 1	T2:2.1
2	Understand the concept of introduction to Data Link Layer	CO 2	T2:2.3
3	Demonstrate the concept of the network layer	CO 3	T2:2.3.1
4	Discuss in details about the transport layer	CO 4	T2:7.2,7.3
5	Demonstrate the introduction to the Application Layer	CO 5	T2:10.3.1

DISCUSSION OF QUESTION BANK			
1	Illustrate the differences between the OSI and TCP/IP Reference Models.	CO 1	T2:2.1
2	Recognize knowledge on previous versions of internet	CO 2	T2:2.3
3	Understands on the various standards and administrations	CO 3	T2:2.3.1
4	Discuss on networks models and understand layering scenarios and protocols	CO 4	T2:7.2,7.3
5	Demonstrate on TCP/IP models	CO 5	T2:10.3.1
6	Demonstrate on Guided and Unguided medium.	CO 5	T2:13.3.2, 13.4.1

Signature of Course Coordinator **HOD,IT**
Mr. S Vinod Kumar , Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY
COURSE DESCRIPTION

Course Title	**OPERATING SYSTEMS LABORATORY**				
Course Code	ACS106				
Program	B.Tech				
Semester	IV	IT			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	3	2
Course Coordinator	DR. I Surya Prabha, Assistant Professor				

I COURSE OVERVIEW:

This course provides a comprehensive introduction to operating system design concepts, data structures and algorithms. The course is designed to provide in-depth critique on the problems of resource management and scheduling, concurrency and synchronization, memory management, file management, peripheral management, protection and security. This course is intended to discuss the topics in a general setting not tied to any one particular operating system. Throughout the course, the study of practical aspects that pertain to the most popular operating systems such as Unix/Linux and Windows are considered as case studies.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS002	II	Data Structures
B.Tech	ACS004	III	Computer Organization and Architecture

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Operating Systems Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

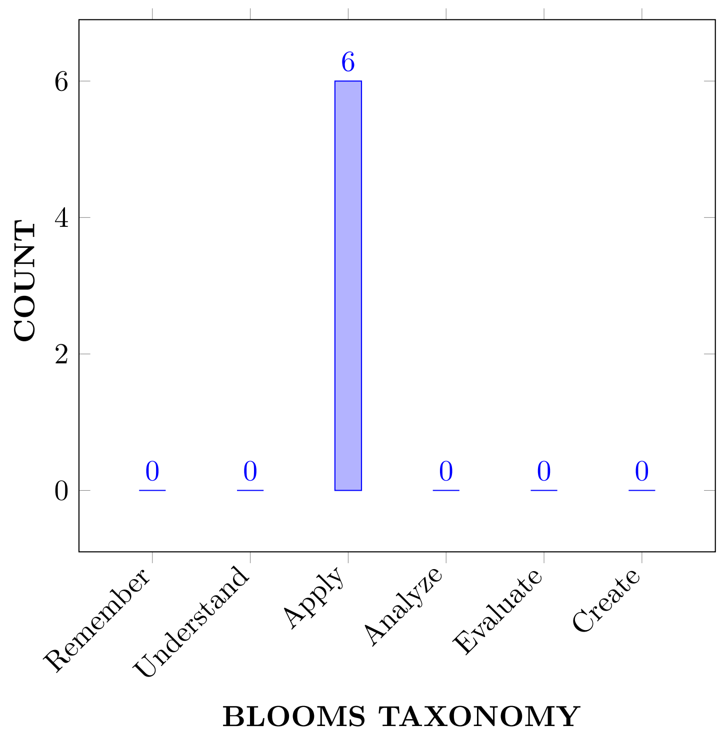
I	The principles of operating systems, services and functionalities with its evolution.
II	The structures, functions and components of modern operating systems
III	The conventional hardware at different OS abstraction levels.
IV	The essential skills to examine issues and methods employed in design of operating systems with identification of various functionalities.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Make use of** pre-emptive and non-pre-emptive scheduling strategies for calculating system performance.	Apply
CO 2	**Choose** page replacement algorithm for effective utilization of main memory.	Apply
CO 3	**Utilize** file allocation strategy for efficient mass storage devices management.	Apply
CO 4	**Develop** deadlock handling procedures for improving process management.	Apply
CO 5	**Build** various memory management techniques for better usage of memory.	Apply
CO 6	**Make use of** various file organization techniques for proper organization of directory structures.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems..	3	Lab Exercises,CIE,SEE
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab Exercises,CIE,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	2	Lab Exercises,CIE,SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Lab Exercises,CIE,SEE
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1	Lab Exercises,CIE,SEE
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2	Lab Exercises,CIE,SEE
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2	Lab Exercises,CIE,SEE
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Lab Exercises,CIE,SEE
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Lab Exercises,CIE,SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	Lab Exercises
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	3	Lab Exercises
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply scientific principles and methodologies, other engineering disciplines for scheduling in uniand multi-processor systems.	3
	PO 4	Use research-based knowledge and research methods including design of scheduling experiments.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development to run scheduling algorithms of both pre-emptive and non -preemptive.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different tasks by pre-emptive scheduling.	2
	PO 8	Apply professional ethics and responsibilities and norms for performing different tasks by proper scheduling mechanisms.	2
	PO 10	Demonstrate the ability for communicating effectively in writing, speaking style subject matter in process scheduling.	3
	PO 12	Keeping current in CSE and advanced engineering concepts of process scheduling in multi-processor environment.	5
	PSO 1	Understand, design and analyze computer programs in the areas related to virtualization in cloud computing environment.	2
CO 2	PO 1	Apply scientific principles and methodologies, other engineering disciplines to perform page replacement.	5

	PO 2	Use creativity to establish innovative solution to develop various page replacement algorithms.	6
	PO 4	Understanding of appropriate codes of practice solution to develop various page replacement strategies.	4
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on techniques of efficient memory utilization.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different page replacement techniques.	1
	PO 8	Apply professional ethics and responsibilities and norms by using page replacement techniques in an efficient manner.	1
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in page replacement techniques of memory management.	3
	PO 12	Keeping current in CSE and advanced engineering concepts ofpage replacement for proper memory utilization.	4
	PSO 1	Understand, design and analyze computer programs in the areas related to various memory management techniques.	4
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines by using efficient memory management techniques.	2
CO 3	PO 1	Apply scientific principles and methodologies, other engineering disciplines to construct simple applications on file allocation strategies.	3
	PO 2	Experimental design on usage of various file allocation strategies in mass storage devices.	1
	PO 4	Understanding of appropriate codes of practice solution to develop simple programs for proper storage structure in secondary storage devices.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on services by proper storage allocation.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable developmentefficient storage mechanisms for proper functioning of a system.	1
	PO 8	Apply professional ethics and responsibilities and norms for providing efficient mechanisms of file allocation.	1
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in file allocation strategies.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of proper storage mechanisms.	5
	PSO 1	Understand, design and analyze computer programs in the areas related to effective utilization of space in secondary storage devices.	4
CO 4	PO 1	Apply scientific principles and methodologies, other engineering disciplines for deadlock handling.	3

	PO 3	Use creativity to establish innovative solution to develop simple programs on deadlock avoidance mechanisms.	5
	PO 4	Understanding of appropriate codes of practice solution to develop simple deadlock handling mechanisms.	5
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development onproper handling of deadlocks.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different deadlock handling mechanisms.	1
	PO 8	Apply professional ethics and responsibilities and norms different services for proper handling of deadlocks.	1
	PO 9	Effective teamwork and process management services rendered will handle deadlocks.	1
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in four ways of handling deadlocks.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of deadlock prevention and handling.	5
	PSO 1	Understand, design and analyze computer programs in the areas related to deadlock handling.	4
CO 5	PO 1	Apply scientific principles and methodologies, other engineering disciplines to construct simple programs of various techniques of memory management.	3
	PO 2	Experimental design on usage of various techniques of memory management in multiprocessor environment .	6
	PO 3	Use creativity to establish innovative solution to develop simple applications on efficient memory management.	5
	PO 4	Understanding of appropriate codes of practice solution to develop simple programs for memory management.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on memory management techniques.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different memory management techniques.	1
	PO 8	Apply professional ethics and responsibilities and norms at the time of implementing memory management.	1
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in memory management techniques.	4

	PO 12	Keeping current in CSE and advanced engineering concepts of proper memory management.	5
	PSO 1	Understand, design and analyze computer programs in the areas related to programs for memory management.	4
CO 6	PO 1	Apply scientific principles and methodologies, other engineering disciplines to properly organize directory structures.	1
	PO 3	Use creativity to establish innovative solution to develop variousfile organization techniques.	5
	PO 4	Understanding of appropriate codes of practice to develop various file organization techniques.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development in various file organization techniques.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for various file organization techniques.	1
	PO 8	Apply professional ethics and responsibilities and norms for proper development of techniques for file organization.	1
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in various file organization techniques.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of various file organization techniques.	5
	PSO 1	Understand, design and analyze computer programs in the areas related to proper file organization.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines by applying various file organization techniques.	2
	PSO 3	Make use of modern computer tools for creating innovative paths, to be an entrepreneur in development of operating systems.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	1	2	2	-	3	-	2	2	-	-
CO 2	3	3	-	2	-	1	2	2	-	3	-	2	3	3	-
CO 3	3	1	-	1	-	1	2	2	-	3	-	2	3	-	-
CO 4	3	-	2	2	-	1	2	2	1	3	-	2	3	-	-
CO 5	3	3	2	1	-	1	2	2	-	3	-	2	3	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 6	2	-	2	1	-	1	2	2	-	3	-	2	2	3	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**CPU SCHEDULING ALGORITHMS**
	Write a program to simulate the FCFS and SJF non-preemptive CPU Scheduling algorithms to find turnaround time and waiting time.
WEEK II	**CPU SCHEDULING ALGORITHMS**
	Write a program to simulate the Round Robin and Proiorty CPU Scheduling algorithms to find turnaround timeand waiting time.
WEEK III	**PAGE REPLACEMENT ALGORITHMS**
	Write a program to simulate FIFO page replacement algorithm.
WEEK IV	**PAGE REPLACEMENT ALGORITHMS**
	Write a program to simulate LRU and LFU page replacement algorithms.
WEEK V	**FILE ALLOCATION STRATEGIES**
	Write a program to simulate the Sequential file allocation strategies
WEEK VI	**BANKER ALGORITHMS**
	Write a program to simulate Bankers algorithm for the purpose of deadlock avoidance.
WEEK VII	**BANKER ALGORITHMS**
	Write a program to simulate Bankers algorithm for the purpose of deadlock Prevention.
WEEK VIII	**MEMORY MANAGEMENT TECHNIQUES**
	Write a program to simulate the MVT memory management techniques.
WEEK IX	**MEMORY MANAGEMENT TECHNIQUES**
	Write a program to simulate the MFT memory management techniques
WEEK X	**FILE ORGANIZATION TECHNIQUES**

	Write a program to simulate the Single level directory file organization techniques.
WEEK XI	**FILE ORGANIZATION TECHNIQUES**
	Write a program to simulate the Two level directory file organization techniques
WEEK XII	**PAGING TECHNIQUES**
	Write a program to Simulate paging technique of memory management

REFERENCE BOOKS

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Principles", Wiley StudentEdition, 8th Edition, 2010.
2. Andrew S Tanenbaum, "Modern Operating Systems", PHI, 3rd Edition, 2007.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Simulate the FCFS and SJF	CO1	R1:1.2
2	Simulate the Round Robin and Proiorty	CO1	R2:2.4
3	simulate page replacement algorithms FIFO.	CO2	R2:2.5
4	Simulate page replacement algorithms LRU and LFU	CO2	R1:2.6
5	Simulate the Sequential file allocation strategies.	CO3	R2:22.7
6	Simulate Bankers algorithm for the purpose of deadlock avoidance	CO4	R2:5.3
7	Simulate Bankers algorithm for the purpose of deadlock prevention	CO4	R1:6.3
8	Simulate the MVT memory management techniques	CO5	R2:6.8
9	Simulate the MFT memory management techniques.	CO5	R2:13.1
10	Simulate the Single level directory file organization techniques.	CO6	R1:13.2
11	Simulate the Two level directory file organization techniques.	CO6	R2:13.7
12	Simulate paging technique of memory management	CO5	R1:10.2

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Interrupts, Exceptions, and System Calls.
2	Multicore Programming, Multithreading Models
3	Free Space Management, I/O Systems

Signature of Course Coordinator **HOD,IT**
DR. I Surya Prabha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**WEB TECHNOLOGIES**				
Course Code	ACS006				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	CH.Srividya, Assistant Professor				

I COURSE OVERVIEW:

This course emphasize on website development, build dynamic and database driven web applications. using tools. Content of this course covers an insight into HTTP communication protocol, the markup languages HTML, DHTML , XML and the CSS for formatting and transforming web content, interactive graphics and multimedia content on the web. It also enriches client-side and server side programming using servlets JSP, PHP and connects with Data bases . There is a growing need for management and decision makers to gain a clearer understanding of the application development process, from planning through to deployment and maintenance. It will also give you how you can analyze requirements, plan, design, implement and test arrange of web applications.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS001	I	Computer Programming
B.Tech	ACS003	III	Object Oriented Programming Through Java Laboratory

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Web Technologies	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20	Remember
40	Understand
25	Apply
15	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI COURSE OBJECTIVES:

The students will try to learn:

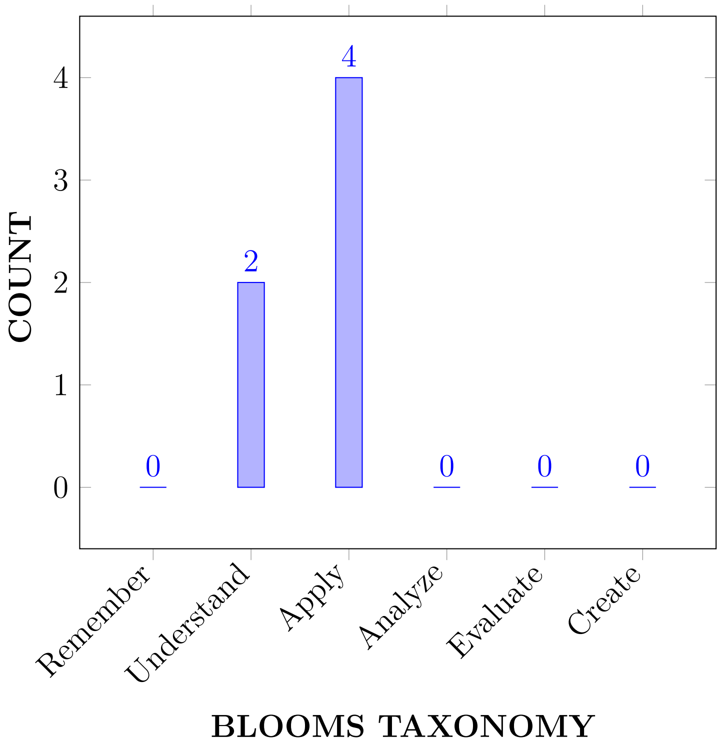
I	The fundamentals of designing static and dynamic web pages using HTML and DHTML for creation of websites..
II	The concepts of client - server programming with JavaScript, XML, Servlets, JSP and PHP..
III	The project-based experience needed for designing real time web based client-server applications..

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** basic elements of HTML and CSS for designing static web pages.	Understand
CO 2	**Develop** effective and interactive web pages using dynamic HTML with javascript and XML for client/server based applications.	Apply
CO 3	**Make use of** Servlets and Java Server Pages for server side programming with Model View Control architecture.	Apply
CO 4	**Summarize** basic concepts of PHP for designing static and dynamic web pages.	Understand
CO 5	**Build** dynamic web pages using XML and PHP with database connectivity to perform CRUD operations and validate using AJAX and Java Script.	Apply
CO 6	**Construct** website by using front end and backend end programming.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	CIE/Quiz/AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE/Quiz/AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	Assignments
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Professional Skills: Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2	CIA/SEE/AAT
PSO 2	Problem-Solving Skills: Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	2	CIA/SEE/AAT
PSO 3	Successful Career and Entrepreneurship: Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry. .	3	CIA/SEE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	-	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 3	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 4	✓	-	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 5	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 6	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Identify(knowledge) the structure of web page using HTML elements with their importance in webpage designing by applying basic principles of mathematics and engineering Fundamentals of programming.	2
	PO 3	Understand the customer needs of static and dynamic webpages and use creativity to provide innovative solutions in designing attractive webpages using various mark-up languages ,scripting languages by considering all aspects of the problem by managing the design process cost effectively and evaluate the outcomes to achieve engineering objectives to provide sustainable development.	5

	PO 5	Apply appropriate techniques, modern Engineering and IT tools to design a web page with HTML and CSS and use search tools such as browsers to produce the view of webpage.	1
	PO 10	Communicate effectively on complex Engineering activities with the Engineering community related to web development and with society at large, to design web pages and write effective Programming by using the elements of HTML and CSS.	2
	PO 12	Recognize the need for advanced concepts related to HTML and CSS for understanding and developingweb applications through continuing education efforts with ongoing learning – stays up with industry trends.	2
	PSO 1	Identify the Customer needs and problem specific constraints in designing web pages related to the basic concepts of HTML and CSS.	2
	PSO 3	Make use of modern computer tool in designing Web applications by applying the technical skills and Knowledge on advanced frameworks and platforms and desire for higher studies.	1
CO 2	PO 1	Apply the knowledge of client side and server-side scripting, mark-up languages to develop effective web pages by applying principles of mathematics and engineering fundamentals.	2
	PO 2	Understand the problem statement and formulate (complex)specific engineering problems related to the concepts of HTML, Javascript and XML by considering the information and data provided by the customer to provide sustained conclusions by using model translation and validate the implementation of webpage byinterpretation of results .	8
	PO 3	Design solution for effective webpage by considering the customer requirementsand use creativity and to ensure sustainable development in design processof web application toensure fitness of the problemby using HTML,Javascript,XML. .	5
	PO 5	Effective web pages are developed by using computer software related to web development with concepts related to Dynamic HTML ,XML and Java script for client/server based web applications.	1
	PO 10	Communicate effectively on complex Engineering activities related to web development with the customer to take the specific needs in designing client/server based web applications by using HTML ,XML and Java script concepts.	2

	PO 12	Recognize the need for advanced concepts in developing web applicationsand through continuing education efforts with ongoing learning – stays up with industry trends/ new technology related to the concepts of HTML,Javascript,XML.	2
	PSO 1	Understand the need and constraints related to programming concepts of dynamic HTML, Java Script and XML languages in designing web pages.	2
	PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2
CO 3	PO 1	Illustrate the use of servlets and JSP for server-side programming by applying principles of programming engineering fundamentals and mathematics.	2
	PO 2	Understand the given problem statement and formulate (complex)specific engineering problems related to Servlets ,and JSPs by appliying MVC architecture from the information and data collection.	2
	PO 3	Design solution for effective webpage by considering the customer requirementsand use creativity and to ensure sustainable development in design process of web application to ensure fitness of the problem by using servlets and jsp with MVC architecture.	5
	PO 5	Effective server side web pages are developed by using computer software related to web development with concepts related to Servlets and JSP,s by using MVC architecture.	1
	PO 10	Communicate effectively on complex Engineering activities related to web development with the customer to take the specific needs in designing web pages by using Servlets and JSP with MVC architecture	2
	PO 12	Recognize the need for advanced concepts in developing web applications and through continuing education efforts with ongoing learning –stays up with industry trends/ new technology related to the concepts of Servlets , JSP with MVC architecture.	2
	PSO 1	Understand the need and constraints related to programming concepts of servlets, and JSP in designing web pages.	2
	PSO 3	Make use of modern computer tool in designing Web applications it desire for higher studies andto be an entrepreneur .	2
CO 4	PO 1	Understand the basic concepts of PHP in designing webpages by applying the principles of programming Engineering fundamentals and mathematics.	2

	PO 3	Understand the customer needsin designing static and dynamic web pages to ensure fitness of the problem by managing all the aspects under design process and to provide sustainable development.	4
	PO 5	Effective web pages are developed by using computer software related to web development with concepts related to PHP for designing static and dynamic web pages.	1
	PO 10	Communicate effectively on complex Engineering activities related to web development with the customer to take the specific needs in designing static and dynamic web pages by using PHP .	2
	PO 12	Recognize the need for advanced concepts in developing web applications through continuing education efforts with ongoing learning – stays up with industry trends/ new technology related to the concepts of PHP.	2
	PSO 1	Understand the need and constraints related to programming concepts of PHP in designing web pages.	2
	PSO 3	Make use of modern computer tool in designing Web applications by applying the technical skills and Knowledge on advanced frameworks and platforms .	1
CO 5	PO 1	Illustrate the use of XML.PHP,AJAX and data base connectivity in designing web pages by applying the principles of mathematics and engineering fundamentals	2
	PO 2	Understand the given problem statement and formulate the(complex) engineering problems of creating dynamic webpages using XML,PHP,AJAX and Javascriptby considering all the specifications by the information provided by the user and use model translations if required and validate the conclusion of the problem by the Interpretation of results by implementing the webpages.	8
	PO 3	Design dynamic webpages using XML,PHP,AJAX and database connectivity by considering the customer requirementsand use creativity to ensure sustainable development in design process of web pages to ensure fitness of the problemand to manage cost drivers.	6
	PO 5	Design web pages by using the computer software related to programming by using the concepts of PHP interaction with the database to perform CRUD and by using XML and AJAX.	1
	PO 10	Communicate effectively with the customer to take the specific needs in designing dynamic web pages by using the concepts of PHP with data base connectivity and AJAX.	2

	PO 12	Build web applications according to technological changes done in software environment trelated to the concepts of PHP,XML,AJAX with database connectivity through continuing education efforts with ongoing learning.	2
	PSO 1	Understand the need and constraints of the customers related to the web design by using the concepts of PHP,XML and AJAX.	2
	PSO 2	Understand and develop web applications using PHP for Improving software reliability.	1
	PSO 3	Make use of modern computer tool in designing Web applications for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2
CO 6	PO 1	Apply the knowledge of front end and back end programming in designing website by applying principles of mathematics and engineering fundamentals	2
	PO 2	Understand the given problem statement and formulate the(complex) engineering problems of creating dynamic webpages using XML,PHP,AJAX and Javascriptby considering all the specifications by the information provided by the user and use model translations if required and validate the conclusion of the problem by the Interpretation of results by implementing the webpages.	9
	PO 3	Create dynamic website using front end and backend programminglanguages by considering the customer requirementsand use creativity to ensure sustainable development in design process of web pages to ensure fitness of the problem and to manage cost drivers.	6
	PO 4	Design website by conducting investigations on complex requirements of the user including design process,technologies,analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	7
	PO 5	Create web site by using front end and backend technologies in developing web application by using Computer software .	1
	PO 10	Communicate effectively in designing website with the customer to take the requirements related to the designing of web pages by using front end and back end programming.	2
	PO 12	Construct web site according to technological changes done in software environment related to front end and backend programming through continuing education efforts with ongoing learning – stays up with industry trends/ new technology.	2

	PSO 1	Design the web applications by considered all the constraints of the customer in designing web pages by using front end and backend programming languages.	2
	PSO 2	Understand and develop web applications for Improving software reliability.	1
	PSO 3	Make use of modern computer tool in designing Web applications for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	-	5	-	1	-	-	-	-	2	-	2	2	-	1
CO 2	2	8	5	-	1	-	-	-	-	2	-	2	2	-	1
CO 3	2	2	5	-	1	-	-	-	-	2	-	2	2	-	2
CO 4	2	-	4	-	1	-	-	-	-	2	-	2	2	-	1
CO 5	2	8	6	-	1	-	-	-	-	2	-	2	2	1	2
CO 6	2	9	6	7	1	-	-	-	-	2	-	2	2	1	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	-	50	-	100	-	-	-	-	40	-	25	33.3	-	50
CO 2	66.7	80	50	-	100	-	-	-	-	40	-	25	33.3	-	50
CO 3	66.7	20	50	-	100	-	-	-	-	40	-	25	33.3	-	100
CO 4	66.7	-	40	-	100	-	-	-	-	40	-	25	33.3	-	50
CO 5	66.7	80	60	-	100	-	-	-	-	40	-	25	33.3	50	100
CO 6	66.7	90	60	63.6	100	-	-	-	-	40	-	25	33.3	50	100

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	2	-	3	-	-	-	-	1	-	1	2	-	2
CO 2	3	3	2	-	3	-	-	-	-	1	-	1	2	-	2

CO 3	3	1	2	-	3	-	-	-	-	1	-	1	2	-	3
CO 4	3	-	1	-	3	-	-	-	-	1	-	1	2	-	2
CO 5	3	3	3	-	3	-	-	-	-	1	-	1	2	2	3
CO 6	3	3	3	-	3	-	-	-	-	1	-	1	2	2	3
TOTAL	18	10	13	3	18	-	-	-	-	6	-	6	6	4	15
AVER-AGE	3	2.5	2.1	3	3	-	-	-	-	1	-	1	2	2	2.5

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
Seminars	-	Student Viva	-	Certification	-
Laboratory Practices	-	5 Minutes Video	-	Open Ended Experiments	-
Term Paper	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INRODUCTION TO HTML AND JAVA SCRIPT**
	Introduction to html: fundamentals of HTML elements, Document body, text, hyperlink, lists, tables, color and images, frames; Cascading Style Sheets: Introduction, defining your own styles, properties and values in styles, style sheets, formatting blocks, and layers. JavaScript: JavaScript basics, variables, string manipulation, mathematical functions, statements, operators, arrays and functions.
MODULE II	**OBJECTS IN JAVASCRIPT AND XML**
	Objects in JavaScript: Data and objects in JavaScript, regular expressions, exception handling, built- in objects, events; Dynamic HTML with JavaScript: Data validation, opening a new window, Rollover buttons, moving images, multiple pages in a single download, floating logos. XML: Basics XML, document type definition, xml schemas, Document Object Model, presenting XML.
MODULE III	**SERVLETS AND JSP**
	Servlet: Lifecycle of a Servlet, a simple Servlet, the Servlet API, the Javax. Servlet package, reading Servlet parameters, the javax.Servlet.HTTP package, Handling HTTP requests and responses, using cookies and sessions. JSP: The anatomy of a JSP page, JSP processing, declarations, directives, expressions, code snippets, implicit objects, using beans in JSP pages, connecting to database inJSP.

MODULE IV	**INTRODUCTION TO PHP**
	Basics of PHP: downloading, installing, configuring PHP, programming in a web environment and the anatomy of a PHP page; Overview of PHP data types and concepts: Variables and data types, operators, expressions and statements, strings, arrays and functions
MODULE V	**PHP AND DATABASE ACCESS**
	PHP and database access: Basic database concepts, connecting to a My SQL database, retrieving and displaying results, modifying, updating and deleting data; MVC architecture: PHP and AJAX other web technologies: PHP and XML.

TEXTBOOKS

1. Chris Bates, "Web Programming: Building Internet Applications", Wiley Dream Tech, 2nd Edition, 2002.
2. Jeffrey C K Jackson, "Web Technologies", Pearson Education, 1st Edition, 2006
3. Steven Holzner, "The Complete reference PHP", Tata McGraw-Hill, 1st Edition, 2007.

REFERENCE BOOKS:

1. WHans Bergsten, "Java Server Pages", O Reilly, 3rd Edition, 2003.
2. D. Flanagan, "Java Script", O Reilly, 6th Edition, 2011.
3. Jon Duckett, "Beginning Web Programming", WROX, 2nd Edition, 2008.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	https://lms.iare.ac.in/index?route=course/details&course_id=177
CONTENT DELIVERY (THEORY)			
1	Basic concepts: Introduction to HTML	CO 1	T1:1.1 T1:2.1
2	Fundamentals of HTML elements, Document body	CO 1	T1:2.1 R2 : 1.4
3	Text,Hyperlink, Lists,Tables,color and images,Frames	CO 1	T1:2.2-2.8
4	Introduction to CascadingStyleSheets,Defining your own styles	CO1	T1:4.1-4.4.3

5	Properties and values in styles	CO 3	T1:4.4
6	Stylesheets,Formattingblocks,Layers	CO 1,	T1:4.5
7	JavaScript basics,variables,	CO 2,	T1:5.1 -5.4
8	String manipulation	CO 2	T1:5.5
9	Mathematicalfunctions,statements, operators	CO 2	T1:5.6-5.8
10	Arrays and Functions.	CO 2	T1:5.9-5.10
11	Data and objects in JavaScript, built-in objects.	CO 2	T1:6.1,6.4
12	Regular expressions.	CO 2	T1:6.2
13	Exception handling	CO 2	T1:6.3
14	Events	CO 2	T1:6.5
15	HTML with JavaScript: Data validation	CO 2	T1:7.1
16	Opening a window, Roll over buttons	CO 2	T1:7.2,7.6
17	Moving images, multiple pages in a single download, floating logos	CO 2	T1:7.7-7.10
18	Basics XML, document type definition	CO 2	T1: 14.1,14.2
19	Xml schemas.	CO 2	T1: 14.3
20	Document Object Model	CO 2	T1: 14.4
21	Presenting XML	CO 2	T1: 14.5
22	Life cycle of a Servlet, a simple Servlet	CO 3	T2: 6.1-6.4
23	The servlet API, the Javax. servlet package.	CO 3	T2: 6.1-6.4
24	Reading Servlet parameters	CO 3	T1:6.5
25	Handling HTTP requests and responses,Packages.	CO 3	T1:6.5
26	Cookies and sessions	CO 3	T2: 6.6-6.7
27	The anatomy of a JSP page, JSP processing, declarations	CO 3	T2: 8.1-8.2
28	Directives,Eexpressions, Code snippets	CO 3	T2: 8.3-8.4
29	Implicit objects, using beans in JSP pages, connecting to database in JSP.	CO 3	T2: 8.5
30	Basics of PHP, downloading, installing, configuring PHP	CO4	T3:1.1
31	Programming in a web environment and the anatomy of a PHP page	CO4	T3:1.1
32	Overview of PHP datatypes and concepts:Variables,datatypes,operators,expressionsand statements	CO 4	T3:1. 2
33	Complex structures, structures and functions	CO 4	T3:2.1
34	Passing structures through pointers, self-referential structures	CO 4	T3:3.4
35	Strings, arrays, Functions	CO 4	T3: 3.10
36	PHP and data base access :Basic database concepts, connecting to a My SQL	CO 5	T3:3.10

37	Retrieving and displaying results,modifying,updating and deleting data	CO 5	T3: 3.18
38	MVC Architecture	CO 5	T3: 3.12
39	PHP and other web technologies: PHP and XML	CO 5	T3: 3.13
40	PHP and AJAX.	CO 5	T3: 3.14
	PROBLEM SOLVING		
41	Create a table to show your class timetable.	CO 1	T1:2.7
42	Build a HTML document that has the form with the following controls: (a) A text box to collect the customer's name. (b) Four checkboxes, one each for the following items: i. Four HTML textbooks for Rs.1000. ii. Eight XML textbooks for Rs.2000. iii. Four Javabeans books for Rs.2500. iv. Eight UML textbooks for Rs.1500.	CO 1	T1:2.6
43	Build a script that inputs three integers from the user and displays sum, average, product, smallest and largest of these numbers in an alert dialog	CO 2	T1:6.3
44	Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button should show the number of characters, words and lines in the entered using an alert message. Words are separated with space and lines are separated with new line character.	CO 2	T1: 2.1-2.9
45	Build the page(s) for accepting the values of name and marks in a table then display them in the descending order of the marks.	CO 2	T1:2.5
46	Build web page for a library system, page should be in such a way that it should contain all book details- details include fields like Book name, Author name, ISBN and no. of copies available. Design webpage using CSS.	CO 6	T1: 2.1-2.9
47	Construct HTML page for any company home page and explain.	CO 6	T1: 2.4
48	Write a Java Script function to print an integer with commas as thousands separators.	CO 2	T1:4.8
49	Write a Java Script program to test the first character of a string is uppercase or not. Write a pattern that matches e-mail addresses.	CO 2	T1:2.2
50	Write a Java Script program to sort a list of elements using quick sort.	CO 2	T2: 4.1-4.5
51	Write a Java Script function which will take an array of numbers stored and find the second lowest and second greatest numbers, respectively.	CO 2	T2: 4.2-4.6

52	Write a Java Script program which compute, the average marks of the following students then determine the corresponding grade.	CO 2	T2: 4.1-4.6
53	To design the scientific calculator and make event for each button using java script.	CO 2	T1: 4.1
54	A simple calculator web application	CO 6	T1: 4.4
55	Write php program how to send mail using PHP.	CO 4	T3:9.5
56	Write php program to upload image to the server using html and PHP.	CO 4	T3: 4.4
57	Write php program to upload registration form into database	CO 5	T3: 5.5
58	Write php program to display the registration form from the database.	CO 5	T3: 6.5
59	Write php program to delete the registration form from database	CO 5	T3: 6.7
DISCUSSION ON DEFINITION AND TERMINOLOGY			
60	HTML, Java script, CSS, arrays, functions, string manipulation	CO 1,CO 2	T1:1.1 T1:2.1
61	Data validation, regular expressions, exception handling	CO 2	T1:2.1
62	Servlet, cookies and sessions, JSP page	CO 3	T2:6.2-6.8
63	PHP	CO 4	T3 :2.1
64	My SQL database, retrieving MVC architecture	CO 5	T3:10,11,12
DISCUSSION ON QUESTION BANK			
65	A simple calculator web application that takes two numbers and an operator (+, -,/,*) from an HTML page and returns the result page with the operation performed on the operands	CO 2	T1: 2.1-2.9
66	State the order of evaluation of the operators in the following JavaScript statements and show the value of x after each statement is performed. X=2/2+2*2- 2/2; X=(3*9*(3+(9*3/(3)))));	CO 2	T1:5.1-5.9
67	The MVC architecture in PHP with a neat diagram?	CO 5	T2:8.7
68	create a database using PHP and My SQL	CO 5	T3: 5,10
69	Write a PHP Script to validate username and password by reading values from html form and then validate the html form information using XML file?	CO 5	T3:10,11,12
70	My SQL database, retrieving MVC architecture	CO 5	T3:10

Course Coordinator
Ms.CH.Srividya, Assistant Professor

HOD,CSE

iare.png

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**				
Course Title	**OBJECT ORIENTED ANALYSIS AND DESIGN**				
Course Code	ACS009				
Program	B.Tech				
Semester	V				
Course Type	CORE				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3		-
Course Coordinator	Mr.G.Chandra Sekhar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITB01	III	Object Oriented Programming through Python

II COURSE OVERVIEW:

This course is intended to provide an in depth understanding of object-oriented approaches to software development, in particular to the analysis and design phase of the software life cycle. Topic include notation, methods, competing methodologies, issues in object-oriented development, and recent advancements which complement traditional object-oriented methodologies

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Object Oriented Analysis and Design	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

x	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
70 %	Understand
20%	Apply
0%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

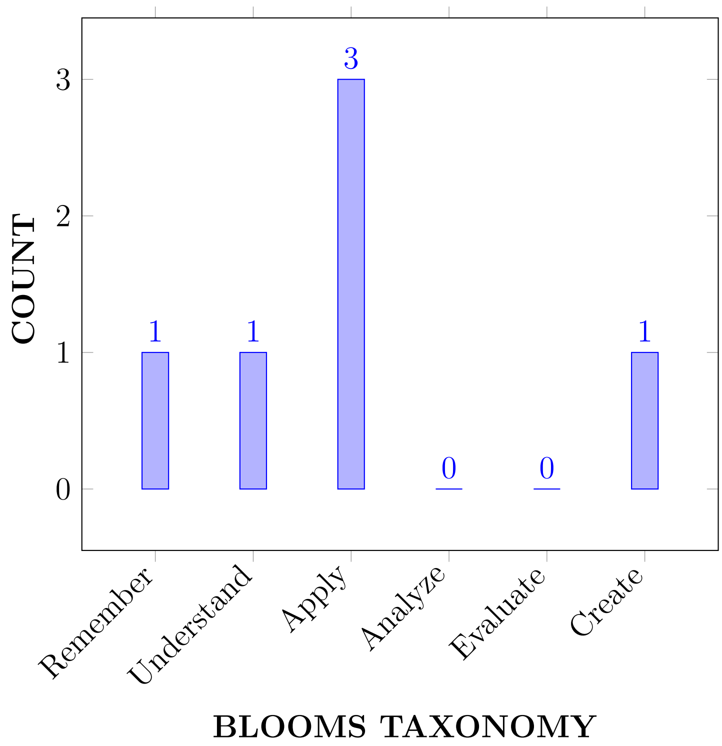
I	Develop the skills to analyze and design object-oriented problems.
II	Create design patterns to solve problems based on object oriented concepts.
III	Understand the various processes and techniques for building object-oriented software systems.
IV	Prepare unified modeling techniques for case studies.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**List** the importance and use of basic principles in object oriented modeling g for appropriate analysis and design of given scenarios.	Remember
CO 2	**Identify** basic building blocks for visualizing objects of an object-orientedsystem	Apply
CO 3	**Summarize** building blocks in structural and behavioral modeling of a software system for visualizing the relationships	Understand
CO 4	**Make use of** building blocks and different views for creating conceptual model architectural view of system in unified software development life cycle	Apply
CO 5	**Design** and conduct experiments as well as analyze and interpret data,alone or as a member of small group or team	Create
CO 6	**Apply** design patterns and auto formulate and analyze problems in computing and solve them.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools	3	Quiz
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges	1	Quiz
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in it industry	1	Quiz

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	✓	-	-	-	-	-	-	-		✓	-	-
CO 2	✓	-	✓	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 3	-	✓	-	✓	✓	-	-	-	-	-	-	-	✓	-	✓
CO 4	✓	-	✓	✓	✓	-	-	-	-	✓	-		-	✓	✓
CO 5	-	-	-	✓	✓	-	-	-	✓	✓	-	✓	-	-	✓
CO 6	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 4	**Conduct investigations of complex problems:** Use research-based **knowledge** and **research methods** including **design of experiments,** analysis and **interpretation of data,** and **synthesis of the information** to provide **valid conclusions.**	7
	PSO1	**Design next-generation computer systems,** networking devices, **search engines, soft computing** and intelligent systems, web browsers, and knowledge discovery tools	2
CO 2	PO 1	Engineering knowledge: **Apply the knowledge of mathematics,** science, **engineering fundamentals,** an engineering specialization modelling principles, to **the solution of complex engineering problems.**	3
	PO 3	Design solutions for simple and **complex problems** by Defining understanding and **customer requirements,** identifying **various static and dynamic functions,** managing design process and evaluate the outcomes as UML diagrams.	3
	PO4	**Conduct investigation** of **complex problems for visualizing artefacts** by **using basic and advanced building blocks** with knowledge of process, **laboratory skills,** understanding knowledge and ability to **apply a systems approach to engineering problems.**	6
	PO 5	Usage of **CASE tool ffor modelling simple to complex** engineering activities with understanding requirements and limitations of user for architectural view of system.	1
	PO 10	**Make use ofbuilding blocks for creating architectural view of system** using **UML by by communicating effectively to engineering community.**	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	**Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**	5
	PSO 1	**Design next-generation computer systems,** networking devices, search engines, soft computing and intelligent systems, **web browsers,** and knowledge discovery tools	2
	PSO 3	**Make use of computational and advanced CASE tools tools for creating innovative career paths,** to be an entrepreneur and desire for higher studies.	3
CO3	PO 2	**Understand the given problem and system definition,problem formulation, collecting data, modelling, solution development and documentation by using diagrams for static and dynamic aspects of the system.**	7
	PO 4	**Conduct investigation of complex problems for visualizing diagrams of static** and **dynamic aspects** by using basic and advanced building blocks blocks knowledge of process, **laboratory skills,** understanding knowledge and ability to apply a systems approach to engineering problems.	4
	PO 5	Usage of **CASE tool for modelling simple to complex engineering** activities with understanding requirements and limitations of user.	1
	PSO 1	**Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery** tools	5
	PSO 3	Practical experience in shipping **real world software,** using **industry standard tools and collaboration techniques** will equip to secure and succeed in first job upon graduation in it industry	3
CO4	PO 1	Apply **Engineering knowledge and modelling** principles, , in identifying **basic building blocks for visualizing artefacts of system.**	3
	PO 3	**Design solutions for simple and complex problems by defining problem, understand customer requirements, identifying basic building blocks to draw UML diagrams.**	7
	PO 4	Conduct **investigation of complex problems** for visualizing artefacts by using basic building blocks with knowledge and **system approach of process.**	2
	PO 5	Usage of **CASE tool for modelling simple to complex engineering** activities with understanding requirements and limitations of user	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	**Communicate static and dynamic aspects of the system using UML diagrams for specifying** structure and **interaction of objects during runtime.**	5
	PSO 3	**Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in it industry.**	5
CO5	PO 4	Conduct **investigations of complex problems:** Use **research-based knowledge** and research methods including **design of experiments, analysis and interpretation of data,** and synthesis of the information to provide valid conclusions.	6
	PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and **modeling to complex engineering activities** with an understanding of the limitations.	1
	PO 9	**Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**	5
	PO 10	**Communication:** Communicate effectively on **complex engineering** activities with **the engineering** community and with **society at large,** such as, being able to comprehend and write effective reports and **design documentation,** make effective presentations, and give and receive clear instructions.	5
	PO 12	Life-long learning: **Recognize the need** for, and have **the preparation** and ability to engage in independent and **life-long learning** in the broadest context of technological change.	4
	PSO 3	**Practical experience** in shipping **real world software** and using **industry standard tools** and **collaboration techniques** will equip to secure and succeed in first job upon graduation in it industry	4
CO6	PO 1	Engineering knowledge: Apply the **knowledge of mathematics,** science, engineering fundamentals,and an engineering specialization to **the solution of complex engineering problems.**	2
	PO 2	Problem analysis: **Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,** natural sciences, and engineering sciences.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Design/development of solutions: **Design solutions** for complex **engineering problems and design system components** or processes that meet the specified needs with appropriate consideration for the **public health and safety,** and the cultural, societal, and **environmental considerations.**	5
	PO 4	Conduct investigations of complex problems: Use **research-based knowledge and research methods** including design of experiments, **analysis and interpretation of data**, and synthesis of the information to provide valid conclusions.	2
	PO 10	Communication: **Communicate effectively on complex engineering** activities with **the engineering community and with society at large,** such as, being able to **comprehend and write effective reports and design documentation,** make effective presentations, and give and **receive clear instructions**	5
	PSO 1	Practical experience in shipping **real world software,** using industry standard tools and **collaboration techniques** will equip to secure and succeed in first job upon graduation in it industry	2
	PSO 3	**Practical experience in shipping real world software** and using industry standard tools and **collaboration techniques** will equip to secure and succeed in first job upon graduation in it industry	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	63	-	-	-	-	-	-	-		33	-	-
CO 2	100	-	60	54	100	-	-	-	-	100	-	62	33	-	100
CO 3	-	70	-	45	100	-	-	-	-	-	-	-	33	-	100
CO 4	100	-	30	36	100	-	-	-	-	100	-		-	-	100
CO 5	-	-	-	54	100	-	-	-	41.6	100	-	50	-	-	100
CO 6	100	50	50	45	-	-	-	-	-	100	-	-	33	-	100

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	7	-	-	-	-	-	-	-		2	-	-
CO 2	3	-	3	6	1	-	-	-	-	5	-	5	2	-	3

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 3	-	7	-	4	1	-	-	-	-	-	-	-	2	-	3
CO 4	2	-	7	2	1	-	-	-	-	5	-	-	-	-	3
CO 5	-	-	-	6	1	-	-	-	5	5	5	4	-	-	2
CO 6	2	5	5	5	-	-	-	-	-	5	-		2	-	2

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	3	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	1	2	3	-	-	-	-	3	-	3	1	-	3
CO 3	-	3	-	1	3	-	-	-	-	-	-	-	1	-	3
CO 4	3	-	3	2	3	-	-	-	-	3	-	-	-	-	3
CO 5	-	-	-	2	3	-	-	-	2	3	-	2	-	-	3
CO 6	3	2	2	2	-	-	-	-	-	3	-	-	1	-	3
TOTAL	9	5	6	12	12	-	-	-	2	12	-	5	4	-	15
AVERAGE	3	2.5	2	2	3	-	-	-	2	3	-	2.5	1	-	3

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams		SEE Exams		Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments			✓		

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT I	STRUCTURAL MODELLING
	Introduction to UML: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, architecture, software development life cycle; Classes, relationships, common mechanisms and diagrams.
UNIT II	ADVANCED BEHAVIORAL MODELING
	Advanced classes, advanced relationships, interfaces, types and roles, packages, terms, concepts, modeling techniques for class and object diagrams; Interactions: Interaction diagrams; Use cases: Use case diagrams, activity diagrams.
UNIT III	ARCHITECTURAL MODELING
	Events and signals, state machines, processes and threads, time and space. State chart diagrams, component diagrams, deployment diagrams.
UNIT IV	DESIGN PATTERN
	GRASP: Designing objects with responsibilities, creator, information expert, low coupling, high cohesion, design patterns, creational, factory method, structural, bridge, adaptor, behavioral, strategy.
UNIT V	APPLYING DESIGN PATTENS
	System sequence diagrams, relation between sequence diagrams and use case logical architecture and UML package diagram, logical architecture refinement; Case study: The next gen POS system, inception, use case modeling, relating use cases, include, extend and generalization, domain models, domain model refinement.

TEXTBOOKS

1. Grady Booch, James Rumbaugh, Ivar Jacobson, ―The Unified Modeling Language User Guide‖, Pearson Education, 2nd Edition, 2004.

2. Craig Larman, ―Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development‖, Pearson Education, 3rd Edition, 2005

REFERENCE BOOKS:

1. MeilirPage-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education, 1st Edition, 2006.

2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, "UML 2 Toolkit", WILEY-Dreamtech India Pvt. Ltd., Pearson Education, 3rd Edition, 2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105224

COURSE WEB PAGE:

https://akanksha.iare.ac.in/index.php?route=course/index

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students,Parents, Industry Personnel and Recruiters. OBE is all about feedback and outcomes.In this we will discuss about the course outcomes and program outcomes and their attainment		
CONTENT DELIVERY (THEORY)			
1-2	Introduction to UML: Importance of Modeling, Things, Principles of Modeling.	CO1	T2: 1.1-1.3
2-5	Object Oriented Modeling, Structural things, Structural diagrams.	CO2	T1: 2.2-2.3
6-9	Conceptual model of the UML, Structural diagrams	CO4	T1: 2.1,2-3-2.6
11-12	Behavioral diagrams.	CO3	R2: 3.4-3.9
11-12	UML architecture, Software Development Life Cycle.	CO5	R2: 4.1-4.3
12-13	Basic class diagram symbols and notations.	CO5	T1: 27.1, T1:27.2, 27.6
14	Class diagram: Purpose, Benefits with example.	CO5	T1: 28.1
15-17	Relationships: Dependencies, Generalizations, Associations with example	CO4	T2: 4.1-4.3
18-19	Aggregation vs. Composition, Common mechanisms.	CO6,CO5	T1: 4.4-4.7
20-21	Advanced classes: scope, multiplicity, operations, examples	CO2	R1: 1.1-1.4
22-24	Common modeling techniques for class diagram, Advanced relationships: dependency, generalization,association, realization, common modeling techniques	CO2	T1 8.1-8.4
25-28	ThPackages: Key elements of package diagram, visibility of packages, import and access	CO3, CO1	T1:9.1, 9.3,9.4,9.6
29-33	Terms and Concepts: common uses, common modeling techniques, forward and reverse engineering.	CO4	T1:11.1, 11.3-11.4
34-37	Class Diagrams- Terms, concepts and common modeling techniques.	CO3	T1:10.2, 10.5
38-44	Object Diagrams: Terms, concepts and common modeling techniques.	CO2	T1:17.3, 17.6-17.8 T1:18.1-18.6
45-47	GRASP: Designing objects with responsibilities, creator.information expert, low coupling.	CO1	T1:10.1-1.3

48-51	high cohesion, design patterns. creational, factory method.structural, bridge, adaptor.	CO1	T1: 26.2, 26.6.4, T2:26.6.6, 26.10
52-55	behavioral, strategy. System sequence diagrams.relation between sequence diagrams and use case logical architecture and UML package diagram.	CO1,CO2	T1:26.1-26.3 28.1-28.7
56-59	logical architecture refinement,Case study: The next gen POS system, inception, use case modeling, relating use cases,	CO3,CO4	T1:27.1-27.6
60-62	Extend and generalization,domain models, domain model refinement.	CO2	T1:25.1-25.6
PROBLEM SOLVING/ CASE STUDIES			
1	The major components of Unified Modelling Language	CO 6	T1:11.2.1
2	Ticket Reservation System in UML	CO 6	T1:11.2.2
3	UML Diagrams For The Case Studies Library Management System .	CO 6	T1:11.2.18
4	UML Diagrams For The Case Studies Online Mobile Recharge	CO 6	T1:11.2.25
5	UML Diagrams For The Case Studies for ATM System	CO 6	T1:11.4.1
6	Interaction diagrams.	CO 6	T1:11.4.2
7	Use case diagrams, activity diagrams.	CO 6	R2:7.5
8	State chart diagrams, component diagrams,	CO 6	R2:7.5
4	Deployment diagrams.	CO 6	R2:7.5
10	GRASP: Designing objects with responsibilities	CO 6	R2:7.5
11	Design patterns	CO 6	T1:11.4.1
12	behavioral, strategy. elements.	CO 6	T1:11.4.2
13	System sequence diagrams,	CO 6	T1:11.5.1
14	relation between sequence diagrams and use case logical architecture and UML package diagram,	CO 6	T1:11.5.2
15	Domain model refinement.	CO 6	T2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define model?	CO 1	R1:2.1-2.11
2	What is analysis?	CO 2, 3	R1:4.2-4.11
3	Define persistent objects?	CO 4	R2:5.6-5.9
4	Define UML?	CO 5	R4:8.1-8.9
5	Define the structure of a component?	CO 6	R2:12.1-12.16
DISCUSSION OF QUESTION BANK			
1	What are the steps involved in design process?	CO 1,	R1:2.1-2.11
2	What is class diagram?	CO 2, 3	R1:4.2-4.11

3	What is an activity diagram?	CO 4	R2:5.6-5.9
4	What are common modeling techniques of state chart diagrams?	CO 5	R4:8.1-8.9
5	Discuss in detail about creational and bridge patterns with examples.	CO 6	R2:12.1-12.16

Signature of Course Coordinator **HOD,IT**
Mr. G.Chandra Sekhar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**					
Course Title	**COMPILER DESIGN**					
Course Code	AIT004					
Program	B.Tech					
Semester	V					
Course Type	Core					
Regulation	R16					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. U Sivaji , Assistant Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	ACS01	I	Computer Programming
UG	ACS02	II	Data Structures
UG	AHS013	III	Discrete Mathematical Structures
UG	AIT002	IV	Theory of Computation

II COURSE OVERVIEW:

This course describes the basic techniques for compiler construction and tools that can be used to perform syntax-directed translation of a high-level programming language into an executable code. It will provide deeper insights into the more advanced semantics aspects of programming languages, machine independent optimizations and code generation.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Compiler Design	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Chalk & Talk	✓	Quiz	✓	Assignments	x	MOOCs
✓	PPT	✓	Seminars	x	Mini Project	✓	Videos
x	open Ended Experiments						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
40 %	Understand
50 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	**Theory**		**Total Marks**
Type of Assessment	**CIE Exam**	**Quiz \AAT**	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

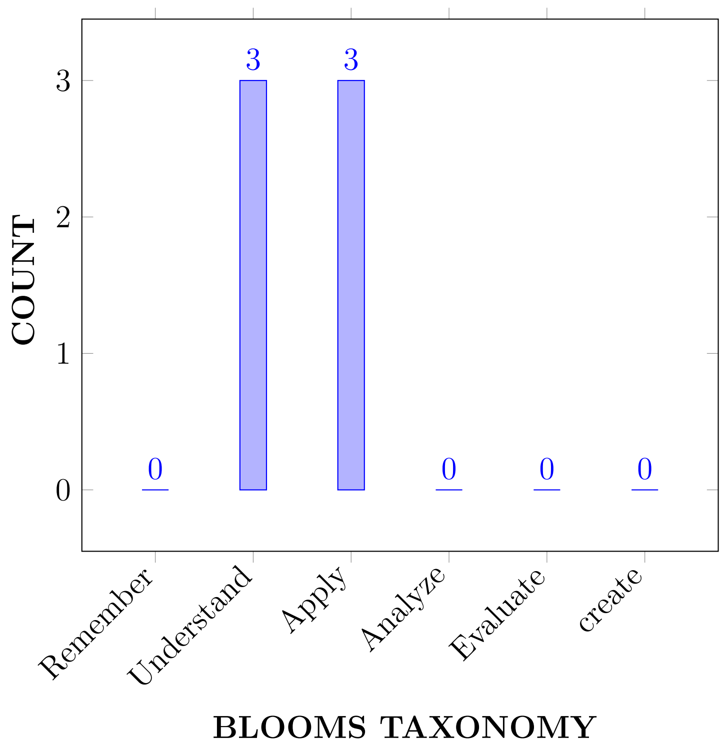
VI COURSE OBJECTIVES:
The students will try to learn:

I	The process of translating a high-level language to machine code required for compiler construction.
II	The Software tools and techniques used in compiler construction such as lexical analyser and parser generators.
III	The data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code, and stack machines.
IV	The deeper insights into the syntax and semantic aspects of programming languages, dynamic memory allocation and code generation.

VII COURSE OUTCOMES:
After successful completion of the course, students should be able to:

CO 1	**Summarize** phases of a compiler in the construction of language processors.	Understand
CO 2	**Make use of** finite automata for designing a lexical analyzer for a specific programming language constructs.	Apply
CO 3	**Choose** top down, bottom up parsing methods for developing a parser with representation of a parse table or tree.	Apply
CO 4	**Outline** syntax directed translations, intermediate forms for performing semantic analysis along with code generation.	Understand
CO 5	**Relate** symbol table, type checking and storage allocation strategies used in run-time environment.	Understand
CO 6	**Select** code optimization techniques on intermediate code form for generating target code.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / Quiz / AAT
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	CIE / Quiz / AAT
PO 3	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE / Quiz / AAT
PO 5	Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	3	CIE / Quiz / AAT

PO 10	Communication: Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	CIE / Quiz / AAT/Tech-Talk

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Understand, design and analyse computer programs in the areas related to Algorithms, System Software, Web design, Bigdata, Artificial Intelligence, Machine Learning and Networking.	3	Group discussion/ Short term courses
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	3	Industry exposure/AAT
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	Group discussion/ Short term courses/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-
CO 4	✓	-	✓	-	✓	-	-	-	-	-	-	-	-	-	-
CO 5	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Describe the role of lexical analyzer and recognition of tokens, from regular expressions to finite automataby applying engineering fundamentals and provide solutions to engineering problems.	2
	PO 5	Understand the phases of compiler in optimizing regular Expressions by using the mathematical principles and computer science methodologies.	1
	PSO 1	Understand pass and phases of translation for specific problems with lexical analyzer generator.	1
CO2	PO 1	Understand the significant phases of translation, bootstrapping, LEX-lexical analyzer generator in lexical analysis using mathematical principles, fundamental of Computer engineering specialization and scientific principles.	3
	PSO 1	Understand the finite automata, regular Expressions in the area related to lexical analysis.	1
CO 3	PO 1	Understand the different types of parsing methods including the backtracking by apply the knowledge of computer engineering fundamentals and mathematical principles	2
	PO 2	Understand the problem statement and choose appropriate techniques by analyzing various grammars including stack implementation of parser by the interpretation of results.	3
	PSO 2	Understand the basic difference between top down parsing and bottom up parsing with reference to grammars and parser generator.	2
CO 4	PO 1	Describe Intermediate forms using syntax tree and three address code using mathematical principles and scientific principles.	2
	PO 3	Explain and demonstrate the translation of simple statements, Boolean expression and flow of control statements with three address code.	2
	PO 5	Understand the concepts of three address statements and its implementation in the intermediate code generation.	1
CO 5	PO 2	Analyze the process of symbol tables in runtime environment.	1
	PO 3	Understand the concepts of runtime environment evaluate the Source languageissues.	2

CO 6	PO 1	Demonstrate the code optimization by applying the principles of mathematics and engineering fundamentals.	2
	PO 2	Understand the given problem statement and formulate the (complex) engineering problems in the Design of a Code Generator and addresses in the target Code in reaching substantiated conclusions by the interpretation of results.	3
	PO 5	Create the addresses for Design of a Code Generator (complex) Engineering activities in Computer software.	1
	PO 10	Understand code optimization techniques on intermediate code forms such as syntax trees and design documentation, for improving the performance of a program.	1
	PSO 3	Demonstrate the basic optimization in real world software, using industry standard tools and collaboration techniques in the field of application programming.	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2				1								1		
CO 2	3												1		
CO 3	2	3												2	
CO 4	2		2		1										
CO 5		1	2												
CO6	2	3			1					1					1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
CO 2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
CO 3	66.7	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
CO 4	66.7	0.0	20.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 5	0.0	10.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 6	66.7	30.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	50.0

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - 0≤ C≤ 5% – No correlation
2 - 40 % <C < 60% –Moderate
1-5 <C≤ 40% – Low/ Slight
3 - 60% ≤ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 4	3	-	1	-	3	-	-	-	-	-	-	-	-	-	-
CO 5	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	1	-	-	3	-	-	-	-	2	-	-	-	-	2
TOTAL	15	3	2		9					2			6	3	2
AVERAGE	3	1	1		3					2			3	3	2

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO COMPILERS AND PARSING**
	Introduction to compilers: Definition of compiler, interpreter and its differences, the phases of a compiler; Lexical Analysis: Role of lexical analyzer, input buffering, recognition of tokens, finite automata, regular Expressions, from regular expressions to finite automata, pass and phases of translation, bootstrapping, LEX-lexical analyzer generator. Parsing: Parsing, role of parser, context free grammar, derivations, parse trees, ambiguity, elimination of left recursion, left factoring, eliminating ambiguity from dangling-else grammar, classes of parsing, topdown parsing: backtracking, recursive-descent parsing, predictive parsers, LL(1) grammars.
MODULE II	**BOTTOM-UP PARSING**
	Bottom-up parsing: Definition of bottom-up parsing, handles, handle pruning, stack implementation of shift- reduce parsing, conflicts during shift-reduce parsing, LR grammars, LR parsers-simple LR, canonical LR and Look Ahead LR parsers, error recovery in parsing, parsing ambiguous grammars,YACC-automatic parser generator.
MODULE III	**SYNTAX-DIRECTED TRANSLATION AND INTERMEDIATE CODE GENERATION**
	Syntax-directed translation: Syntax directed definition, construction of syntax trees, S-attributed and L- attributed definitions, translation schemes, emitting a translation. Intermediate code generation: Intermediate forms of source programs– abstract syntax tree, polish notation and three address code, types of three address statements and its implementation, syntax directed translation into three-address code, translation of simple statements, Boolean expressions and flow-of control statements
MODULE IV	**TYPE CHECKING ANDRUN TIME ENVIRONMENT**
	Type checking: Definition of type checking, type expressions, type systems, static and dynamic checking of types, specification of a simple type checker, equivalence of type expressions, type conversions, overloading of functions and operators; Run time environments: Source language issues, Storage organization, storage- allocation strategies, access to nonlocal names, parameter passing, symbol tables, and language facilities for dynamic storage allocation.
MODULE V	**CODE OPTIMIZATION AND CODE GENERATION**
	Code optimization: The principle sources of optimization, optimization of basic blocks, loops in flow graphs, peephole optimization; Code generator: Issues in the design of a code generator, the target machine, runtime storage management, basic blocks and flow graphs, a simple code generator, register allocation and assignment, DAG representation of basic blocks.

TEXTBOOKS

1. Alfred V.Aho, RaviSethi,JeffreyD, Ullman, —Compilers–Principles,TechniquesandTools, Pearson Education, 2nd Edition, 2006.

REFERENCE BOOKS:

1. Kenneth C.Louden,Thomson, —CompilerConstruction–PrinciplesandPractice, PWS Publishing, 1st Edition,1997.

2. Andrew W. Appel, —Modern Compiler Implementation C, Cambridge University Press, Revised Edition, 2004.

COURSE WEB PAGE:

1. http://csenote.weebly.com/principles-of-compiler-design.html

2. http://www.faadooengineers.com/threads/32857-Compiler-Design-Notes-full-book-pdf-download

3. http://www.e-booksdirectory.com/details.php?ebook=10166

4. http://www.e-booksdirectory.com/details.php?ebook=7400re

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
CONTENT DELIVERY (THEORY)			
1	Introduction to compilers: Definition of compiler, interpreter and its differences	CO 1	T1:1.1-1.5 R1:1.1
2	The phases of a compiler	CO 1	T1:3.6-3.7 R1:2.2-2.4
3	Lexical Analysis: Role of lexical analyzer, input buffering	CO 1	T1: 1.5
4	recognition of tokens, finite automata.	CO 2	T1:1.1 R1:1.6
5	regular Expressions	CO 2	T1:3.8-4.3 R1:3.1-3.3
6	from regular expressions to finite automata.	CO 2	T1: 4.3-4.4 R1:4.1
7-8	pass and phases of translation, bootstrapping, LEX-lexical analyzer generator.	CO 2	T1:4.5-4.7 R1:4.3-4.5
9	Syntax Analysis: Parsing, role of parser, context free grammar.	CO 3	T1:4.5-4.7 R1:5.1-5.2
10	derivations, parse trees, ambiguity	CO 3	T1:4.7 R1:5.3
11	elimination of left recursion, left factoring	CO 3	T1: 4.7 R1:5.4-5.5
12	eliminating ambiguity from dangling-else grammar	CO 3	T1:4.7 R1:5.6
13	Types of parsing: Top-down parsing	CO 3	T1:4.9 R1:5.5

14	backtracking, recursive-descent parsing, predictive parsers,	CO 3	T1: 4.9
15	LL (1) grammars	CO 3	T1: 5.1-5.4 R1:6.1
16	Bottom-up parsing: Definition of bottom-up parsing,.	CO 3	T1:8.4-8.6
17	handles, handle pruning, stack implementation of shift-reduce parsing,	CO 3	T1: 6.1 R1:6.4-6.5
18	conflicts during shift-reduce parsing,	CO 3	T1: 7.1-7.5 R1:7.1
19	LR grammars, LR parsers-simple LR,	CO 3	T1: 7.6-7.7
20	canonical LR and Look Ahead LR parsers,	CO 3	T1: 10.2
21	YACC-automatic parser generator.	CO 3	T1:10.1-10.2 T1:10.4,9.9
22	Syntax-Directed Translation: Syntax directed definitions, construction of syntax trees	CO 4	T1: 9.1-9.2
23	S-attributed and L- attributed definitions; Syntax Directed Translation schemes.	CO 4	T1: 9.3 R1:7.6
24	Intermediate code generation: Intermediate forms of source	CO 4	T1: 9.4
25	programs– abstract syntax tree, polish notation and three address code,	CO 4	T1:9.6-9.7 R1:8.1-8.8
26	Types of three address statements and its implementation	CO 4	T1: 9.8
27	syntax directed translation into three-address code	CO 4	T1: 9.1-9.2
28	translation of simple statements, Boolean expressions	CO 4	T1: 9.1-9.2
29	Flow-of- Control statements.	CO 4	R1:8.1-8.8
30	Type checking: Definition of type checking,	CO 5	R1:8.1-8.8
31	type expressions, type systems, static and dynamic checking of	CO 5	T1: 9.4
32	specification of a simple type checker	CO 5	T1: 9.1-9.2
33	Run time environments: Source language issues,	CO 5	T1: 9.1-9.2
34	Types Storage organization	CO 5	T1: 9.1-9.2
35	storage-allocation strategies,	CO 5	T1: 9.1-9.2
36	access to nonlocal data on the stack,	CO 5	T1: 9.1-9.2
37	Garbage collection, symbol tables.	CO 5	T1: 9.1-9.2
38	Code optimization: The principle sources of optimization	CO 6	T1: 9.1-9.2
39	optimization of blocks	CO 6	T1:10.1-10.2 T1:10.4,9.9
40	loops in flow graphs	CO 6	T1: 10.2
41	peephole optimization	CO 6	T1: 9.1-9.2

42	Code Generation: Issues in the Design of a Code Generator	CO 6	T1: 9.1-9.2
43-44	The Target Language, addresses in the Target Code,	CO 6	T1:10.1-10.4
45-46	Basic Blocks and Flow Graphs	CO 6	T1: 9.1-9.2
47	Optimization of Basic Blocks	CO 6	T1: 9.1-9.2
48	A Simple Code Generator	CO 6	T1:9.6-9.7 R1:8.1-8.8
49	register allocation and assignment	CO 6	T1:9.6-9.7
50-52	DAG representation of basic blocks.	CO 6	R1:8.1-8.8
PROBLEM SOLVING/ CASE STUDIES			
1	Consider the following fragment of C code: float i, j; i = i*70+j+2; Construct the output at all phases of the compiler for above C code	CO 1	T1:1.1-1.5 R1:1.1
2	For the following expression total = count + rate * 5 Construct the output after each phase of compiler?	CO 1	T1:1.1-1.5 R1:1.1
3	Convert NFA with ϵ to equivalent NFA M=({q0,q1,q2},{0,1,2}, δ, q0, {q2}) where δ is given by [δ (q0,0)={q0}, δ (q0,1)=ϕ, δ (q0,2)=ϕ, δ(q0, ϵ)=q1] [δ (q1,0)=ϕ, δ (q1,1)=q1 , δ (q1,2)=ϕ ,δ (q1, ϵ)=q2] [δ (q2,0)=ϕ, δ (q2,1)= ϕ , δ (q2,2)= {q2},δ (q2, ϵ)= ϕ]	CO 2	T1:1.1 R1:1.6
4	Describe a DFA for the following language L={w/|w | mod5=0,w belongs to (a,b)*} L={w/|w | mod5=1,w belongs to (a,b)*}	CO 2	T1:1.1 R1:1.6
5	Describe the DFA Transition diagram for equivalent Regular expression (ab+a) *(aa+b)	CO 2	T1:3.8-4.3 R1:3.1-3.3
6	Construct the FIRST and FOLLOW sets for following grammar S$\rightarrow$ aBDh , B $\rightarrow$ cC , C $\rightarrow$ bC / ϵ , D $\rightarrow$ EF , E $\rightarrow$ g / ϵ , F $\rightarrow$ f / ϵ	CO 3	T1: 4.9
7	Construct SLR parsing table for the below grammar? E $\rightarrow$ E+T |T T $\rightarrow$ T*F | F F$\rightarrow$ (E) |id.	CO 3	T1: 7.6-7.7
8	Outline the CLR Parsing model and write the CLR parsing algorithm for constructing the parsing table	CO 3	T1: 10.2

9	Construct production rules and semantic actions for the following grammar along with annotated parse tree for the expression: "int a, b, c"? D →T L T →int T → float; L→ L1,id L → id	CO 4	T1: 9.1-9.2
10	Construct the three address code and draw the abstract tree for the following expressions? a) (x-y)*z+m-n b) a+(b-c)+(b+c)*(a*e)	CO 4	T1: 9.1-9.2
11	Translate the expression – (a + b) * (c + d) + (a + b +c) into a) quadruples b) triples	CO 4	T1: 9.8
12	Explain briefly about Activation record with block diagram	CO 5	T1: 9.1-9.2
13	Explain the specification of a simple type checker	CO 5	R1:8.1-8.8
14	Construct the code sequence generated by the simple code generation algorithm for x*y+(m-k)-(g+b)	CO 6	T1:9.6-9.7 R1:8.1-8.8
15	Explain the concept of Function-Preserving Transformations	CO 6	T1:10.1-10.2 T1:10.4,9.9
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Definition of compiler, interpreter and its differences, the phases of a compiler	CO 1	T1:1.1-1.5 R1:1.1
2	LR grammars, LR parsers-simple LR,CLR ,LALR	CO 3	T1: 7.6-7.7
3	Syntax directed definition, construction of syntax trees, S-attributed and L- attributed definitions	CO 4	T1: 9.1-9.2
4	Storage organization, storage- allocation strategies, access to nonlocal names	CO 5	T1: 9.1-9.2
5	optimization of basic blocks, loops in flow graphs, peephole optimization; Code generator	CO 6	T1:10.1-10.2 T1:10.4,9.9
DISCUSSION ON QUESTION BANK			
1	Describe how various phases could be combined as a pass in compiler	CO 1	T1:1.1-1.5 R1:1.1
2	Identify whether the following grammar is CLR or not with reasons? S→ AA , A →aA | b	CO 3	T1: 7.6-7.7

3	Construct production rules and semantic actions for S-attributed grammar for the following grammar along with syntax tree and annotated parse tree for the given string a*b-c/d+e? L→E E→ E+T | E-T|T T→ T*F | T/F |F F→ P-F | P P→(E) P→ID	CO 4	T1: 9.1-9.2
4	Explain briefly about stack storage allocation with block diagram.	CO 5	T1: 9.1-9.2
5	Identify the register descriptor target code for the source language Statement and its cost. (a-b) + (a-c) + (a-c)	CO 6	T1:10.1-10.2 T1:10.4,9.9

Prepared by **HOD,CSE**
Mr. U Sivaji, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**				
Course Title	**OPTIMIZATION TECHNIQUES**				
Course Code	AHS012				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	1	3	-	-
Course Coordinator	Dr K Suvarchala				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS003	I	Computational Mathematics and Integral Calculus

II COURSE OVERVIEW:

The primary objective of this course is to introduce the methods of optimization techniques, precise mathematical concept, study how to design algorithms, establish their correctness, study their efficiency and memory needs. The goal is to maintain a balance between theory, numerical computation, and problem setup for solution by optimization software and applications to engineering systems.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Optimization Techniques	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	x	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
60%	Understand
20%	Apply
10%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course

is given in table.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

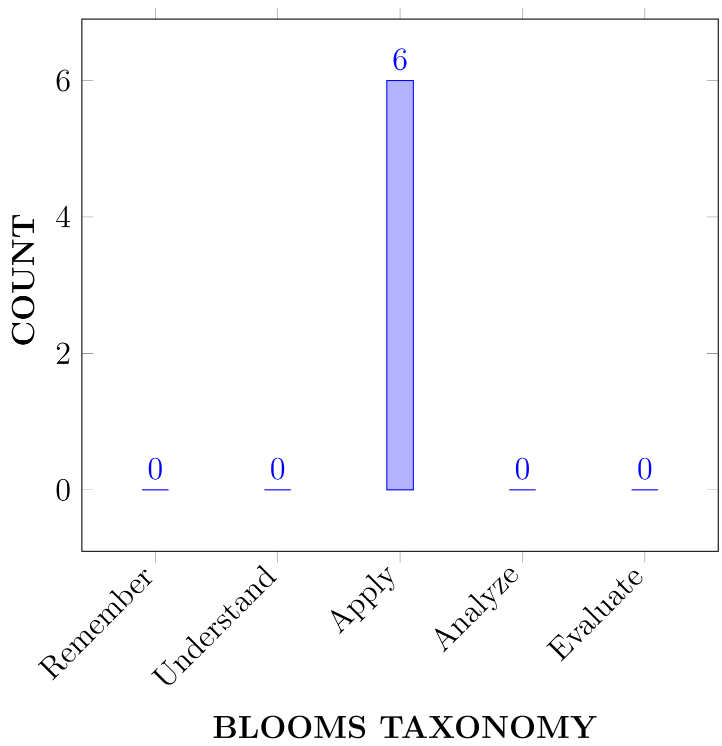
I	Learn fundamentals of linear programming through optimization
II	Apply the mathematical results and numerical techniques of optimization theory to concrete Engineering Problems
III	Understand and apply optimization techniques to industrial applications.
IV	Apply the dynamic programming and quadratic approximation to electrical and electronic problems and applications .

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Solve** Linear Programming Problems of different applications in engineering by formulating LP model with optimization principles.	Apply
CO 2	**Make use of** transportation and assignment problems to obtain feasible and optimal values in allocating and assigning resources for real-time applications.	Apply
CO 3	**Select** appropriate game theory and sequencing technique to reduce conflicting solutions and in completion of jobs with minimum possible time.	Apply
CO 4	**Choose** appropriate dynamic programming methods to transform complex optimization problem into sequence of simpler in solving various types of problems.	Apply
CO 5	**Identify** dappropriate quadratic approximation techniques to solve constrained optimization problems.	Apply
CO 6	**Develop** an ability to identify, formulate and solve simple and complex engineering problems Iby using appropriate optimization technique.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	SEE / CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	SEE / CIE / AAT

PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	SEE / CIE / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	**Design next-generation** ccomputer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	SEE/AAT
PSO 3	**Practical experience** in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry..	2	SEE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 2	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 4	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 5	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 6	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	-	✓

XII JUSTIFICATIONS FOR CO – PO / PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Linear Programming Problems of different applications in engineering are solved by using scientific, mathematical and own engineering discipline principles.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Linear Programming Problems of different applications in engineering are solved by identifying, defining and formulating the problem with data collection, solution development and interpretation of results.	6
	PO 3	Design/Development of solution for LP models of different engineering applications to meet the specified needs with appropriate Consideration of various constraints.	6
	PO 10	Linear programming problems will be solved with clear applications of engineering and optimization principals.	2
	PO 12	Applying LP problems in computer science related, industry oriented applications for continous development.	3
	PSO 1	Formulate LP problems for given statement with constraints, design and develop an algorithm to solve the same for voluminous data processing .	4
	PSO 3	Apply knowledge on frameworks associated with optimization techniques for solving LP problems	1
CO 2	PO 1	Transportation and Assignment Problems of different applications in engineering are solved by using scientific, mathematical and own engineering discipline principles	3
	PO 2	Transportation and Assignment problems of different real time applications in engineering are solved by identifying, defining and formulating the problem with data collection, solution development and interpretation of results.	7
	PO 3	Design/Development of solution for Transportation and Assignment models of different engineering applications to meet the specified needs with appropriate Consideration of allocating and assigning resources for real-time applications.	6
	PO 4	Use the knowledge of characteristics of transportation and Assignment methods to design , analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	8
	PO 10	Transportation and Assignment problems will be solved with clear applications of engineering and optimization principals.	2
	PO 12	UApplying Transportation and Assignment problems in computer science related, industry oriented applications for continous development.	3
	PSO 1	Formulate Transportation and Assignment problems for given statement with constraints, design and develop an algorithm to solve the same for voluminous data processing .	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Apply knowledge on frameworks associated with optimization techniques for solving Transportation and Assignment problems	1
CO 3	PO 1	Selection of algorithm for assigning a suitable person to existing vacancy of jobs positions, need the knowledge of science and engineering fundamentals	3
	PO 2	Problem analysis based on principles of mathematics, Manufacturing engineering fundamentals and sciences is essential to identify and analyze the material distribution schedule to minimize total distribution cost	8
	PO 3	Design/Development of solution for Sequencing and Game Theory to reduce conflicting solutions and in completion of jobs with minimum possible time of different engineering applications to meet the specified needs with appropriate Consideration.	8
	PO 10	Sequencing and Game Theory problems will be solved with clear applications of engineering and optimization principals.	2
	PO 12	Applying Sequencing and Game Theory problems in computer science related, industry oriented applications for continuous development.	3
	PSO 1	Formulate Sequencing and Game Theory problems for given statement with constraints, design and develop an algorithm to solve the same for voluminous data processing.	4
	PSO 3	Develop practical experience for solving the real time problem using computational and experimental tools in the field of Manufacturing process	1
CO 4	PO 1	Analyze the dynamic programming concepts to solve shortest path and queuing models by applying the knowledge of mathematics, science and metrology engineering fundamentals.	3
	PO 2	Choose appropriate dynamic programming methods to transform complex optimization problem into sequence of simpler in solving various types of real time applications in engineering are solved by identifying, defining and formulating the problem with data collection, solution development and interpretation of results.	6
	PO 3	Design/Development of solution for dynamic programming problems of different engineering applications to meet the specified needs with appropriate Consideration.	6

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Dynamic Programming problems will be solved with clear applications of engineering and optimization principals.	2
	PO 12	Applying Dynamic Programming problems problems in computer science related, industry oriented applications for continous development.	3
	PSO 1	Formulate for the given statement with constraints, design and develop an algorithm to solve the same for voluminous data processing.	4
	PSO 3	Apply knowledge on frameworks associated with optimization techniques for solving Dynamic Programming problems problems	1
CO 5	PO 1	Quadratic approximation techniques to solve constrained optimization problems by using scientific, mathematical and own engineering discipline principles	3
	PO 2	Direct Quadratic Approximation of different real time applications in engineering are solved by identifying, defining and formulating the problem with data collection, solution development and interpretation of results.	8
	PO 3	Design/Development of solution for Direct Quadratic Approximation problems to solve constrained optimization problems of different engineering applications to meet the specified needs with appropriate Consideration.	8
	PO 4	Use the knowledge of characteristics of Quadrartric Approximation to design , analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	8
	PO 10	Direct Quadratic Approximation problems will be solved with clear applications of engineering and optimization principals.	2
	PO 12	Applying Direct Quadratic Approximation problems in computer science related, industry oriented applications for continous development.	3
	PSO 1	Formulate Direct Quadratic Approximation problems for given statement with constraints, design and develop an algorithm to solve the same for voluminous data processing .	4
	PSO 3	Apply knowledge on frameworks associated with optimization techniques for solving Direct Quadratic Approximation problems	1
CO 6	PO 1	Complex engineering problems are solved by using scientific, mathematical and own engineering discipline principles	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Complex engineering problems of different real time applications in engineering are solved by identifying, defining and formulating the problem with data collection, solution development and interpretation of results.	8
	PO 3	Design/Development of solution for Complex engineering problems of different engineering applications to meet the specified needs with appropriate Consideration.	8
	PO 4	Use the knowledge of characteristics of optimization techniques to design , analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	8
	PO 10	Complex engineering problems will be solved with clear applications of engineering and optimization principals.	2
	PO 12	Applying Complex engineering problems in computer science related, industry oriented applications for continous development.	3
	PSO 1	Formulate Complex engineering problems for the given statement with constraints, design and develop an algorithm to solve the same for voluminous data processing .	4
	PSO 3	Apply knowledge on frameworks associated with optimization techniques for solving Complex Engineering problems	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO / PSO MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	3	6	6	-	-	-	-	-	-	2	-	3	4	-	1
CO 2	3	7	6	8	-	-	-	-	-	2	-	3	4	-	1
CO 3	3	8	8	-	-	-	-	-	-	2	-	3	4	-	1
CO 4	3	6	6	-	-	-	-	-	-	2	-	3	4	-	1
CO 5	3	8	8	8	-	-	-	-	-	2	-	3	4	-	1
CO 6	3	8	8	8	-	-	-	-	-	2	-	3	4	-	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO / PSO:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	100.0	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 2	100.0	70.0	60.0	72.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 3	100.0	80.0	80.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 4	100.0	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 5	100.0	80.0	80.0	72.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0
CO 6	100.0	80.0	80.0	72.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	37.5	66.66	0.0	50.0

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - $0 \leq C \leq 5\%$ – No correlation
2 - 40 % $< C < 60\%$ –Moderate
1-5 $< C \leq 40\%$ – Low/ Slight
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	3	-	-	-	-	-	-	1	-	1	3	-	2
CO 2	3	3	3	3	-	-	-	-	-	1	-	1	3	-	2
CO 3	3	3	3	-	-	-	-	-	-	1	-	1	3	-	2
CO 4	3	3	3	-	-	-	-	-	-	1	-	1	3	-	2
CO 5	3	3	3	3	-	-	-	-	-	1	-	1	3	-	2
CO 6	3	3	3	3	-	-	-	-	-	1	-	1	3	-	2
TOTAL	18	18	18	9	-	-	-	-	-	6	-	6	18	-	12
AVERAGE	3.0	3.0	3.0	3.0	-	-	-	-	-	1	-	1	3.0	-	2

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**LINEAR PROGRAMMING**
	Definition, characteristics and phases, types of models, operations research models, applications, linear programming problem formulation, graphical solution, simplex method; Artificial variables techniques: Two-phase method, Big-M method.
MODULE II	**TRANSPORTATION AND ASSIGNMENT PROBLEMS**
	Transportation problem, formulation, optimal solution, unbalanced transportation problem, degeneracy, assignment problem, formulation, optimal solution, variants of assignment problem, traveling salesman problem
MODULE III	**SEQUENCING AND THEORY OF GAMES**
	Sequencing: Introduction, flow-shop sequencing, n jobs through two machines, n jobs through three machines, job shop sequencing two jobs through m machines. Theory of games: Introduction, terminology, solution of games with saddle points and without saddle points, 2 x 2 games, dominance principle, m x 2 and 2 x n games, graphical method.
MODULE IV	**DYNAMIC PROGRAMMING**
	Introduction: Terminology, Bellman's principle of optimality, applications of dynamic programming shortest path problem, linear programming problem.
MODULE V	**QUADRATIC APPROXIMATION**
	Quadratic approximation methods for constrained problems: Direct quadratic approximation, quadratic approximation of the Lagrangian function, variable metric methods for constrained optimization

TEXT BOOKS

1. A Ravindran, "Engineering Optimization", JohnWiley&Sons Publications, 4thEdition, 2009.
2. Hillier, Liberman, "Introduction to Operation Research", Tata McGraw-Hill, 2nd Edition,2000.

REFERENCE BOOKS:

1. Dr. J K Sharma, "Operation Research", Mac Milan Publications, 5thEdition, 2013.
2. Ronald L. Rardin, "Optimization in Operation Research", Pearson Education Pvt. Limited, 2005.
3. N V S Raju, "Operation Research", S M S Education, 3rdRevised Edition.

COURSE WEB PAGE:

https://lms.iare.ac.in/index ?route=course/details& course id=84

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https://lms.iare.ac.in/index ?route=course/details& course id=84
CONTENT DELIVERY (THEORY)			
1-3	Definition, characteristics and phases, types of models	CO 1, ,CO 6	T1:1.1,1.2
4-6	operations research models, applications	CO 1,CO 6	T1: 1.2.7, 1.2.8
7	linear programming problem formulation, graphical solution	CO 1	T1:1.2.9, 1.2.11, 1.3
8– 14	simplex method, Artificial variables techniques: Two-phase method, Big-M method	CO 1	T1:1.5, 1.4.2,1.4.3
15-20	Transportation problem, formulation, optimal solution, unbalanced transportation problem	CO 2,CO 6	T1:1.4.3, 1.4.4,2.3.1, 2.3.2,2.3.6,2.3.7,2.3.8
21-25	degeneracy, assignment problem, formulation, optimal solution, variants of assignment problem	CO 2	R2:4.3 T1:2.4.1, 2.4.2,2.4.3, 4.1
26-29	traveling salesman problem, Sequencing: Introduction, flow-shop sequencing	CO 2,CO 3,CO 6	T1:3.1,3.2 R1:6.2-6.8
30-35	n jobs through two machines, n jobs through three machines, job shop sequencing two jobs through m machines.	CO 3 ,CO 6	R1: 7.1-7.6
36-38	Theory of games: Introduction, terminology, solution of games with saddle points and without saddle points	CO 3,CO 6	R2:8.1
39-44	2 x 2 games, dominance principle, m x 2 and 2 x n games, graphical method	CO 3	R2:8.2, 8.3
45-48	Introduction: Terminology, Bellman's principle of optimality	CO 4,CO 6	R2: 9.1-9.3
49-54	Applications of dynamic programming shortest path problem, linear programming problem.	CO 4	R2: 9.8, 9.9, 10.1, 10.2

55-59	Quadratic approximation methods for constrained problems: Direct quadratic approximation, quadratic approximation of the Lagrangian function	CO 5,CO 6	T2:5.5, 5.9, 5.10
60	variable metric methods for constrained optimization	CO 5,CO 6	R2:10.4, 10.6,10.7
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on Linear programming formulation	CO1,CO 6	T2:2.1
2	Problems on Simplex methods	CO1	T2:2.3
3	Problems on graphical method	CO1,CO 6	T2:2.3.1
4	Problems on transportation formulation	CO 2	T2:7.2,7.3
5	Problems on Assignment formulation	CO 2,CO 6	T2:10.3.1
6	Problems on unbalanced transportation problems	CO 2,CO 6	T2:13.3.2, 13.4.1
7	Problems on Degeneracy	CO 2	T2:17.1.1, 17.1.3
8	Problems on n jobs on two/three/n machines	CO 2,CO 6	T2:18.3.4, 18.3.4.1
9	Problems on games with saddle point and without saddle point	CO 3	T2:22.12, 19.1.2
10	Problems on 2X2,mx2,2xn and graphical method.	CO 3,CO 6	T2:18.4, 18.4.3
11	Problems on shortest path algorithm	CO 5,CO 6	T2:19.2, 18.4.4
12	Problems on variable metric methods for constrained optimization	CO 5,CO 6	T2:23.1.1, 23.1.3
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Definition on Linear programming	CO 1,CO 6	T2:18.3.4, 18.3.4.1
2	Definition on Transportation and Assignment problems	CO 2,CO 6	T2:22.12, 19.1.2
3	Definition on Sequencing and Game theory	CO 3,CO 6	T2:18.4, 18.4.3
4	Definitions on Quadratic Approximation	CO 4,CO 6	T2:19.2, 18.4.4
5	Definitions on Direct Quadratric Approximation	CO 5, CO6	T2:23.1.1, 23.1.3
DISCUSSION ON QUESTION BANK			
1	Module I	CO 1, CO 6	T2:18.3.4, 18.3.4.1
2	Module II	CO 2, CO 6	T2:22.12, 19.1.2

3	Module III	CO 3, CO6,	T2:18.4, 18.4.3
4	Module IV	CO4, CO 6	T2:19.2, 18.4.4
5	Module V	CO 5, CO 6	T2:23.1.1, 23.1.3

Signature of Course Coordinator **HOD,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION

Course Title	**RESEARCH AND CONTENT DEVELOPMENT**				
Course Code	AHS106				
Program	B.Tech				
Semester	V	ECE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr. B. Surekha Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

Research-based learning (RBL) presents as an alternative learning model that can develop the critical thinking skills. The research-based learning is conducted under constructivism which covers four aspects: learning which constructs students understanding, learning through developing prior knowledge, learning which involves social interaction process, and meaningful learning which is achieved through real-world experience. The major focus is to engage students in the inquiry process where they formulate questions, conduct investigations, apply information and media to learning, and generate products that illustrate learning. The 5E learning cycle adopted for RBL leads students through five phases: Engage, Explore, Explain, Elaborate, and Evaluate which results in greater benefits concerning students ability for scientific inquiry.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Research and Content Development	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

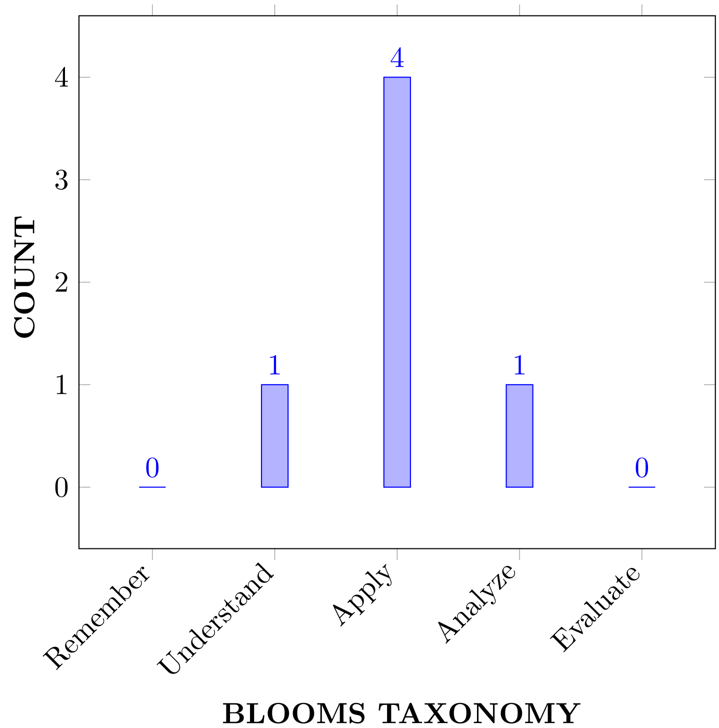
I	Gain a practical understanding of the various methodological tools used for social scientific research.
II	Learn the ethical, political, and pragmatic issues involved in the research process.
III	Improve their ability to develop technical writing.
IV	Identify the overall process of designing a research study from its inception to its report.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Apply** the knowledge of research in finding the gaps from literature survey to formulate new ideas. .	Apply
CO 2	**Apply** the techniques of data collection and sample design involved with different case studies for solving the research problem.	Apply
CO 3	**Analyze** the process of testing involved with the survey results for implementing novel models.	Analyze
CO 4	**Understand** the concepts of formatting styles for different documentation procedures.	Understand
CO 5	**Explore** the knowledge on multimedia tutorials and blogs for research paper development.	Apply
CO 6	**Develop** the presentation skills on the literature findings and research methodologies for advanced interacting tools.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab exercises/ CIE/SEE

PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	2	Lab exercises/ CIE/SEE
PO 9	**Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Lab Exercises
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Lab Exercises
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	2	Lab Exercises
PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	2	Lab Exercises
PSO 3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	**No. of Key Competencies**
CO 1	PO 2	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.	3
	PO 9	**Individual and team work:Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**	2

	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3
CO2	PO2	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.	3
	PO5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3
	PO 9	Individual and team work:Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2
	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3
CO3	PO2	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.	3

	PO5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3
	PO 9	Individual and team work:Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3
	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3
CO4	PO5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3
	PO 9	Individual and team work:Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3
	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3
CO5	PO5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3
	PO 9	Individual and team work:Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3

	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3
CO6	PO 9	Individual and team work:Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3
	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	-	3	-	-	-	-	-	-	2	1	-	2	3	3	3
CO 2	-	3	-	-	3	-	-	-	2	1	-	2	3	3	3
CO 3	-	3	-	-	3	-	-	-	3	1	-	3	3	3	3
CO 4	-	-	-	-	3	-	-	-	3	3	-		3	3	3
CO 5	-	-	-	-	3	-	-	-	3	3	-	2	3	3	3
CO 6	-	-	-	-	-	-	-	-	3	3	-	-	3	3	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	LATEX FOR DOCUMENTATION
	Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check and Track Changes using LaTeX; Mathematical expressions, Subscripts and superscripts, brackets and parentheses, fractions and binomials, aligning equations, operators, spacing in math mode, integrals, sums and limits, display style in math mode, list of Greek letters and math symbols, mathematical fonts; Prepare class timetable and student marks list using LaTex;

WEEK II	RESEARCH FORMULATION AND DESIGN
	Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.
WEEK III	DATA COLLECTION AND SAMPLING DESIGN
	Sources of Date: Primary Dada, Secondary Data; Procedure Questionnaire -Survey and Experiments - Design of survey and Experiments- Sampling Merits and Demirts - Control Observations - Procedures - Sampling Errors.
WEEK IV	CONTENT DEVELOPMENT
	Document design and layout; Papers; Articles; E-book formats. Forums; Multimedia tutorials; Wikis; Blogs; Websites
WEEK V	PROOF READING PROCESS AND REPORT WRITING
	Definition, purpose, difference between content and copy, editing, competing priorities, elements of structure, style and appearance, evaluation, overall organizing, clarity of expression, grammatical accuracy, correctness of layout; Meaning of Interpretation, technique of Interpretation, precaution in Interpretation; Significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports, conclusions.

TEXTBOOKS

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, "An Introduction to Research Methodology", RBSA Publishers. U.K., 2002.
2. Kothari, C.R, "Research Methodology: Methods and Techniques". New Age International. 418p, 1990.
3. Stefan Kottwitz , " LATEX Beginner's Guide", Packt Publishing Limited, 2011.

REFERENCE BOOKS:

1. Meenakshi Raman, Sangeeta Sharma, "Technical Communication", Oxford Publishers, 1st Edition, 2004.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, ESS Publications. 2 volumes.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Introduction to Research Methodology, Documentation and Content Development	CO 1	T1: 1.2
2	Topic selection, Research Formulation and Design for writing working paper by students.	CO 1	T2: 3.5
3	Data Collection and Sampling Design exercises for writing working paper by students	CO 2	T1: 3.4

4	Data Collection and Sampling Design exercises for writing working paper by students	CO 2	T2: 2.2
5	Abstract Writing by using LATEX software.	CO 3	T1: 2.4
6	Writing a Working Paper using LATEX software (Introduction)	CO 3	T3: 4.5
7	Writing a Working Paper using LATEX software (Literature Survey with References)	CO 3	T3: 4.6
8	Report Submission and Seminar of Working Paper (till Literature Survey only)	CO 3	T2: 5.1
9	Writing a Working Paper using LATEX software (Research Methodology)	CO 4	T2: 5.2
10	Writing a Working Paper using LATEX software (Research Methodology)	CO 4	T1: 7.1
11	Writing a Working Paper using LATEX software (Results and Discussion).	CO 4	T1:7.2
12	Writing a Working Paper using LATEX software (Results and Discussion)	CO 5	T1:7.3
13	Writing Working Paper using LATEX software (Conclusion)	CO 5	T1:7.3
14	Proof reading exercises on Working Paper	CO 6	T1:7.3
15	Plagiarism Analysis and Paraphrasing Exercises on Working Paper	CO 6	T2:7.3
16	Report Submission and Seminar on Full Length Working Paper	CO 6	T2:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Integration of knowledge and skills from various areas through more complex investigations and multi-disciplinary projects.
2	Autonomous learning encouraged through independent research of unstructured problems
3	Teamwork, which helps prepare students for a social environment
4	Self-evaluation and self-criticism, against self-competency, trying to see beyond their own ideas and knowledge

Signature of Course Coordinator **HOD,ECE**
Dr. B. Surekha Reddy, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**				
Course Title	**Microprocessors Interfacing and Applications**				
Course Code	AEC023				
Program	B.Tech				
Semester	VI				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms B. Lakshmi Prasanna, Assistant Professor				

I COURSE OVERVIEW:

Microprocessors are the key components in most of the modern embedded and system-on-chip designs. This course outlines the architecture and signal description of Intel microprocessors. The instruction set and assembly language programming along with I/O and memory interfacing techniques are covered. The knowledge acquired from this course will enable the students in development of embedded hardware projects and models for engineering and scientific applications.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS004	III	Computer Organization and Architecture
B.Tech	AEC020	III	Digital Logic Design

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Microprocessors and Interfacing	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with

"either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
50 %	Understand
30 %	Apply
10 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

VI COURSE OBJECTIVES:

The students will try to learn:

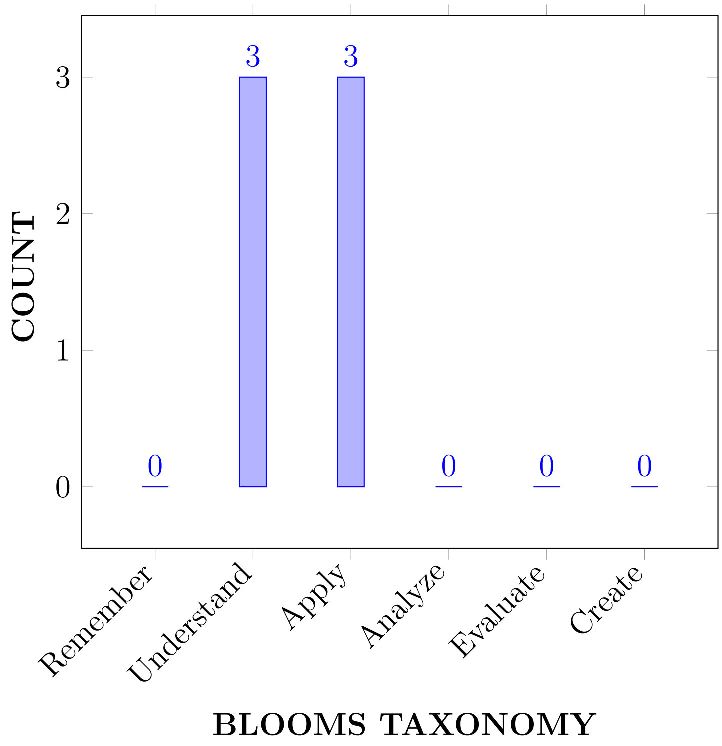
I	The signal descriptions along with functional architecture and hardware interfacing skills using microprocessors.
II	The instruction set and logic to build assembly language programs for arithmetic, logic and automated electronic systems.
III	The essential concepts of development through a practical hands-on approach on advanced ARM processors and Internet of Things based systems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Outline** the functional components of microprocessors for understanding the operation of architectures.	Understand
CO 2	**Make use of** addressing modes and instruction set of target microprocessors for writing an assembly language programs to perform a task.	Apply
CO 3	**Demonstrate** the internal architecture and modes of operation of peripheral devices for interfacing memory and I/O devices.	Understand
CO 4	**Illustrate** the interrupt handling mechanism in microprocessors using interrupt controller.	Understand
CO 5	**Choose** an appropriate data transfer scheme and hardware for data transfer between the devices.	Apply
CO 6	**Develop** microprocessor based applications using necessary input and output devices.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Program Outcomes	
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE, CIE, AAT , QUIZ
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	SEE, CIE, AAT, QUIZ

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE, CIE, AAT , QUIZ
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	SEE, CIE, AAT , QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	✓	-	-	-	-	-	-	-	-	✓	-		-	-	-
CO 2	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	-	-	-	-
CO 4	-	✓	✓	-	-	-	-	-	-	✓	-	-	-	-	-
CO 5	-	✓	✓	-	-	-	-	-	-	✓	-	-	-	-	-
CO 6	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Describe the features and architectures of Intel 8086 processor and Intel 8051 microcontroller (knowledge) by applying the knowledge of **mathematics, Engineering fundamentals,**and electronics **engineering specialization** for understanding the operation.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Explain the functional components of microprocessors and microcontrollers by **giving effective presentations and receive clear instructions** for understanding the operation of architectures.	1
CO 2	PO 1	Illustrate instructions from the set library (knowledge) for efficient assembly level programming by applying the knowledge of **science, engineering fundamentals and mathematics.**	3
	PO 2	Select proper instructions from the instruction set by **Information and data collection** for **Solution development** by writing assembly language level programming efficient and **Interpretation of results**	3
	PO 3	**Manage the design process** and make use of **creativity to establish solutions** by selecting proper mnemonics to write the assembly language level programming by **Understanding of the requirement for engineering activities to promote sustainable development.**	3
	PO 10	Utilize addressing modes and instruction set of target microprocessors and microcontrollers microcontrollers by **giving effective presentations and receive clear instructions** for writing an assembly language programs to perform a task .	1
	PSO 1	Make use of addressing modes and instruction set of target microprocessors and microcontrollers microcontrollers **for designing next-generation computer systems** by writing an assembly language programs to perform a task.	2
CO 3	PO 1	Illustrate the internal architecture and modes of operation of peripheral devices like PPI, DMA controller, PIC, USART by applying the principles of **mathematics, engineering fundamentals, electronics engineering specialization** for the solution of complex engineering problems.	3
	PO 2	Explain the **Problem statement and system definition** for interfacing devices with microprocessor and microcontroller by **Information and data collection** using peripheral devices like PPI, DMA controller, PIC, USART for **Solution development** and **Interpret the results**	4
	PO 3	**Manage the design process and evaluate outcomes** by interfacing devices with microprocessor and microcontroller using Programmable Peripheral Interface (PPI) and Interrupt Controllers **to establish innovative solutions** by**Understanding of the requirement for engineering activities to promote sustainable development**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Describe the internal architecture and modes of operation of peripheral devices by **giving effective presentations and receive clear instructions** for interfacing memory and I/O devices.	1
CO 4	PO 2	Explain the functionality of various types of interrupts and their structure with **Information and data collection** for controlling the processor or controller with program execution flow and**Interpret the results** for **solution development** using interrupt controller.	3
	PO 3	**Understand the requirement for engineering activities to promote sustainable development** in Interrupt handling and **use creativity to establish innovative solutions** using interrupt controller by **Managing the design process and evaluate outcomes**	3
	PO 10	Explain the interrupt handling mechanism in microprocessors and microcontrollers by **giving effective presentations and receive clear instructions** using interrupt controller.	1
CO 5	PO 2	Formulate and analyze (Problem analysis) **complex Engineering problems** by differentiating synchronous & asynchronous communication with **Information and data collection** for data transfer between the devices using first principles of **mathematics and Engineering sciences** and then **Interpret the results**	4
	PO 3	**understand the customer and user needs** and select an appropriate data transfer scheme and hardware by **Managing the design process and evaluate outcomes** to **promote sustainable development** for data transfer between the devices **using creativity to establish innovative solutions**	4
	PO 10	Select an appropriate data transfer scheme and hardware by **giving effective presentations and receive clear instructions** for data transfer between the devices.	1
CO 6	PO 1	Build (Apply)necessary hardware and software interface using microcomputer based systems to provide solution for real world problems by applying **knowledge of mathematics, engineering fundamentals, engineering specialization.**	3
	PO 2	**Identify problem** and Choose necessary hardware and software interface **(information and data collection)** and conduct **experimental design** with **model translation** to provide **solution development** for real world problems **by interpreting results.**	6

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Organize necessary hardware and software interface **based on user needs and importance of considerations** for **innovative solutions, of the problem including all aspects to manage design process** , in microcomputer based systems **by applying different techniques, to achieve required sustained development, with legal requirements governing engineering activities, including personnel, health, safety, and risk issues.**	6
	PO 10	Build microprocessor and microcontroller based applications using necessary input and output devices and **give effective presentations and receive clear instructions.**	1
	PSO 1	**Design next-generation computer systems** and develop microprocessor and microcontroller based applications using necessary input and output devices.	2

Note: For Key Attributes refer **Annexure - I**

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	-	1		-	2	-	-
CO 3	3	4	3	-	-	-	-	-	-	1	-	-	-	-	-
CO 4	-	3	3	-	-	-	-	-	-	1	-	-	-	-	-
CO 5	-	4	4	-	-	-	-	-	-	1	-	-	-	-	-
CO 6	3	6	6	-	-	-	-	-	-	1	-	-	2	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	100	-	-	-	-	-	-	-	-	20	-	-	-	-	-
CO 2	100	30	30	-	-	-	-	-	-	20	-	-	100	-	-
CO 3	100	40	30	-	-	-	-	-	-	20	-	-	-	-	-
CO 4	-	30	30	-	-	-	-	-	-	20	-	-	-	-	-
CO 5	-	40	40	-	-	-	-	-	-	20	-	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 6	100	60	60	-	-	-	-	-	-	20	-	-	100	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	3	1	1	-	-	-	-	-	-	1	-	-	3	-	-
CO 3	3	2	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 4	-	1	1	-	-	-	-	-	-	1	-	-	-	-	-
CO 5	-	2	2	-	-	-	-	-	-	1	-	-	-	-	-
CO 6	3	3	3	-	-	-	-	-	-	1	-	-	3	-	-
TOTAL	**12**	**9**	**8**	-	-	-	-	-	-	**6**	-	-	**6**	-	-
AVERAGE	**3**	**1.8**	**1.6**	-	-	-	-	-	-	**1**	-	-	**3**	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
Quiz	✓	Tech - Talk	-	Certification	-
Term Paper	-	Seminars	-	Student Viva	-
Laboratory Practices	-	5 Minutes Video / Concept Video	-	Open Ended Experiments	-
Micro Projects	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of activities / Modeling and Experimental Tools in Engineering by Experts		

XVIII SYLLABUS:

MODULE I	**OVERVIEW OF 8086 MICROPROCESSOR**
	Introduction to 8085 microprocessor. RISC and CISC processors, architecture of 8086 microprocessor, special functions of general purpose register, 8086 flag register and function of 8086 flags, addressing modes of 8086, instruction set of 8086, assembler directives, simple programs, procedures, and macros.
MODULE II	**PIN DIAGRAM OF 8086 AND AEESMBLY LANGUAGE PROGRAMMING**
	Minimum mode and maximum mode of operation, timing diagram, Assembly language programs: Assembly language programs involving logical, branch and call instructions, sorting, evaluation of arithmetic expressions, string manipulation
MODULE III	**8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI)**
	Various modes of 8255 operation and interfacing to 8086; Interfacing keyboard, displays, 8279 Stepper motor and actuators, digital to analog and analog to digital converter interfacing. Interrupt structure of 8086: Interrupt structure of 8086, Vector interrupt table, interrupt service routines; Introduction to DOS and BIOS interrupts, 8259 PIC architecture and interfacing cascading of interrupt controller and its importance.
MODULE IV	**SERIAL DATA TRANSFER SCHEMES**
	Asynchronous and synchronous data transfer schemes, 8251 USART architecture and interfacing; TTL to RS 232C and RS232C to TTL conversion; Sample program of serial data transfer; Introduction to high-speed serial communications standards, USB.
MODULE V	**ADVANCED MICROPROCESSORS**
	80286 microprocessor: Architecture, registers (Real/Protected mode), privilege levels, descriptor cache, memory access in GDT and LDT, multitasking, addressing modes; Flag register 80386: Architecture, register organization, memory access in protected mode, paging; 80486: Only the technical features.

TEXTBOOKS

1. D. V. Hall, "Microprocessors and Interfacing", Tata McGraw-Hill Education, 3rd Edition 2013.

2. A.K Ray, K. M. Bhurchandani, "Advanced Microprocessors and Peripherals" Tata McGraw-Hill Education, 2nd Edition, 2006.

3. Savaliya M. T, "8086 Programming and Advance Processor Architecture", Wiley India Pvt., 1st Edition,2012.

REFERENCE BOOKS:

1. N. Senthil Kumar, M. Saravanan, S.Jeevanathan, S. K. Shah, "Microprocessors and Interfacing", Oxford University, 1st Edition, 2012.

2. Lyla B. Das, "The x86 Microprocessors", Pearson India, 2nd Edition, 2014.

WEB REFERENCES:

1. http://www.daenotes.com/electronics/digital-electronics/Intel-8085 8 bit microprocessor/axzz2I9yUSe7I

2. http://www.smartzworld.com/notes/microprocessor-and-microcontroller-pdf-notes-mpmc-notes-pdf/

3. http://www.iare.ac.in

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/information technology-autonomous/microprocessors-and-interfacing

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https://https://www.iare.ac.in/?q=courses/computer science-and-engineering-engineering-autonomous/microprocessors-and-interfacing
CONTENT DELIVERY (THEORY)			
2	Register organization of 8086 microprocessor	CO 1	T1:1.1 R2:1.3
3	Flag Register of 8086 Microprocessor	CO 1	T1:1.1 R2:1.2.2
4	Architecture and signal description of 8086 microprocessor	CO 1	T1:1.2 R2:1.1,6.1
5	Physical memory organization of 8086 microprocessor	CO 1	T1:1.4 R2:2.3
7	General bus operation, I/O addressing capability and special purpose activities	CO 1	T1:1.5,1.6,1.7
8	Operation of 8086 microprocessor in minimum mode with read nd write timing diagrams	CO 1	T1:1.8 R2:6.3
9	Operation of 8086 microprocessor in maximum mode with read nd write timing diagrams	CO 1	T1:1.9 R2:6.4
10	Machine language instruction formats	CO 2	T1:2.1 R2:3.1
11	Addressing modes of 8086 Microprocessor	CO 2	T1:2.2 R2:1.4
12	Instruction Set Of 8086 Microprocessor: Data transfer instructions	CO 2	T1:2.3 R2:3.2
13	Instruction Set Of 8086 Microprocessor: Arithmetic and Logical instructions	CO 2	T1: 2.3 R2:3.4,3.5
14	Instruction Set Of 8086 Microprocessor: Program control transfer instructions	CO 2	T1: 2.3 R2:3.3
15	Instruction Set Of 8086 Microprocessor: Machine Control Instructions and Flag manipulation instructions	CO 2	T1: 2.3 R2:3.7
16	Instruction Set Of 8086 Microprocessor: Shift and rotate instructions	CO 2	T1: 2.3 R2:3.6
17	Instruction Set Of 8086 Microprocessor: String instructions	CO 2	T1: 2.3 R2:4.1

18	Assembler Directives and operators	CO 2	T1:2.4 R2:2.2
19	Machine level programs, programming with an assembler	CO 2	T1:3.1,3.2,3.3 R2:2.1
24	Introduction to stack and stack structure of 8086/8088 microprocessor	CO 1	T1:4.1,4.2
25	Interrupts and Interrupt service routines	CO 4	T1:4.3 R2:8.1
26	Interrupt cycle of 8086 microprocessor, non- mask able interrupt and mask able interrupts	CO 4	T1:4.4,4.5,4.6 R2:8.2
27	Interrupt programming	CO 4	T1:4.7
28	Interfacing I/O ports	CO 3	T1:5.3
29	Pin diagram and Architecture 8255 PPI	CO 3	T1:5.4 R2:9.2
30	Operating modes of 8255 PPI	CO 3	T1:5.5 R2:9.3
31	A/D and D/A converters	CO 6	T1:5.6,5.7 R2:9.8,9.9
33	Stepper motor interfacing	CO 6	T1:5.8 R2:9.11
34	Control of high power devices using 8255 PPI	CO 6	T1:5.9
35	Pin configuration of 8259 PIC	CO 4	T1:6.2 R2:10.3
36	Architecture of 8259 PIC	CO 4	T1:6.2 R2:10.3
38	Keyboard /display controller 8279	CO 6	T1:6.3 R2:10.2
40	Programmable communication interface 8251 USART	CO 5	T1:6.4 R2:11.3
42	DMA Controller 8257	CO 3	T1:7.1 R2:11.6
43	TTL to RS 232C and RS232C to TTL conversion	CO 5	T1:17.2 R2:20.1
44	Introduction to high speed serial communications standards	CO 5	T1:17.3
45	USB	CO 5	T1:17.8 R2:19.9
46	80286 microprocessor: Architecture, registers (Real/Protected mode)	CO 1	T1:17.4 R2:19.10
48	privilege levels, descriptor cache, memory access in GDT and LDT	CO 1	T1:17.5 R2:20.3,20.4
49	multitasking	CO 1	T1:17.6 R2:20.6
50	Flag register 80386: Architecture, register organization, memory access in protected mode	CO 1	T1:17.7 R2:20.5
PROBLEM SOLVING/ CASE STUDIES			
6	Physical address calculation	CO 1	T1:1.1 R2:1.1
20	Assembly language programs For Sorting of numbers using 8086 microprocessor	CO 2	T1:3.4 R2:4.7
21	Assembly language programs for multibyte addition and subtraction, sum of squares using 8086 microprocessor	CO 2	T1:3.4 R2:4.7

22	Assembly language programs for String manipulations using 8086 microprocessor	CO 2	T1:3.4 R2:4.1
23	Assembly language programs for Code conversions using 8086 microprocessor	CO 2	T1:3.4 R2:4.4,4.5
28	Memory interfacing to 8086 microprocessor (Static RAM)	CO 3	T1:5.1 R2:12.2,12.3
29	Memory interfacing to 8086 microprocessor (EPROM)	CO 3	T1:5.2 R2:12.4
32	Interfacing A/D and D/A converters with 8086 microprocessor	CO 6	T1:5.6,5.7 R2:9.8,9.9
34	Assembly language programs to rotate stepper motor in clockwise and anticlock wise direction	CO 2	T1:5.8 R2:9.11
37	Cascading of Interrupt Controller and its importance, interfacing 8259 PIC with 8086 microprocessor	CO 4	T1:6.2 R2:10.3,10.4
39	Interfacing keyboard /display controller 8279 to 8086 microprocessor	CO 6	T1:6.3 R2:10.2
41	Interfacing programmable communication interface 8251 USART to 8086 microprocessor	CO 5	T1:6.4 R2:11.3
47	Assembly language programming using data transfer, arithmetic, logical and branch instructions	CO 2	T1:17.8 R2:19.3
51	Sample program of serial data transfer	CO 5	T1:17.6 R2:20.2
52	addressing modes	CO 2	T1:17.9 R2:21.3
53	paging	CO 1	T1:17.9 R2:21.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
54	OVERVIEW OF 8086 MICROPROCESSOR	CO 1, CO 2	T1, R2
55	PIN DIAGRAM OF 8086 AND AEESMBLY LANGUAGE PROGRAMMING	CO 1, CO 2, CO 3	T1, R2
56	8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI)	CO 2, CO 3, CO 4, CO 5, CO 6	T1, R2
57	SERIAL DATA TRANSFER SCHEMES	CO 2, CO 5,	T1, R2
58	ADVANCED MICROPROCESSORS	CO 1, CO 2, CO 6	T1, R2
DISCUSSION OF QUESTION BANK			
59	OVERVIEW OF 8086 MICROPROCESSOR	CO 1, CO 2	T1, R2
60	PIN DIAGRAM OF 8086 AND AEESMBLY LANGUAGE PROGRAMMING	CO 1, CO 2, CO 3	T1, R2

61	8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI)	CO 2, CO 3, CO 4, CO 5, CO 6	T1, R2
62	SERIAL DATA TRANSFER SCHEMES	CO 2, CO 5	T1, R2
63	ADVANCED MICROPROCESSORS	CO 1, CO 2, CO 6	T1, R2

Signature of Course Coordinator
Ms B. Lakshmi Prasanna, Assistant Professor **HOD, ECE**

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences **(Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations **(Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions	**10**

	5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	
PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**

PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project.	**12**

	6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	
PO 10	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally" 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**
PO 11	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**

PO 12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**DATA WAREHOUSING AND DATA MINING**				
Course Code	AIT006				
Program	B.Tech				
Semester	VI	CSE			
Course Type	Core				
Regulation	IARE-R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. M Madhubala, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS005	IV	Database Management System
B.Tech	AHS010	II	Probability and statistics

II COURSE OVERVIEW:

Data mining refers to extracting or mining knowledge from large amounts of data. It emphasizes various techniques and algorithms used to explore, analyze and leverage data and turn it into valuable and actionable information. It includes data warehousing and data mining functionalities such as analytical processing, descriptive analysis, association mining, classification, clustering and outlier analysis. The techniques are used to tackle data centric applications in various domains such as financial analysis, telecommunication industry, intrusion detection, and complex data mining applications in stream, web, text, spatial and other scientific applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Warehousing and Data Mining	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
20 %	Understand
60 %	Apply
10 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

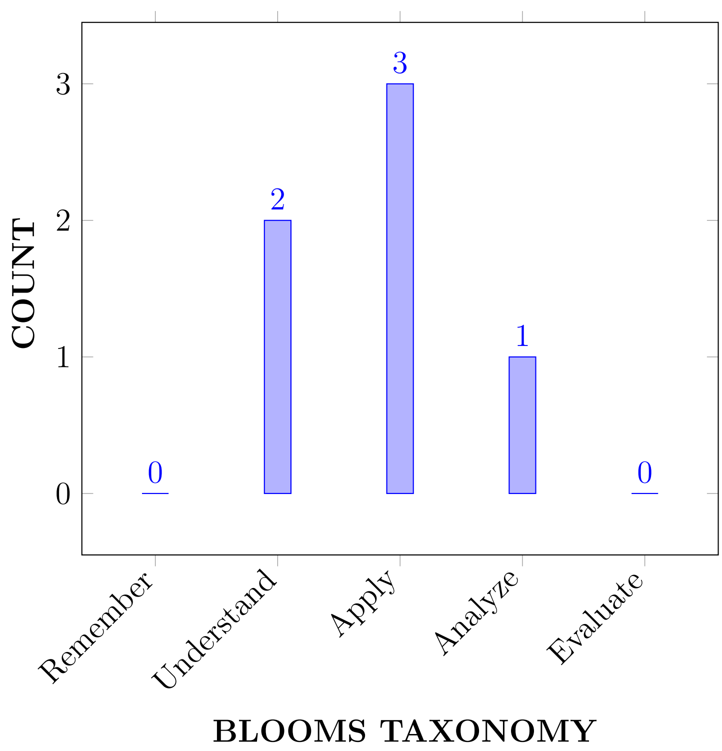
I	The scope and essentiality of data warehousing and mining.
II	The analysis of data, choosing relevant models and algorithms for respective applications.
III	The process and mining of complex data types such as streams, spatial, web and multimedia
IV	The research perspectives towards advances in data mining

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Relate** knowledge discovery in databases (KDD) process with the help of data warehouse fundamentals and data mining functionalities	Understand
CO 2	**Select** appropriate preprocessing techniques on real time data for usage of data mining algorithms	Apply
CO 3	**Apply** Apriori and FP growth methods on transaction data for frequent pattern mining	Apply
CO 4	**Choose** classification or clustering algorithm for building a classification or prediction model.	Apply
CO 5	**Infer** complex data models with respect to multimedia, streams, spatial and web mining	Understand
CO 6	**Examine** data mining algorithms for solving real world problems	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/Quiz/AAT
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE/Quiz/AAT
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	CIE/Quiz/AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyse computer programs in the areas related to Algorithms, System Software, Web design, Bigdata,Artificial Intelligence, Machine Learning and Networking.	3	Quiz
PSO 2	Focus on improving software reliability, network security and information retrieval systems	1	Quiz
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	CIE/Quiz/ AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	✓
CO 4	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓	-	-	-	-	✓	-	-	✓	✓	✓
CO 6	✓	✓	✓	✓	✓	-	-	-	-	✓	-	-	✓	✓	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the knowledge extraction Process by using mathematical ,computer science principles by integrating computer science knowledge.	3
CO 2	PO 1	Explain the data preprocessing techniques by applying mathematical principles and computer science principles by integrating computer science knowledge	3
	PO 2	Understand the data and apply the appropriate preprocessing techniques to solve real time data specific Problem statement and system definition, Problem formulation and abstraction , Information and data collection by including variant sizes of information and data collection, validation, experimental design, solution development and interpretation of results.	8

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation of prediction data model with the engineering community by having major focus on clarity on content with appropriate References and good Speaking style.	3
	PO 12	Recognize the need for advanced concepts in classification and prediction for developing data centric applications through continuing education efforts with ongoing learning stays up with industry trends/ new technology	1
	PSO 1	Develop data mining applications for specific problems by including huge volume of data and related to Algorithms, Artificial Intelligence, Machine Learning.	3
	PSO 2	Develop data mining applications for specific problems with a major focus on improving software reliability, network security and information retrieval systems.	1
	PSO 3	Develop applications by using modern computer tools related to create innovative career paths.	1
CO 3	PO 1	Select appropriate frequent pattern mining method for finding associations among attributes of data in transaction data using mathematical principles and computer science principles by integrating computer science knowledge.	3
	PO 2	Make use of Apriori or FP growth methods on transaction Problem statement and system definition, Problem formulation and abstraction , Information and data collection validation, experimental design, Solution development and interpretation of results.	7
	PO 3	Identify the appropriate model for various problems, by understanding customer and user needs, with cost effective and creative solutions by managing the design process, knowledge on economic context, management techniques for the requirement engineering activities to promote sustainable development.	8
	PSO 1	Make use of data mining concepts on huge volume data used to develop analytical solutions related to Machine Learning.	1
CO 4	PO 1	Develop a prediction model by extending classification model with the help of mathematical and scientific principles by integrating computer science knowledge.	3
	PO 2	Extend a created data model for specific prediction problems by including specific problems by including variant sizes of information and data collection, validation, experimental design, solution development,Implementation ,and interpretation of results and documentation is used as a sample data for new projects	8

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Develop a data model by investigating and defining various problems, understanding customer and user needs, with cost effective and creative solutions with variant algorithms by managing the design process, knowledge on economic context, management techniques.	7
	PO 4	Develop a prediction and classification data model with laboratory skills, technical literature and quality issues to Identify, classify and describe the performance of systems through analytical methodsfor quantitative methodsand technical uncertainty	8
	PO 5	Make use of software / libraries for developing prediction model	1
	PO 10	Communicate effectively in orally and written by comprehend and write effective reports and design documentation and presentations on data exploration with the engineering community by having major focus on clarity on **content, Grammar/Punctuation, appropriate References, good Speaking style and depth in subject matter.**	5
	PO 12	Recognize the need for **advanced concepts** in big data technologies for developing applications through **continuing education efforts with ongoing learning** – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change.	5
	PSO 1	Develop data mining applications for specific problems by including huge volume of data and related to Algorithms, Artificial Intelligence, Machine Learning	3
	PSO 2	Develop data mining applications for specific problems with a major focus on improving software reliability, network security and information retrieval systems.	1
	PSO 3	Develop applications by using modern computer tools related to create innovative career paths	1
. CO 5	PO 1	Select any data models with respect to multimedia, streams, spatial and web mining using mathematical principles and computer science principles by integrating computer science knowledge.	3
	PO 2	Make use of spatial and web mining methods on transaction data collection, validation, experimental design, Solution development and interpretation of results.	5
	PO 3	Select appropriate frequent pattern mining methodfor investigating and defining various problems, understanding customer and user needs, with cost effective and creative solutions with variant algorithms by managing the design process, knowledge on economic context, management techniques.	8

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Develop a text based model with laboratory skills, technical literature and quality issues to Identify, classify and describe the performance of systems through analytical methodsfor quantitative methodsand technical uncertainty	7
	PO 5	Make use of software / libraries for finding text based and web based mining	1
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation of multimedia data model with the engineering community by having major focus on clarity on content	1
	PSO 1	Explain the complex data models used to process and querying the data in the areas related to Algorithms, Artificial Intelligence, Machine Learning	3
	PSO 2	Develop applications using data mining concepts with a major focus on improving software reliability, network securityand information retrieval systems.	1
	PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies	1
. CO 6	PO 1	Understand the data mining model and examine the accuracy of the model by applying mathematical and scientific principles by integrating computer science knowledge.	3
	PO 2	Extend a created data model for specific real time problems by including specific problems by including variant sizes of information and data collection, validation, experimental design, solution development,Implementation ,and interpretation of results and documentation is used as a sample data for new projects	8
	PO 3	Develop a real time model by investigating and defining various problems, understanding customer and user needs, with variant algorithms by managing the design process, knowledge on economic context, management techniques	6
	PO 4	Develop a data model with laboratory skills, technical literature and quality issues to Identify, classify and describe the performance of systems through analytical methods	6
	PO 5	Make use of software / libraries for developing mining model.	1
	PO 10	Communicate in orally form by comprehending and writing effective reports and design documentation data mining applications with the engineering community by having major focus content with good Speaking style.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Categorize various data mining concepts in the areas related to Algorithms, Artificial Intelligence, Machine Learning.	3
	PSO 2	Develop applications using data mining concepts with a major focus on improving software reliability, network securityand information retrieval systems.	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	8	-	-	-	-	-	-	-	1	-	2	3	-	2
CO 3	3	7	8	-	-	-	-	-	-	-	-	-	-	-	1
CO 4	3	8	7	8	1	-	-	-	-	3	-	1	3	1	1
CO 5	3	5	8	7	1	-	-	-	-	1	-	-	3	1	1
CO 6	3	8	6	6	1	-	-	-	-	1	-		3	1	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	100	80	-	-	-	-	-	-	-	20	-	16.6	50	-	100
CO 3	100	70	80	-	-	-	-	-	-	-	-	-	-	-	50
CO 4	100	80	70	72.7	100	-	-	-	-	60	-	8.3	50	50	50
CO 5	100	50	80	63.6	100	-	-	-	-	20	-	-	50	50	50
CO 6	100	80	60	54.5	100	-	-	-	-	20	-		50	50	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\ \% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	3	-	-	-	-	-	-	-	1	-	1	2	-	3
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	3	-	-	-	-	2	-	1	2	2	1
CO 5	3	2	3	3	3	-	-	-	-	1	-	-	2	2	2
CO 6	3	3	2	2	3	-	-	-	-	1	-	-	2	2	-
TOTAL	18	14	11	8	9	-	-	-	-	5	-	2	8	6	8
AVERAGE	3	2.8	2.75	2.6	3.0	-	-	-	-	1.25	-	1	2.0	2.0	2.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**DATA WAREHOUSING**
	Introduction to Data warehouse, A Multi-dimensional data model- Star, Snow flake and Fact constellationschemas, Measures, Concept hierarchy, Data warehouse architecture- A three tier Data warehouse architecture, types of OLAP servers, Data warehouse Implementation, Data Marts, Differences between OLAT and OLTP.
MODULE II	**DATA MINING**
	Introduction, What is Data Mining, Definition, Knowledge Discovery in Data (KDD), Kinds of data bases, Data mining functionalities, Classification of data mining systems, Data mining task primitives, Data Preprocessing: Data cleaning, Data integration and transformation, Data reduction, Data discretization and Concept hierarchy.

MODULE III	**ASSOCIATION RULE MINING**
	Association Rules: Problem Definition, Frequent item set generation, The APRIORI Principle, support and confidence measures, association rule generation; APRIORI algorithm. FP-Growth Algorithms, Compact Representation of Frequent item Set-Maximal Frequent item set, closed frequent item set.
MODULE IV	**CLASSIFICATION AND PRIDICTION**
	Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy.
MODULE V	**CLUSTERING**
	Types of data, categorization of major clustering methods, K-means partitioning methods, hierarchical methods, density based methods, grid based methods, model based clustering methods, outlier analysis. Mining Complex Types of Data: Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.

TEXTBOOKS

1. Jiawei Han, Michelin Kamber, “Data Mining-Concepts and techniques”, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006
2. Alex Berson, Stephen J.Smith, “Data warehousing Data mining and OLAP”, Tata McGraw- Hill, 2nd Edition, 2007

REFERENCE BOOKS:

1. Arum K Pujari, “Data Mining Techniques”, 3rd Edition, Universities Press, 2005
2. Pualraj Ponnaiah, Wiley, “Data Warehousing Fundamentals”, Student Edition, 2004
3. Ralph Kimball, Wiley, “The Data Warehouse Life Cycle Toolkit”, Student Edition, 2006.
4. Vikram Pudi, P Radha Krishna, —Data Mining, Oxford University, 1st Edition, 2007.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. http://www.anderson.ucla.edu
3. https://www.smartzworld.com

COURSE WEB PAGE:

https://www.youtube.com/watch?v=IlD7-ipjQUk

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
CONTENT DELIVERY (THEORY)			
2	Introduction to Data warehouse	CO1	T1: 3.1
3	Difference between operational database systems and datawarehouses	CO1	T1: 3.1
4	Data warehouse architecture- A three tier Data warehouse architecture	CO1	T1: 3.3
5	Types of OLAP servers	CO1	T1: 3.3
6	Data warehouse Implementation	CO1	T1: 3.3
7	Data Marts, Differences between OLAT and OLTP.	CO1	T1: 3.3
8	Multi-dimensional data model: Star Schema	CO5	T1: 3.2
9	Multi-dimensional data model: Snow Flake Schema	CO5	T1: 3.2
10	Fact Consultation, Fact Table, Dimension Table	CO5	T1: 3.2
11	OLAP Cube and OLAP Operations	CO2	T1: 3.4-3.5
12	OLAP Server Architecture-ROLAP	CO2	T1: 3.4-3.5
13	OLAP Server Architecture- MOLAP	CO2	T1: 3.4-3.5
14	OLAP Server Architecture- HOLAP.	CO2	T1: 3.4-3.5
15	Data Mining: Introduction, Fundamentals of Data Mining, Definition	CO1	T1: 1.1-1.7
16	KDD, Challenges, Data Mining Tasks.	CO1	T1: 1.1-1.7
17	Data Processing	CO2	T1: 2.1-2.5
18	Data Cleaning	CO2	T1: 2.1-2.5
19	Dimensionality Reduction	CO2	T1: 2.1-2.5
20	Feature Subset Selections	CO4	T1: 2.3-2.4
21	Data Transformation.	CO4	T1: 2.3-2.4

22	Discretization and Measures of Similarity and Dissimilarity-Basics.	CO4	T1: 2.3-2.4
23	Association Rules	CO5	T1: 5.3
24	Problem definition	CO5	T1: 5.3
25	Frequent item set generation,	CO5	T1: 5.3
26	The APRIORI Principle, Support and confidence measures	CO3	T1: 5.2
27	Association rule generation; APRIORI algorithm.	CO3	T1: 5.2
28	The partition algorithms	CO3	T1: 5.2.2
29	FP-growth Algorithm.	CO3	T1: 5.2.2
30	Compact Representation of Frequent item Set-Maximal Frequent item set closed frequent itemset.	CO5	T1: 5.2.4
31	Classification and prediction	CO4	T1: 6.1-6.2
32	Basic concepts	CO4	T1: 6.1-6.2
33	Classification by Decision Tree Induction	CO4	T1: 6.1-6.2
34	Classification by Back propagation	CO4	T1: 6.1-6.2
35	Issues Regarding Classification and Prediction	CO4	T1: 6.1-6.2
36	Introduction about Bayesian classification	CO4	T1: 6.4
37	Types of Bayesian classification	CO4	T1: 6.4
38	Rule based classification C	CO4	T1: 6.5
39	Classification by back propagation	CO4	T1: 6.5
40	Classification Based on Concepts from Association Rule Mining	CO4, CO6	T1: 6.6
41	Other Classification Methods	CO4, CO6	T1: 6.6
42	Prediction, Classifier Accuracy	CO4, CO6	T1: 6.6
43	Clustering Analysis, Hierarchical methods	CO4	T1: 7.1-7.3
44	Density based methods	CO5	T1: 7.5
45	Grid based methods, outlier analysis	CO5	T1: 7.6
46	Mining Complex Types of Data	CO5	T1: 7.11
47	Multi dimensional Analysis and Descriptive Mining of Complex	CO5	T1: 7.11
48	Types of Data: Data Objects	CO5	T1: 7.11
49	Mining Spatial Databases	CO5	T1: 7.11
50	Mining Multimedia Databases	CO5	T1: 7.11
51	Mining Time-Series and Sequence Data	CO5	T1: 7.11
52	Mining Text Databases	CO6	T1: 7.11
53	Mining The World Wide Web	CO6	T1: 7.11
54	Real Time Applications	CO6	T1: 7.11

55	Example Systems	CO6	T1: 7.11
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on Hierarchical and lattice structures of attributes in warehouse dimensions for location and time.	CO 3	R2:7.5
2	Problems on Multi-dimensional modelling	CO 2	R2:7.5
3	Problems on Analytical processing	CO 3	R2:7.5
4	Problems on Implementation techniques of data warehouse	CO 2	R2:7.5
5	Problems on OLAP operations on multi-dimensional data cube at possible levels.	CO 2	R2:7.5
6	Problems on preprocessing techniques and relate to the given data to perform summarization and visualization	CO 3	R2:7.5
7	Problems on applications of frequent pattern mining methods	CO 3	R2:7.5
8	Problems on frequent item set methods and pattern growth approach	CO 3	R2:7.5
9	Problems on Basic Classification Methods	CO 3	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions on Data Warehousing	CO 1	T1:1.2
2	Definitions on Data Mining	CO 2	T1:1.6
3	Definitions on Association Rule Mining	CO 3	T1:8,9
4	Definitions on Classification and Prediction	CO 4	T1:9.1
5	Definitions on Clustering	CO 5	T1:10,11
DISCUSSION OF QUESTION BANK			
1	Data warehouse architecture	CO 1	T1:1.2
2	Classification of data mining systems	CO 2	T1:1.5
3	FP-Growth Algorithms	CO 3	T1:8,9
4	Issues Regarding Classification and Prediction	CO 4	T1:9.1
5	Clustering Methods	CO 5,6	T1:10,11

Signature of Course Coordinator **HOD,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING
COURSE DESCRIPTION

Course Title	IDEATION AND PRODUCT DEVELOPMENT				
Course Code	AEC201				
Program	B.Tech				
Semester	V	ECE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr. D Srikar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

Ideation and product development lab mainly focuses on the creation of concrete solutions to specific problems. This is particularly challenging when the solution and its elements are entirely unknown. In so-called top-down approaches, the development focus is on the desired features of the new product rather than on already existing solutions or their elements. Both methods from product development, such as creativity techniques, and methods from lightweight design, such as physical surrogate modeling, help to explore the unknown and find a way to new solutions to complex problems. For complex problems, it is often important to consider the entire system by adopting a holistic and interdisciplinary view. In both lightweight design and in product development, all relevant requirements on a product, all aspects of feasibility and constraints on realization, and all interactions of all system components have to be taken into account.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Research and Content Development	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

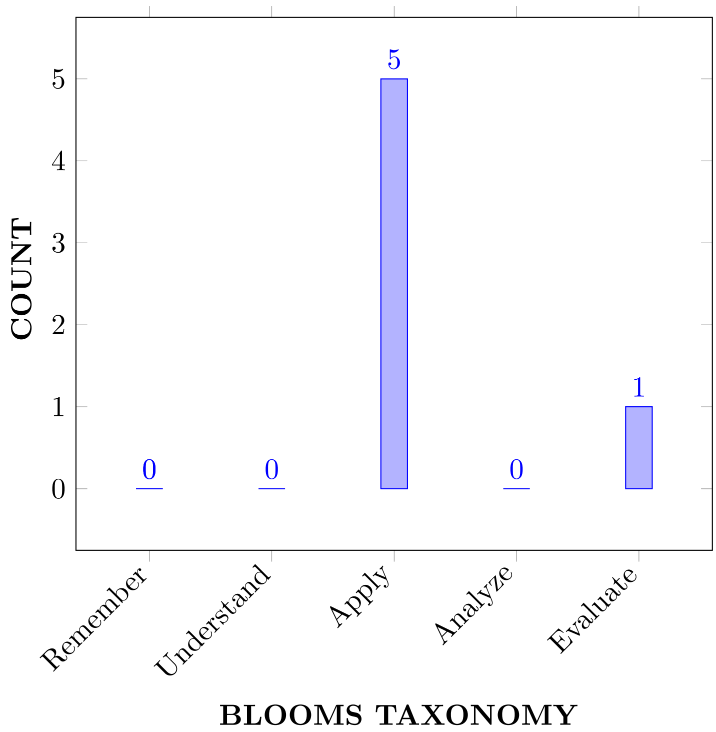
I	To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
II	To understand about the future needs of industries.
III	To transform innovative ideas into successful businesses.
IV	To use a range of creative thinking tools to develop Out of the Box Ideas.
V	To develop Breakthrough Innovators and Dynamic Thinkers.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Develop** knowledge and skills from various areas through more complex and multidisciplinary projects to select a research topic. .	Apply
CO 2	**Organize** the collected evidences to make quantitative, qualitative and statistical analysis for finding the research problem.	Apply
CO 3	**Solve** unstructured problems that need research as an individual or as a member/leader in diverse teams to discern which information is reliable and which is not.	Apply
CO 4	**Make use of** a software tool by running simulations rigorously to get the desired output for the research problem found.	Apply
CO 5	**Assess** the outputs achieved by making judgments about information and validity of ideas for confirming the quality of work based on a set of criteria.	Evaluate
CO 6	**Build** a hardware prototype to test and analyze the product designed for an application.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.	2	Lab exercises/ CIE/SEE

PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab exercises/ CIE/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.	2	Lab exercises/ CIE/SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Lab exercises/ CIE/SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	2	Lab exercises/ CIE/SEE
PO 9	**Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Lab Exercises
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Lab Exercises
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	2	Lab Exercises
PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	2	Lab Exercises

PSO 3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.	3
	PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
CO 2	PO 2	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.	1
	PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1
	PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2
	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
	PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems..	3
	PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1

CO 3	PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2
	PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2
	PO 10	Communicate effectively on complex Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
CO 4	PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2
	PO 5	Create, select, and apply appropriate techniques, resources, and modernEngineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations .	3
	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3
	PSO 1	Build Embedded Software and Digital Circuit Development platform for Robotics, Embedded Systems and Signal Processing Applications.	3
	PSO2	Focus on the Application Specific Integrated Circuit (ASIC) Prototype designs, Virtual Instrumentation and System on Chip (SOC) designs.	3
	PSO3	Make use of High Frequency Structure Simulator (HFSS) for modeling and evaluating the Patch and Smart Antennas for Wired and Wireless Communication Applications.	3
CO 5	PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.	2
	PO 2	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.	1
	PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3

	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2
CO 6	PO 2	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.	1
	PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3
	PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	11	9	8
CO 1	3	-	-	2	-	-	-	-	-	2	-	-	-	-	-
CO 2	-	1	1	2	-	-	-	-	-	2	-	-	-	-	-
CO 3	3	-	1	2	-	-	-	-	-	2	-	-	-	-	-
CO 4	-	-	-	2	3	-	-	-	-	3	-		3	3	3
CO 5	2	1	-	1	-	-	-	-	-	3	-	2	-	-	-
CO 6	-	1	-	1	-	-	-	-	-	3	-	2	-	-	-

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 2, PO 9, PO 12	SEE Exams	PO 2,PO 9, PO 12	Seminars	-
Laboratory Practices	PO 2,PO 5, PO 9, P012 ,PSO1,PSO2	Student Viva	PO 2, PO5, PSO2,PSO3	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**INTRODUCTION TO PRODUCT DEVELOPMENT**
	Product development -Examples of product development process-theories and methodologies-Product development teams- Product development planning process-Technical and business concerns. Understanding customer needs-Customer satisfaction -gathering customer needsOrganising and prioritizing customer needs.
WEEK II	**ESTABLISHING PRODUCT FUNCTION**
	Functional decomposition, Modeling process, Function trees, Creating function structure, Auguementation, Functional common basis.
WEEK III	**PRODUCT TEARDOWN AND EXPERIMENTATION**
	Teardown process, Teardown methods, Post teardown reporting- Applications of product teardown.

WEEK IV	**BENCHMARKING AND ESTABLISHING ENGINEERING SPECIFICATIONS**
	Benchmarking approach, examples, Support tools, Setting product specifications-Product portfolios architecture types, theory, platforms. Product architecture - Types and examples, Product modularity, Modular design and methods.
WEEK V	**GENERATING, SELECTION AND EMBODIMENT OF CONCEPTS**
	Concept generation process, methodsBasic and advanced-Morphological analysis, Concept selection process, Factors, Design evaluation, Information quality, Feasibility-Basic and advanced methods, Concept embodiment: General process, advanced methods Modeling of product metrics: Model selection, Model preparation, Mathematical modeling, Construction of product models.

TEXTBOOKS

1. Product Design: Techniques in Reverse engineering New Product development. K Otto K Wood. Prentice Hall, 2001. ISBN 0-13-0212271-7 TCD Shelf Mark. HL-236-568.
2. Invention by design: how engineers get from thought to thing, Petroski H. Cambridge, Mass., London, Harvard University Press, 1996. ISBN 0674463676. TCD Shelf Mark. HL-201-280.
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Tim Brown, Harper Business, 2009, ISBN 978-0061766084.
4. Creative Confidence: Unleashing the Creative Potential Within Us All, Tom David Kelley, Crown Business, 2013, ISBN 978-0385349369.

REFERENCE BOOKS:

1. Kevin N. Otto and Kristin L. Wood - Product Design Pearson Education 2001
2. Smith, Preston G., Reinertsen Donald G. (1991) Developing products in half the time, Van Nostrand Reinhold, New York.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Successful team formation and management	CO 3	T1: 1.3
2	Introduction to user-centred design	CO 1	T2: 2.4
3	Ideation and use of personas and POVs	CO 2	T1: 3.2
4	Need finding	CO 2	T2: 2.5
5	Embedded Microcontrollers for consumer products	CO 6	T1: 3.3
6	Human factors in engineering design	CO 2	T3: 4.2
7	Critical Experience and Critical Function Prototyping	CO 4	T3: 4.5
9	Dark Horse and Funky' prototyping	CO 5	T4: 5.1
10	Rapid prototyping and manufacturing	CO 6	T4: 6.5
11	User testing	CO 6	T1:6.1
12	Use of video/electronic media for communication	CO 6	T1:6.4

13	Start-ups and entrepreneurship	CO 6	T1:6.5
14	Intellectual Property	CO 6	T1:6.6

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Integration of knowledge and skills from various areas through more complex investigations and multi-disciplinary projects.
2	Autonomous learning encouraged through independent research of unstructured problems
3	Teamwork, which helps prepare students for a social environment
4	Self-evaluation and self-criticism, against self-competency, trying to see beyond their own ideas and knowledge

Signature of Course Coordinator **HOD,ECE**
Dr. D Srikar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**Information Technology**				
Course Title	**Software Testing Methodologies**				
Course Code	AIT008				
Program	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	1	2
Course Coordinator	Mr E Sunil Reddy,Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS008	IV	Software Engineering

II COURSE OVERVIEW:

The course will describe the basic techniques for testing and tools that can be used to perform automatic and manual testing for generating and validating test data. It will provide deeper insights into domain testing, path testing, transaction flow testing and transition testing. This course is used in the applications of banking system, library management, hotel management etc.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Software Testing Methodology	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	✓	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
40%	Understand
33 %	Apply
17%	Analyze
0%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI COURSE OBJECTIVES:

The students will try to learn:

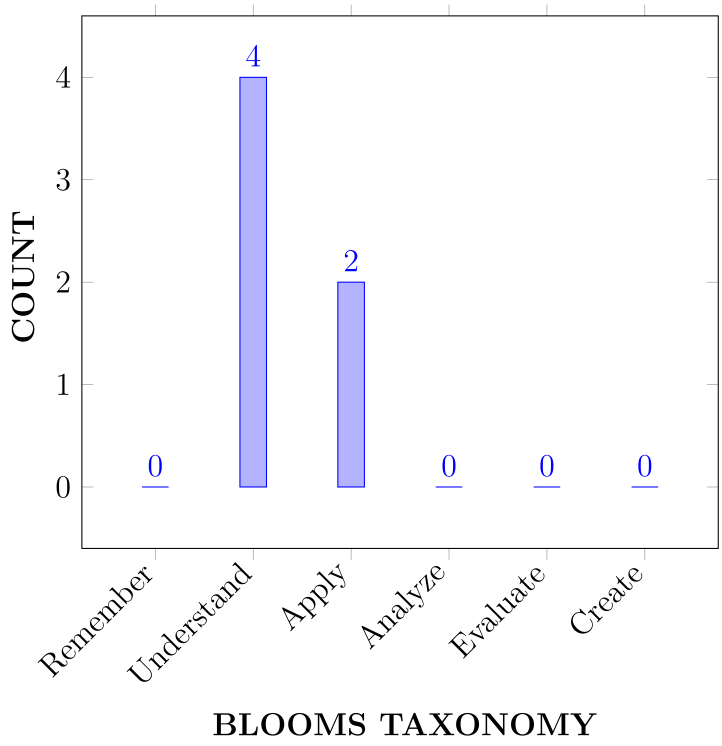
I	The scope and essentiality of software testing concepts, taxonomy and dichotomies related to software testing.
II	The techniques used to test a path, branch, statement coverage of a given software module.
III	The techniques and principles in software testing related to transaction flow and statement testing.
IV	The hypothesis on the optimized software module used in solving complex problems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the concept of software testing objectives, process criteria, strategies and methods for effective testing.	Understand
CO 2	**Classify** the key issues and applications in transaction flow testing and data flow testing strategies.	Understand
CO 3	**Make use of** domains and paths in order to identify nice and ugly domains in domain testing	Apply
CO 4	**Translate** the path expressions using logic based testing to KV charts and its specifications.	Understand
CO 5	**Develop** a defect free module using path products and path expressions.	Apply
CO 6	**Explain** the importance of good state graph and bad state graph related to transition testing for effective transition testing.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	SEE/CIE/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE/CIE/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE/CIE/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	2	SEE/CIE/AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	SEE/CIE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	SEE/CIE/AAT
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	1	SEE/CIE/AAT
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry	3	SEE/CIE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	✓	-	-		-	-	-	-	-	-	-	-	-	
CO 5	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓	✓
CO	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the concept of software testing objectives, process criteria, strategies and methods related to testing.	1
CO 2	PO 1	Explain the basics of data flow testing and the criteria related to data flow testing	2
	PO 2	Make use of domains and paths in order to identify nice and ugly domains in domain testing	6
	PO 3	Translate the path expressions using logic based testing to KV charts and its specifications.	7

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 1	Make use of domains and paths in order to identify nice and ugly domains in domain testing.	1
	PO 2	Explain the basics of data flow testing and the criteria related to data flow testing.	3
	PO 4	Make use of domains and paths in order to identify nice and ugly domains in domain testing.	3
	PSO 1	Translate the path expressions using logic based testing to KV charts and its specifications.	4
CO 4	PO 1	Develop a defect free module using path products and path expressions.	2
	PO 2	Develop applications for path expressions and path products	6
CO 5	PO 1	Explain the importance of good state graph and bad state graph related to transition testing.	3
	PO 2	Demonstrate state graphs and transition testing with its various testability tips.	6
	PO 3	Explain the basics of data flow testing and the criteria related to data flow testing.	7
	PO 4	Make use of domains and paths in order to identify nice and ugly domains in domain testing.	5
	PO 5	Translate the path expressions using logic based testing to KV charts and its specifications.	4
	PSO 1	Explain the basics of data flow testing and the criteria related to data flow testing.	1
	PSO 2	Make use of domains and paths in order to identify nice and ugly domains in domain testing.	1
	PSO 3	Translate the path expressions using logic based testing to KV charts and its specifications.	2
CO 6	PO 1	Develop a defect free module using path products and path expressions.	3
	PO 2	Develop applications for path expressions and path products.	6
	PO 3	Explain the importance of good state graph and bad state graph related to transition testing.	7
	PSO 1	Demonstrate state graphs and transition testing with its various testability tips.	5

*Note: Refer appendix-I for key competencies

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	1	1	1

CO 1	1	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	6	7	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	6	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	3	6	7	5	1	-	-	-	-	-	-	-	4	1	2
CO 6	3	6	7	-	-	-	-	-	-	-	-	-	5	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	60.0	70.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	33.3	30.0	30.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	60.0	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	100	60.0	70.0	45.5	100	-	-	-	-	-	-	-	66.7	33.3	66.7
CO 6	100	60.0	70.0	-	-	-	-	-	-	-	-	-	66.7	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -5 $< C \leq 40\%$ – Low/ Slight

2 - 40 % $< C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	3	3	3	2	3	-	-	-	-	-	-	-	3	1	3 -
CO 6	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
TOTAL	14	13	10	2	3	-	-	-	-	-	-	-	6	1	3
AVERAGE	2.3	2.6	2.5	2.0	3.0	-	-	-	-	-	-	-	3.0	1.0	3.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO TESTING**
	Introduction: Purpose of testing, dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and path testing: Basics concepts of path testing, predicates, path predicates and Achievable paths, path sensitizing, path instrumentation, application of path testing.
MODULE II	**TRANSACTION FLOW TESTING**
	Transaction flow testing: Transaction flows, transaction flow testing techniques, dataflow testing, basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.
MODULE III	**LEVELS OF TESTING**
	Domain testing: Domains and paths, nice and ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability. Logic based testing: Overview, decision tables, path expressions, kv charts, and specifications.
MODULE IV	**PATH PRODUCTS**
	Paths, path products and regular expressions: Path products and path expression, reduction procedure, applications, regular expressions and flow anomaly detection.
MODULE V	**TRANSITION TESTING**
	State, state graphs and transition testing: State graphs, good and bad state graphs, state testing, testability tips.

TEXTBOOKS

1. Boris Beizer, —Software Testing Techniques‖, Dreamtech Press, 2 nd Edition, 2003.

REFERENCE BOOKS:

1. P. C. Jorgenson, —Software Testing: A Craftmen‘s Approach, Auerbach Publications, 3 rd Edition, 2013.
2. Perry, —Effective Methods of Software Testing‖, John Wiley, 2 nd Edition, 1999.
3. P. Nageswara Rao, —Software Testing Concepts and Tools, DreamTech Press, 2 nd Edition, 2007.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		W1
CONTENT DELIVERY (THEORY)			
2	Introduction: Purpose of testing	CO 1	R1:1.1
3	Dichotomies, model for testing.	CO 2	T1:1.2
5	Model for testing.	CO 3	T1:1.3
6	Consequences of bugs, taxonomy of bugs.	CO 4	R1:1.5
9	Path testing and predicate, loops and path Sensitization.	CO 5	T1:3.2
10	Path instrumentation and their applications and link markers.	CO 6	T1:3.5
11	Transaction flows techniques ,Transaction flows, transaction flow testing technique	CO 7	T1:4.3
13	Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.	CO 8	T1:5.2
14	Domains and paths, Nice and ugly domains, domain testing.	CO 9	T1:6.2;
15	Domains and interfaces testing,	CO 10	T1:6.5
16	Domains and testability.	CO 11	T1:6.5
18	Logic based testing and decision tables.	CO 12	T1:10.2
20	Path expressions, k v charts, specifications	CO 13	T1:10.4
21	Path products and path expression	CO 14	R1:4.2.4
22	Reduction procedure, applications, regular expressions and flow anomaly detection	CO 15,CO 16, CO 17	T1:8.4
23	State graphs, good bad state graphs	CO 18,CO 19, CO 20	T1:11.3
25	State testing, Testability tips.	CO 19,CO 20	T1:11.3

Signature of Course Coordinator **HOD, IT**
Mr E Sunil Reddy Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY

COURSE DESCRIPTION

Course Title	**BIG DATA AND BUSINESS ANALYTICS**				
Course Code	ACS012				
Program	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	3	2
Course Coordinator	B Pravallika,Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB08	IV	Database Management Systems

II COURSE OVERVIEW:

This course provides a clear understanding on concepts of sources of big data, characteristics, storing and processing components, and analytics applications. This course emphasizes on potential impact of big data challenges, open research issues, and various tools associated with it. This course includes the introduction and processing big data with an overview of Hadoop technology and its components such as pig, hive, etc.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Big Data and Business Analytics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
40 %	Understand
50 %	Apply
10 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

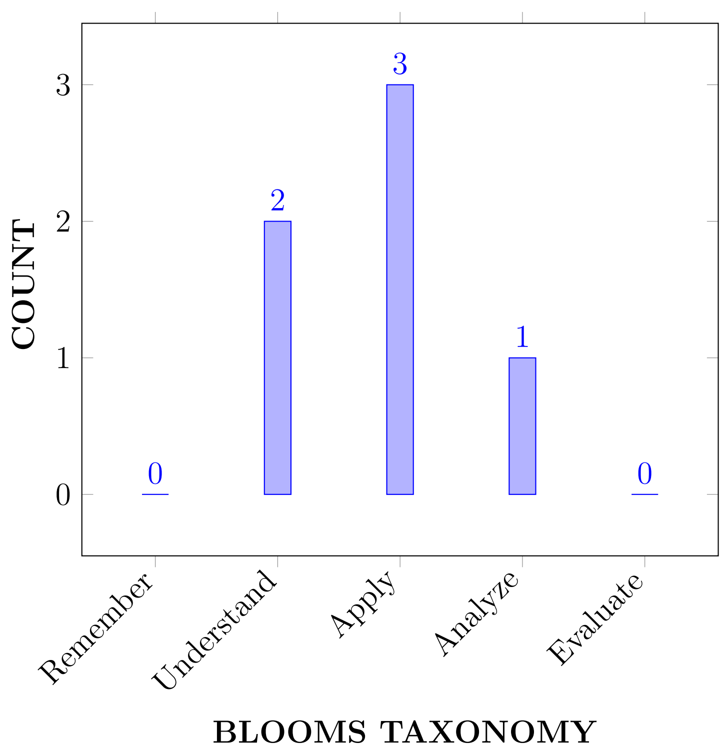
I	The scope and essentiality of Big Data and Business Analytics.
II	The technologies used to store, manage, and analyze big data in a Hadoop ecosystem.
III	The techniques and principles in big data analytics with scalability and streaming capability.
IV	The hypothesis on the optimized business decisions in solving complex real-world problems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the evolution of big data and big data analytics along with its characteristics and challenges included in traditional business intelligence.	Understand
CO 2	**Make use of** appropriate components for processing, scheduling and knowledge extraction from large volumes the applications for handling huge volume of data	Apply
CO 3	**Develop** a Map Reduce application for optimizing the jobs.	Apply
CO 4	**Develop** the applications for handling huge volume of data using Pig Latin.	Apply
CO 5	**Explain** the importance of bigdata framework HIVE and its built-in functions, data types and services like DDL in Hadoop distributed file system.	Understand
CO 6	**Extend** the big data technologies used to process and querying the bigdata in Hadoop, MapReduce, Pig and Hive.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ SEE /CIE,AAT, QUIZ
PO 5	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Assignments
PO 12	**Life - Long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	SEE/ CIE, AAT, QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	Research papers/ Group discussion/ Short term courses
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	2	Research papers/ Group discussion/ Short term courses
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	3	Research papers/ Group discussion/ Short term courses

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 3	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓-	✓	✓
CO 4	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 5	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 6	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Compare big data analysis and analytics in optimizing business decisions **knowledge** by using the **mathematical principles** and **computer science methodologies**.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	Explain the evolution of big data and big data analytics along with its characteristics the **problem** and challenges includes the **problem statement,data collection ,validation** and **documentation** in traditional business intelligence.	5
	PO 3	Explain the evolution of big data in **knowledge and understanding** the big data analytics along with its characteristics and **understand** and **manage**challenges included in traditional business intelligence in **engineering process**.	4
	PO 5	Explain the evolution of big data and big data analytics along with its characteristics and challenges included in traditional business intelligence in **computer software**.	1
	PO 10	Explain the evolution of big data and big data analytics along with its characteristics in**clarity** and also challenges included in traditional business intelligence in **reference**.	2
	PO 12	**keeping trend in CSE** Explain the evolution of big data and big data analytics along with its characteristics in **personal continuing** and **on going learning** in challenges included in traditional business intelligence in **project management**.	4
	PSO 1	Explain the evolution of big data and big data analytics along with its characteristics and challenges in **search engines ,next generation computer systems,networking devices**,included in traditional business intelligence in **knowledge discovery tools**.	4
	PSO 2	Explain the evolution of big data and big data analytics along with its characteristics and challenges in **mobile and web application development** included in traditional business intelligence.	2
	PSO 3	Explain the evolution of big data and big data analytics along with its characteristics and challenges included in traditional business intelligence in **practical experience in shipping real world software ,using industry standard tools**.	2
CO 2	PO 1	Make use of appropriate components for processing, scheduling and knowledge extraction from large volumes the applications for handling huge volume of data by **applying mathematical principles,scientific methodology,computer science**	3
	PO 2	**identify problem,problem statement** and Make use of appropriate components for processing, scheduling and knowledge extraction to **validate the data** from large volumes for applications to handling huge volume of data in **information and data collection** in **documentation**	7

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	**Investigate and define a problem identification** appropriate components for processing, scheduling and knowledge extraction from large volumes the applications for handling huge volume of data **to manage the design process**	4
	PO 5	Make use of appropriate components for processing, scheduling and knowledge extraction from large volumes the applications for handling huge volume of data in **computer software**	1
	PO 10	Make use of appropriate components for processing, scheduling and knowledge extraction from large volumes in **clarity** the applications for handling huge volume of data with **reference**	2
	PO 12	Make use of appropriate components for processing, scheduling and knowledge extraction from large volumes the applications for handling huge volume of data **In personal continued and ongoing learning**	3
	PSO 1	Make use of Hadoop components on huge volume data used to develop analytical solutions related to **Bigdata, Artificial Intelligence, Machine Learning and Networking**.	4
	PSO 2	Make use of Hadoop components on huge volume data used to develop analytical solutions related to **mobile and web application in emerging technologies**.	3
	PSO 3	Make use of Hadoop components on huge volume data used to develop analytical solutions related to**using industry standard tools and collabaration**.	2
CO 3	PO 1	Apply scientific **principles and methodologies, other engineering disciplines** in map reduce, Hadoop.	3
	PO 2	**Problem** Analysis in map reduce,**problem statement,datacollection,validation,documentation** in Hadoop.	5
	PO 3	Get the **knowledge and understanding** of a Map Reduce application **understand** and **manage** for optimizing the jobs in **engineering process**.	5
	PO 5	Develop a Map Reduce application for optimizing the jobs in **computer software**.	1
	PO 12	**keeping trend in CSE** Develop a Map Reduce application for optimizing the jobs in **personal continuing,on going learning, project management**.	4
	PSO 1	Develop a Map Reduce application for optimizing the jobs in **Big data,Artificial Intelligence,Machine learning**.	3
	PSO 2	Develop a Map Reduce application for optimizing the jobs in **mobile and web application in emerging technologies**.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Develop a Map Reduce application for optimizing the jobs related to using **industry standard tools**	1
CO 4	PO 1	Apply **scientific principles and methodologies, other engineering disciplines** to applications for handling huge volume of data using Pig Latin.	3
	PO 2	Analyze **problem,problem statement** in applications for handling huge volume of data using Pig Latin in **data collection,validation,documentation**.	5
	PO 3	**Conduct investigation of complex problems** for developing virtual machines using **knowledge of process, laboratory skills, understanding knowledge and ability to apply a systems approach** application for handling huge volume of data using Pig Latin.	4
	PO 5	Develop the applications for handling huge volume of data using Pig Latin in **computer software**.	1
	PO 10	Develop the applications with **clarity** for handling huge volume of data using Pig Latin with **reference**.	2
	PO 12	**Keeping current in CSE and advanced engineering concepts** of advanced applications for handling huge volume of data using Pig Latin in **personal continuing,on going,project management**	4
	PSO 1	**Understand, Design and Analyze Computer Programs** used in applications for handling huge volume of data using Pig Latin.	2
	PSO 2	**Focus on improving Network Security and IRS** in developing applications for handling huge volume of data using Pig Latin.	1
	PSO 3	Develop the applications for handling huge volume of data using Pig Latin in **Industry standard tools and collabaration** .	1
CO 5	PO 1	Understand the importance of big data framework HIVE by using **computer science methodologies, mathematical and scientific principles**.	3
	PO 2	Demonstrate the HIVE functions and services for specific problems by including huge volume of **information and data collection, file structure translation, validation and solution development with proper documentation**.	5
	PO 3	Explain the HIVE application process by including **various problems, customer and user needs, with cost effective and creative solutions by managing the design process, knowledge on economic context, management techniques**.	5
	PO 5	Explain the HIVE application process by **computer software**.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	the importance of bigdata framework HIVE and its built-in functions, data types and services like DDL in **clarity** DDLin Hadoop distributed file system in **reference**	2
	PO 12	**keeping trend in CSE** Explain the HIVE application in **personal continuning** and **On going learning** process by **project management**.	4
	PSO 1	Explain the HIVE features and services for analyzing programs in the areas related to **Algorithms, Bigdata, Artificial Intelligence, Machine Learning and Networking**.	4
	PSO 2	Explain the HIVE features and services for analyzing programs in the areas related to **Mobile and web applicatin in emerging technologies** .	3
	PSO 3	Explain the HIVE features and services for analyzing programs in the areas related to **Industry standard tools and collabaration** .	2
CO 6	PO 1	Explain the big data technologies used to process and querying the bigdata by **applying mathematical principles and computer science methodologies**	3
	PO 2	Understand the **problem** and develop solutions using **big data technologies and document the results for interpretation**	4
	PO 3	Identify the appropriate technology like pig, hive etc. suitable for **various problems, by understanding customer and user needs, with cost effective and creative solutions by managing the design process, knowledge on economic context, management techniques**.	4
	PO 5	Identify the appropriate technology like pig, hive etc. suitable for **computer software**	1
	PO 10	Identify the appropriate technology like pig, hive etc in **clarity**. with suitable examples for **Reference**	2
	PO 12	**keeping current in CSE and advanced engineering concepts**Identify the appropriate technology like pig, hive etc in **personal continuing ,on going,project management**.	7
	PSO 1	Explain the big data technologies used to process and querying the bigdata in the areas related to **Algorithms, Bigdata, Artificial Intelligence, Machine Learning and Networking**.	4
	PSO 2	Explain the big data technologies used to process and querying the bigdata in the areas related to**Mobile and web applicatin in emerging technolgies**.	4
	PSO 3	Explain the big data technologies used to process and querying the bigdata in the areas related to **Industry standard tols and collabaration**.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	8	6	2	3
CO 1	3	4	4	-	1	-	-	-	-	2	-	4	4	2	2
CO 2	3	7	4	-	1	-	-	-	-	2	-	5	4	2	2
CO 3	3	4	4	-	1	-	-	-	-	2	-	4	4	2	2
CO 4	3	4	4	-	1	-	-	-	-	2	-	4	3	1	2
CO 5	3	4	4	-	1	-	-	-	-	2	-	5	4	2	2
CO 6	3	4	4	-	1	-	-	-	-	2	-	4	3	2	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	40	40	-	100	-	-	-	-	40	-	50	66.6	100	66.6
CO 2	100	70	40	-	100	-	-	-	-	40	-	62.5	66.6	66.6	40
CO 3	100	40	40	-	100	-	-	-	-	40	-	50	66.6	60	60
CO 4	40	40	40	-	100	-	-	-	-	40	-	50	40	60	40
CO 5	100	40	40	-	100	-	-	-	-	40	-	62.5	40	60	40
CO 6	100	40	40	-	100	-	-	-	-	40	-	50	40	60	60

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	3	-	-	-	-	2	-	2	3	2	2
CO 2	3	3	2	-	3	-	-	-	-	2	-	3	3	2	2
CO 3	3	2	2	-	3	-	-	-	-	2	-	2	3	2	1
CO 4	3	2	2	-	3	-	-	-	-	2	-	2	2	2	1
CO 5	3	2	2	-	3	-	-	-	-	2	-	3	3	1	1
CO 6	3	2	2	-	3	-	-	-	-	2	-	2	2	3	2

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE-I	**INTRODUCTION TO BIG DATA**
	Introduction to Big data: Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, Traditional Business Intelligence (BI) versus Big Data. Big data analytics: Classification of Analytics, Importance and challenges facing big data, Terminologies Used in Big Data Environments, The Big Data Technology Landscape.
MODULE II	**INTRODUCTION TO HADOOP**
	Introducing Hadoop, RDBMS versus Hadoop, Distributed Computing Challenges, History and overview of Hadoop, Use Case of Hadoop, Hadoop Distributors, Processing Data with Hadoop, Interacting with Hadoop Ecosystem
MODULE III	**THE HADOOP DISTRIBUTED FILESYSTEM**
	Hadoop Distributed File System (HDFS): The Design of HDFS, HDFS Concepts, Basic Filesystem Operations, Hadoop Filesystems. The Java Interface- Reading Data from a Hadoop URL, Reading Data Using the Filesystem API, Writing Data. Data Flow- Anatomy of a File Read, Anatomy of a File Write, Limitations.
MODULE IV	**UNDERSTANDING MAP REDUCE FUNDAMENTALS**
	Map Reduce Framework: Exploring the features of Map Reduce, Working of MapReduce, Exploring Map and Reduce Functions, Techniques to optimize MapReduce jobs, Uses of MapReduce. Controlling MapReduce Execution with Input Format, Reading Data with custom Record Reader, -Reader, Writer, Combiner, Partitioners, MapReduce Phases, Developing simple MapReduce Application.
MODULE V	**INTRODUCTION TO PIG AND HIVE**
	Introducing Pig: Pig architecture, Benefits, Installing Pig, Properties of Pig, Running Pig, Getting started with Pig Latin, Working with operators in Pig, Working with functions in Pig. Introducing Hive: Getting started with Hive, Hive Services, Data types in Hive, Built-in functions in Hive, Hive DDL.

TEXTBOOKS

1. Seema Acharya, Subhashini Chellappan, —Big Data and Analytics, Wiley Publications, 2nd Edition,2014DT Editorial Services, —Big Data, Dream Tech Press, 2nd Edition, 2015.
2. Tom White, —Hadoop: The Definitive Guide, O'Reilly, 3rd Edition, 2012.

3. Black Book Big Data, dreamtech publications, 1st Edition, 2017

REFERENCE BOOKS:

1. Michael Minelli, Michele Chambers, Ambiga Dhiraj, —Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Wiley CIO Series, 1st Edition, 2013.
2. Rajiv Sabherwal, Irma Becerra- Fernandez, —Business Intelligence –Practice, Technologies and Management, John Wiley, 1st Edition, 2011.
3. Arvind Sathi, —Big Data Analytics: Disruptive Technologies for Changing the Game, IBM Corporation, 1st Edition, 2012.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	https:// lms. iare.ac.in /index ? route= course/ details& course id=84
CONTENT DELIVERY (THEORY)			
1	Define big data and its importance.	CO 1	T1:2.3
2-3	Describe the elements of big data-volume, variety, velocity and veracity	CO 1	T1:2.1, 2.5
4-5	Understand the life cycle of big data	CO 1	T1:2.4
6-7	Define the importance and challenges of big data.	CO 1,	T1:2.5 – 2.6 R2:21.51
8	Understand Traditional Vs Big Data Business Approach	CO 1	T1:2.9
9-10	Classify the Big data analytics - Classification of Analytics	CO 1	T1:3.1 R2:21.51
11	Importance and challenges facing big data,	CO 2	T1:3.7 -3.8
12-14	Explain the terminologies Used in Big Data Environments	CO 2	T1:3.12 R2:21.55
15	Explain the Big Data Technology Landscape with Hadoop ecosystem.	CO 3	T1:4.1 – 4.2 R2:21.58
16	Understand the core components of Hadoop-big data.	CO 3	T2:26.16 R2:21.61

17-18	Outline Hadoop ecosystem and Computing Challenges, RDBMS versus Hadoop	CO 3,CO 4	T1:5.1 – 5.5 R2:21.24
19	Recall the history and overview of Hadoop	CO 3,CO 4	T1:5.5 R2:21.29
20	Demonstrate the real time use case in Hadoop	CO 4	T1:5.6 – 5.7 R2:21.31
21-22	Explain Hadoop Distributors and processing Data with Hadoop	CO 4,CO 5	T1:5.8 R2:21.33
23	Summarize the other components in Hadoop Interacting in Hadoop Ecosystem	CO 4,CO 6	T1:5.9
24	Explain the Design concepts of HDFS	CO 5	T1:5.11 R2:21.64
25	Find differences between Basic Filesystem Operations and Hadoop Filesystems.	CO 4,CO 6	T1:5.10-5.13 T2:3
26-27	Explain the Java Interface for Reading Data from a Hadoop URL Using the Filesystem API	CO 4,CO 6	T2:3
28-29	Explain Writing Data and Data Flow- Anatomy of a File Read, Anatomy of a File Write, Limitations	CO 4,CO 6	T1:5.10 T2:3
30-31	Explore the features of MapReduce and Map and Reduce Functions	CO 4	T1:8.1-8.3 T2:8
32	Outline the techniques to optimize MapReduce jobs and uses	CO 4,	T2:27.8
33-35	Illustrate the controlling MapReduce Execution with Input Format	CO 4,CO 6	T2:7
36-37	Explain the reading Data with custom Record Reader, - Reader, Writer, Combiner, Practitioners, MapReduce Phases	CO 5	T1:8.2 – 8.3
38	Develop a simple MapReduce Application	CO 6	T1:8.4 – 8.8
39	Explain Pig architecture	CO 5	T1:10.1-10.6
40-41	Summarize Installation process of Pig along with Properties and getting started with Pig Latin,	CO 4,CO 5	T2:11
42	Develop applications by working with operators in Pig, Working with functions in Pig.	CO 6	T1:10.7-10.12
43	Explain the Hive component and Hive Services	CO 4	T1:9.1-9.2 T2:12
44-45	Demonstrate Hive Data types, Built-in functions and Hive DDL.	CO 6	T1:9.3-9.8
PROBLEM SOLVING/ CASE STUDIES			
1	Develop a simple MapReduce Application	CO3	R2:7.5
2	Explain Pig architecture	CO5	T2:3
3	Summarize Installation process of Pig along with Properties and getting started with Pig Latin.	CO5	R2:7.5
4	Develop applications by working with operators in Pig, Working with functions in Pig.	CO 5	R2:7.5
5	Explain the Hive component and Hive Services	CO 2	T1:4.1

6	Demonstrate Hive Data types, Built-in functions and Hive DDL.	CO 2	T3:4.5
7	Features of Hadoop explain in detail	CO 1	R4:5.2
8	Findingthe differences between Hadoop and Big Data	CO 1	T2:5.2
9	Describe Map Reduce Architecture	CO 3	R2:7.5
10	Challenges of Big data and Business analytics .	CO 1	R2:7.5
11	Features of Hadoop vs SQL	CO 2	R2:7.5
12	Describe Job Tracker and Task Tracker	CO 3	R2:7.5
13	Explain PIG, components of PIG and HIVE	CO 4	R2:7.5
14	Explain word count using pig scripting language	CO 6	R2:7.5
15	Difference between Pig Latin and Apache with example	CO 6	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Big data,Business Analytics,Structured data, semi-structured data,Structured data, Challenges of Big data	CO 1	R4:2.1
2	Hadoop,Hadoop Distributed File System, Features of Hadoop Distributed File System,Key Distinctions of Hadoop, Hadoop Components	CO 2	R4:2.1
3	Streaming Access pattern,File System, Comparing FS and HDFS,Hadoop Cluster, HDFS Architecture,Hadoop vs SQL	CO 3	R4:2.1
4	Definitionof map reduce,Map reduce architecture,Job Tracker,Task tracker, map reduce engine work	CO 4	R4:2.1
5	PIG,HIVEandWord count using pig,Pig components and pig tutorial,pig Latin data language,characteristics of Apache	CO 5	R4:2.1
DISCUSSION OF QUESTION BANK			
1	Module I	CO 1,2	R4:2.1
2	Module II	CO 3	T4:7.3
3	Module III	CO 4	R4:5.1
4	Module IV	CO 5,6	T1:7.5
5	Module V	CO 6	T1: 4.1

Signature of Course Coordinator **HOD,IT**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

Course Title	**CLOUD APPLICATION DEVELOPMENT LABORATORY**				
Course Code	ACS110				
Program	B.Tech				
Semester	VII	CSE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr RM Noorullah, Assistant Professor				

I COURSE OVERVIEW:

This Laboratory course provides a foundation for which we can access the applications as utilities over the internet. It allows us to create, configure, and customize the business applications online. a cloud application, or cloud app, is a software program where cloud-based and local components work together. This model relies on remote servers for processing logic that is accessed through a web browser with a continual internet connection. Hadoop is an open-source framework that allows to store and process big data in a distributed environment across clusters of computers using simple programming models. It is designed to scale up from single servers to thousands of machines, each offering local computation and storage.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS109	VI	Linux Programming Laboratory
B.Tech	ACS104	IV	Database Management Systems Laboratory
B.Tech	ACS101	I	Computer Programming Laboratory

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Cloud Application Development Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

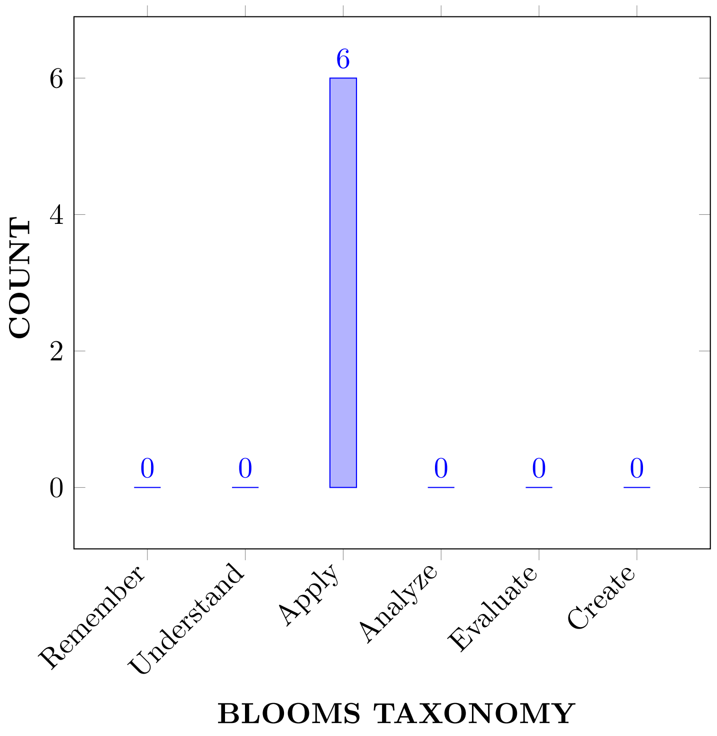
I	To run virtual machines of different configuration.
II	Big data application using Hadoop under cloud environment.
III	The developing web applications in cloud framework.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Make use of** Virtualization and parallel processing on guest and host OS for performing different tasks by installing virtual machines.	Apply
CO 2	**Develop** Mapper and Reducer on simple applications by using Apache Hadoop on single node setup installation.	Apply
CO 3	**Construct** simple applications on services rendered by Amazon Web Service Cloud Service Provider.	Apply
CO 4	**Build** simple applications on services rendered by Google Service Provider.	Apply
CO 5	**Utilize** simple applications on services rendered by Microsoft Azure cloud Service Provider.	Apply
CO 6	**Develop** web based App by using Yahoo! pipes.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercises,CIE,SEE
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Lab Exercises,CIE,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3	Lab Exercises,CIE,SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Lab Exercises,CIE,SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises,CIE,SEE
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1	Lab Exercises,CIE,SEE
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	1	Lab Exercises,CIE,SEE
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1	Lab Exercises,CIE,SEE
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Lab Exercises,CIE,SEE

PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Lab Exercises,CIE,SEE
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Lab Exercises,CIE,SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	1	Lab Exercises
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	3	Lab Exercises
PSO 3	**Successful Career and Entrepreneurship:** Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply scientific principles and methodologies, other engineering disciplines to Make use of virtualization and parallel processing on guest and host OS for performing different tasks by installing virtual machines.	2
	PO 2	Experimental design on usage of virtualization and parallel processing on guest and host OS for performing different tasks by installing of virtual machines in cloud computing environment.	8

	PO 3	Understand customer and user needs and the importance of considerations to run virtualization and parallel processing on guest and host OS for performing different tasks by installing virtual machines.	7
	PO 4	Use research-based knowledge and research methods including design of experiments by installing of virtual machines in cloud computing environment.	11
	PO 5	Create, select, and apply appropriate techniques, resources to Make use of virtualization and parallel processing on guest and host OS for performing different tasks by installing virtual machines.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development to run virtualization and parallel processing on guest and host OS for performing different tasks by installing virtual machines.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different tasks by installing virtual machines.	1
	PO 8	Apply professional ethics and responsibilities and norms for performing different tasks by virtual machines in cloud computing environment.	1
	PO 10	Demonstrate the ability for communicating effectively in writing, speaking style subject matter in virtualization and parallel computing.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of virtual machines in cloud computing environment.	3
	PSO 1	Understand, design and analyze computer programs in the areas related to virtualization in cloud computing environment.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines in cloud computing environment.	1
	PSO 3	Make use of modern computer tools for creating innovative paths, to be an entrepreneur in virtual machines in cloud computing environment.	1
CO 2	PO 1	Apply scientific principles and methodologies, other engineering disciplines to Mapper and Reducer on simple applications by using Apache Hadoop on single node setup installation.	3
	PO 3	Use creativity to establish innovative solution to develop Mapper and Reducer on simple applications by using Apache Hadoop.	7
	PO 4	Understanding of appropriate codes of practice solution to develop Mapper and Reducer on simple applications by using Apache Hadoop.	11
	PO 5	Create, select, and apply appropriate techniques, resources to develop Mapper and Reducer on simple applications by using Apache Hadoop.	1

	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on simple applications by using Apache Hadoop.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different tasks by using Apache Hadoop on single node setup installation.	1
	PO 8	Apply professional ethics and responsibilities and norms by using Apache Hadoop on single node setup installation.	1
	PO 9	Effective teamwork and project management on simple applications by using Apache Hadoop.	6
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in Mapper and Reducer on simple applications by using Apache Hadoop.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of Mapper and Reducer on simple applications by using Apache Hadoop.	3
	PSO 1	Understand, design and analyze computer programs in the areas related to Mapper and Reducer on simple applications by using Apache Hadoop.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines in Mapper and Reducer on simple applications by using Apache Hadoop.	1
	PSO 3	Make use of modern computer tools for creating innovative paths by using Apache Hadoop.	1
CO 3	PO 1	Apply scientific principles and methodologies, other engineering disciplines to construct simple applications on services rendered by Amazon Web Service Cloud Service Provider.	2
	PO 2	Experimental design on usage of Amazon Web Service Cloud Service Provider in cloud computing environment.	8
	PO 3	Use creativity to establish innovative solution to develop simple applications on services rendered by Amazon Web Service Cloud Service Provider.	7
	PO 4	Understanding of appropriate codes of practice solution to develop simple applications on services rendered by Amazon Web Service Cloud Service Provider.	11
	PO 5	Create, select, and apply appropriate techniques, resources to develop simple applications on services rendered by Amazon Web Service Cloud Service Provider.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on services rendered by Amazon Web Service Cloud Service Provider.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different t services rendered by Amazon Web Service Cloud Service Provider.	1
	PO 8	Apply professional ethics and responsibilities and norms different services rendered by Amazon Web Service Cloud Service Provider.	1

	PO 9	Effective teamwork and project management services rendered by Amazon Web Service Cloud Service Provider.	6
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in services rendered by Amazon Web Service Cloud Service Provider.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of services rendered by Amazon Web Service Cloud Service Provider.	4
	PSO 1	Understand, design and analyze computer programs in the areas related to services rendered by Amazon Web Service Cloud Service Provider.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines in Amazon Web Service Cloud Service Provider.	2
	PSO 3	Make use of modern computer tools for creating innovative paths, to be an entrepreneur in Amazon Web Service Cloud Service Provider.	2
CO 4	PO 1	Apply scientific principles and methodologies, other engineering disciplines to construct simple applications on services rendered by Google Cloud Service Provider.	2
	PO 2	Experimental design on usage of Google Cloud Service Provider in cloud computing environment.	8
	PO 3	Use creativity to establish innovative solution to develop simple applications on services rendered by Google Cloud Service Provider.	7
	PO 4	Understanding of appropriate codes of practice solution to develop simple applications on services rendered by Google Cloud Service Provider.	11
	PO 5	Create, select, and apply appropriate techniques, resources to develop simple applications on services rendered by Google Cloud Service Provider.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on services rendered by Google Cloud Service Provider.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different t services rendered by Google Cloud Service Provider.	1
	PO 8	Apply professional ethics and responsibilities and norms different services rendered by Google Cloud Service Provider.	1
	PO 9	Effective teamwork and project management services rendered by Google Cloud Service Provider.	6
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in services rendered by Google Cloud Service Provider.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of services rendered by Google Cloud Service Provider.	4

	PSO 1	Understand, design and analyze computer programs in the areas related to services rendered by Google Cloud Service Provider.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines in Google Cloud Service Provider.	2
	PSO 3	Make use of modern computer tools for creating innovative paths, to be an entrepreneur in Google Cloud Service Provider.	2
CO 5	PO 1	Apply scientific principles and methodologies, other engineering disciplines to construct simple applications on services rendered by Microsoft Azure Cloud Service Provider.	2
	PO 2	Experimental design on usage of Microsoft Azure Cloud Service Provider in cloud computing environment.	8
	PO 3	Use creativity to establish innovative solution to develop simple applications on services rendered by Microsoft Azure Cloud Service Provider.	7
	PO 4	Understanding of appropriate codes of practice solution to develop simple applications on services rendered by Microsoft Azure Cloud Service Provider.	11
	PO 5	Create, select, and apply appropriate techniques, resources to develop simple applications on services rendered by Microsoft Azure Cloud Service Provider.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on services rendered by Microsoft Azure Cloud Service Provider.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different t services rendered by Microsoft Azure Cloud Service Provider.	1
	PO 8	Apply professional ethics and responsibilities and norms different services rendered by Microsoft Azure Cloud Service Provider.	1
	PO 9	Effective teamwork and project management services rendered by Microsoft Azure Cloud Service Provider.	6
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in services rendered by Microsoft Azure Cloud Service Provider.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of services rendered by Microsoft Azure Cloud Service Provider.	4
	PSO 1	Understand, design and analyze computer programs in the areas related to services rendered by Microsoft Azure Cloud Service Provider.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines in Microsoft Azure Cloud Service Provider.	2

	PSO 3	Make use of modern computer tools for creating innovative paths, to be an entrepreneur in Microsoft Azure Cloud Service Provider.	2
CO 6	PO 1	Apply scientific principles and methodologies, other engineering disciplines to develop web based App by using Yahoo! pipes.	2
	PO 2	Experimental design on usage of web based App by using Yahoo! pipes in cloud computing environment.	8
	PO 3	Use creativity to establish innovative solution to develop web based App by using Yahoo! pipes.	7
	PO 4	Understanding of appropriate codes of practice solution to develop web based App by using Yahoo! pipes.	11
	PO 5	Create, select, and apply appropriate techniques, resources to develop web based App by using Yahoo! pipes.	1
	PO 6	Understanding of the requirement for engineering activities to promote sustainable development on web based App by using Yahoo! pipes.	1
	PO 7	Demonstrate the knowledge of, and need for sustainable development for performing different web based App by using Yahoo! pipes.	1
	PO 8	Apply professional ethics and responsibilities and norms different web based App by using Yahoo! pipes.	1
	PO 9	Effective teamwork and project management web based App by using Yahoo! pipes.	6
	PO 10	Demonstrate the ability to communicate effectively in writing, speaking style subject matter in web based App by using Yahoo! pipes.	4
	PO 12	Keeping current in CSE and advanced engineering concepts of web based App by using Yahoo! pipes.	4
	PSO 1	Understand, design and analyze computer programs in the areas related to web based App by using Yahoo! pipes.	2
	PSO 2	Focus on improving software reliability, network security and information retrieval systems machines in web based App by using Yahoo! pipes.	2
	PSO 3	Make use of modern computer tools for creating innovative paths, to be an entrepreneur in web based App by using Yahoo! pipes.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	3	1	1	1	-	3	-	1	1	2	2
CO 2	3	-	3	3	3	1	1	1	2	3	-	1	1	2	2
CO 3	3	3	3	3	3	1	1	1	2	3	-	2	1	3	3
CO 4	3	3	3	3	3	1	1	1	2	3	-	2	1	3	3
CO 5	3	3	3	3	3	1	1	1	2	3	-	2	1	3	3
CO 6	3	3	3	3	3	1	1	1	2	3	-	2	1	3	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**VIRTUALIZATION**
	Install Oracle Virtual box and create two VMs on your laptop.
WEEK II	**VIRTUALIZATION**
	Install Turbo C in guest OS and execute C program.
WEEK III	**VIRTUALIZATION**
	Test ping command to test the communication between the guest OS and Host OS.
WEEK IV	**HADOOP**
	Install Hadoop single node setup.
WEEK V	**HADOOP**
	Develop a simple hadoop application called Word Count. It counts the number of occurrences of each word in a given input set.
WEEK VI	**HADOOP**
	Develop hadoop application to count no of characters, no of words and each character frequency.

WEEK VII	**HADOOP**
	Develop hadoop application to process given data and produce results such as finding the year of maximum usage, year of minimum usage.
WEEK VIII	**HADOOP**
	Develop hadoop application to process given data and produce results such as how many female and male students in both schools the results should be in following format. GP-F #number GP-M #numbers MS-F #number MS-M #number
WEEK IX	**CLOUD PROGRAMMING**
	Establish an AWS account. Use the AWS Management Console to launch an EC2 instance and connect to it.
WEEK X	**CLOUD PROGRAMMING**
	Design a protocol and use Simple Queue Service(SQS)to implement the barrier synchronization after the first phase.
WEEK XI	**CLOUD PROGRAMMING**
	Use the Zookeeper to implement the coordination model in Problem 10.
WEEK XII	**CLOUD PROGRAMMING**
	Develop a Hello World application using Google App Engine
WEEK XIII	**CLOUD PROGRAMMING**
	Develop a Guestbook Application using Google App Engine.
WEEK XIV	**WINDOWS AZURE**
	Develop a Windows Azure Hello World application using.
WEEK XV	**PIPES**
	Create a Mashup using Yahoo! Pipes.

TEXT BOOKS

1. Dan Marinescu, ―Cloud Computing: Theory and Practice‖, M K Publishers, 1st Edition, 2013.

2. Kai Hwang, Jack Dongarra, Geoffrey Foxr, ―Distributed and Cloud Computing, FromParallel Processing to the Internet of Things‖, M K Publishers, 1st Edition, 2013.

REFERENCE BOOKS

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, ―Cloud Computing: A Practical Approach‖, McGraw Hill,, 1st Edition, 2009.

2. Arshdeep Bahga, Vijay Madisetti, ―Distributed and Cloud Computing, Cloud computing A Hands on Approach‖, Universities Publications, 1st Edition, 2013.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Install Virtual Machine on Guest and Host OS	CO1	T1:5.4
2	Single node set up Installation	CO2	T1:5.7
3	Simple applications on services rendered by Amazon Web Service Cloud Service Provider.	CO3	T1:11.1
4	Simple applications on services rendered by Google Service Provider.	CO4	T1:3.2
5	Simple applications on services rendered by Microsoft Azure cloud Service Provider.	CO5	T1:3.3
6	Web based App by using Yahoo! pipes	CO6	R2:2.8

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Install Hadoop in semi-distributed environment.
2	ERP solutions using Google Cloud Service Provider.
3	CRMsolutions using Amazon Web Service Provider.

Signature of Course Coordinator **HOD,CSE**
Mr RM Noorullah, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

INFORMATION TECHNOLOGY

COURSE DESCRIPTION

Course Title	**BIG DATA AND BUSINESS ANALYTICS LABORATORY**				
Course Code	ACS111				
Program	B.Tech				
Semester	VII	IT			
Course Type	Theory				
Regulation	IARE - R16				
Course Structure	LAB			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. B.Pravallika, Assistant Professor				

I COURSE OVERVIEW:

Big data and Business Analytics Laboratory demonstrates distributed computing environment. It includes hands on experience on installation process of VMWare, LINUX commands, HDFS file management, MapReduce functions, Pig and Hive operations. This experience can be used to develop big data applications such as Web click stream analysis, Recommendation systems, Sentiment analysis etc.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB09	III	Database Management Systems Laboratory
B.Tech	ACS002	IV	Object Oriented Programming Through Java Laboratory
B.Tech	ACS002	VI	LINUX Laboratory
B.Tech	ACSB15	VI	DWDM Laboratory

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Database Management Systems Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	The steps involved in creating distributed environment.
II	The platform for creating and run big data MapReduce programs on Hadoop.
III	Fundamental techniques and principles in achieving big data analytics with scalability and streaming capability..

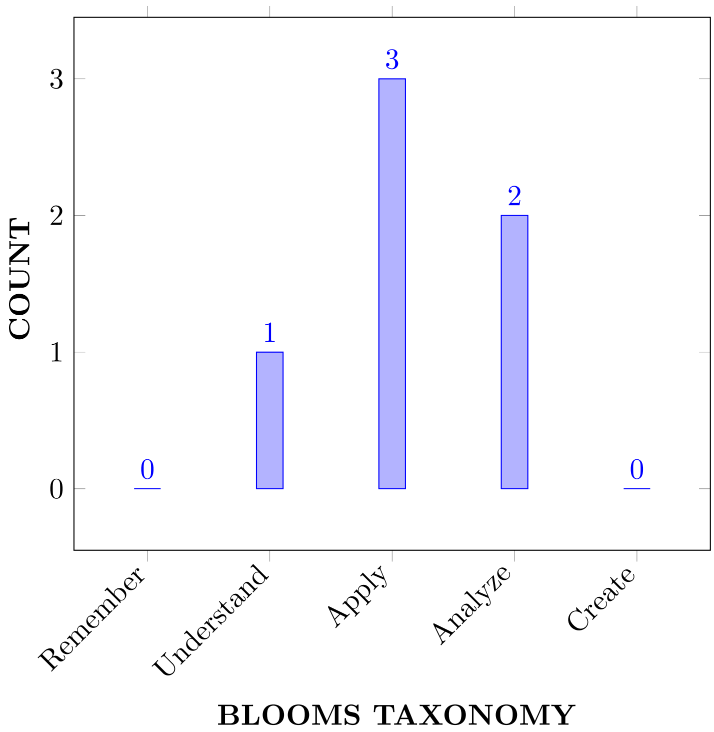
IV	How to solve complex real-world problems in for decision support.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** distributed environment and its ecosystem with the help of VMWare and Linux commands. .	understand
CO 2	**Make use of** hadoop distributed file management modes for handling big data in business analytics.	Apply
CO 3	**Analyze** the Big Data using Map-reduce programming in Hadoop framework.big data in business analytics.	Analyze
CO 4	**Apply** Hive commands for reading, writing and managing large datasets in hdfs .	Apply
CO 5	**Implement** the Pig Latin scripts in two different modes to perform a particular operation on the data that exists in the HDFS.	Apply
CO 6	**Analyze** adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program	Strength	Proficiency Assessed by

PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	Lab Exercises,CIE,SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Lab Exercises,CIE,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3	Lab Exercises,CIE,SEE
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations..	3	Lab Exercises,CIE,SEE

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 2	Software Engineering Practices: The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	No. of Key Competencies
CO 1	PO 1	**Describe**distributed environment and its ecosystem with the help of VMWare and Linux commands **using principles of mathematics, science, and engineering fundamentals.**	3
	PO 2	**Describe** distributed environment and its ecosystem with the help of VMWare and Linux commands. **with Problem statement and system definition , Problem formulation and abstraction**	2
CO 2	PO 1	**Demonstrate**hadoop distributed file management modes for handling big data in business analytics **basic fundamentals of mathematics and engineering fundamentals.**	2

	PO 2	**Demonstrate** hadoop distributed file management modes for handling big data in business analytics**the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation**	3
	PO 3	**Demonstrate** hadoop distributed file management modes for handling big data in business analytics **to Investigate and define a problem and identify constraints Manage the design process and evaluate outcomes**	4
	PO 5	**Demonstrate** hadoop distributed file management modes for handling big data in business analytics **by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of practice and industry standards.**	3
	PSO 2	**Demonstrate** hadoop distributed file management modes for handling big data in business analytics **by using a set of steps.**	1
CO 3	PO 2	**Make Use of** the Big Data using Map-reduce programming in Hadoop framework for memory management and faulty recovery. **the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation.**	2
	PO 3	**Make Use of SQL** Big Data using Map-reduce programming in Hadoop framework for memory management and faulty recovery**Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes**	3
	PO 5	**Make Use of** Big Data using Map-reduce programming in Hadoop framework for memory management and faulty recovery.**by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of practice and industry standards.**	3
	PSO 2	**Make Use of** Big Data using Map-reduce programming in Hadoop framework for memory management and faulty recovery.**by using a set of steps.**	1
CO 4	PO 1	**Define** Hive commands for reading, writing and managing large datasets in hdfs **the knowledge of mathematics, science, and engineering fundamentals.**	3
	PO 2	**Define** Hive commands for reading, writing and managing large datasets in hdfs **the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation**	4

CO 5	PO 2	**Model** the Pig Latin scripts in two different modes to perform a particular operation on the data that exists in the HDFS **with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation.**	4
	PO 3	**Model** the Pig Latin scripts in two different modes to perform a particular operation on the data that exists in the HDFS. by **Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.**	3
	PO 5	**Model** the Pig Latin scripts in two different modes to perform a particular operation on the data that exists in the HDFS. by **Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.**	3
	PSO 2	**Model** the Pig Latin scripts in two different modes to perform a particular operation on the data that exists in the HDFS **by using sequence of steps.**	1
CO 6	PO 2	**Illustrate** adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc **data integrity basic fundamentals of mathematics and engineering fundamentals.**	4
	PO 2	**Illustrate**adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc **Problem statement and system definition, Problemformulation and abstraction , Information and datacollection, Model translation**	4

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	2	3	-	2	-	-	-	-	-	-	-	-	3	-
CO 3	-	2	3	-	3	-	-	-	-	-	-	-	-	3	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	

CO 5	-	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO 6	2	2	3	-	2	-	-	-	-	-	-	-	-	1	-

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 2, PO 3, PSO 3	SEE Exams	PO 2,PO 3, PO 5, PO 10,PO12	Seminars	-
Laboratory Practices	PO 1,PO 3, PO 5	Student Viva	PO 2, PO 3,PO10	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**INSTALL VMWARE**
	Installation of VMWare to setup the Hadoop environment and its ecosystems
WEEK II	**QUERIES USING DDL AND DML**
	a. Perform setting up and Installing Hadoop in its three operating modes. i. Standalone. ii. Pseudo distributed. iii. Fully distributed. b. Use web based tools to monitor your Hadoop setup.
WEEK III	**USING LINUX OPERATING SYSTEM**
	Implementing the basic commands of LINUX Operating System – File/Directory creation, deletion, update operations..
WEEK IV	**FILE MANAGEMENT IN HADOOP**
	Implement the following file management tasks in Hadoop: a.Adding files and directories b.Retrieving files c.Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command linux utilities.
WEEK V	**MAPREDUCE PROGRAM 1**
	Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
WEEK VI	**MAPREDUCE PROGRAM 2**

	Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.
WEEK VII	**MAPREDUCE PROGRAM 3**
	Implement matrix multiplication with Hadoop Map Reduce..
WEEK VIII	**PIG LATIN LANGUAGE – PIG**
	Installation of PIG.
WEEK IX	**PIG COMMANDS**
	Write Pig Latin scripts sort, group, join, project, and filter your data
WEEK X	**PIG LATIN MODES, PROGRAMS**
	a.Run the Pig Latin Scripts to find Word Count. b. Run the Pig Latin Scripts to find a max temp for each and every year.
WEEK XI	**HIVE**
	Installation of HIVE.
WEEK XII	**HIVE OPERATIONS**
	Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

TEXTBOOKS

1. Rajiv Sabherwal, Irma Becerra- Fernandez, "Business Intelligence –Practice, Technologies and Management", John Wiley, 1st Edition, 2011

REFERENCE BOOKS:

1. Jay Liebowitz, "Big Data and Business Analytics Laboratory", CRC Press.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Install VMware.	CO 1	T1:4.1, T2:1.1
2	Hadoop Modes	CO 2	T1:4.9,4.11, T2:7
3	Using Linux Operating System	CO 3,CO4	T1:3, T2:8
4	File Management In Hadoop	CO1,CO 4	T1:6.6, T2:12
5	Mapreduce Program 1	CO 3	T1:4.4, T2:10
6	Mapreduce Program 2	CO 3	T1:4.6, T2:10
7	Mapreduce Program 3	CO 5	T2:15
8	Mapreduce Program 4.	CO 3	T2:18
9	Pig Latin Language – Pig.	CO 6	T2:18
10	Pig Commands.	CO 5	T2:18
11	Pig Latin Modes, Pig Program	CO 6	T2:10
12	Hive	CO 4	T1:2, T2:1
12	Hive Operations	CO 5	T1:2, T2:1

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**I**mplementation of application that stores big data in MongoDB.
2	**E**xperimental Methods for the Evaluation of Big Data Systems.

Signature of Course Coordinator **HOD,IT**
Ms. B Pravallika, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**INFORMATION TECHNOLOGY**				
Course Title	**INFORMATION SECURITY**				
Course Code	ACS013				
Program	B.Tech				
Semester	VIII				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. N BASWANTH, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AIT003	IV	Computer Networks

II COURSE OVERVIEW:

This course focuses on the fundamentals of security that are used in protecting both the information present in computer storage as well as information passing over any computer networks. It includes attacks, security mechanisms, and secret-key and public-key cryptography. The authentication protocols and key management techniques for providing security in Email, IP and web, Firewalls and virtual private networks are learned.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Information Security	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	✓	Quiz	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
45%	Understand
18%	Apply
27%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

VI COURSE OBJECTIVES:

The students will try to learn:

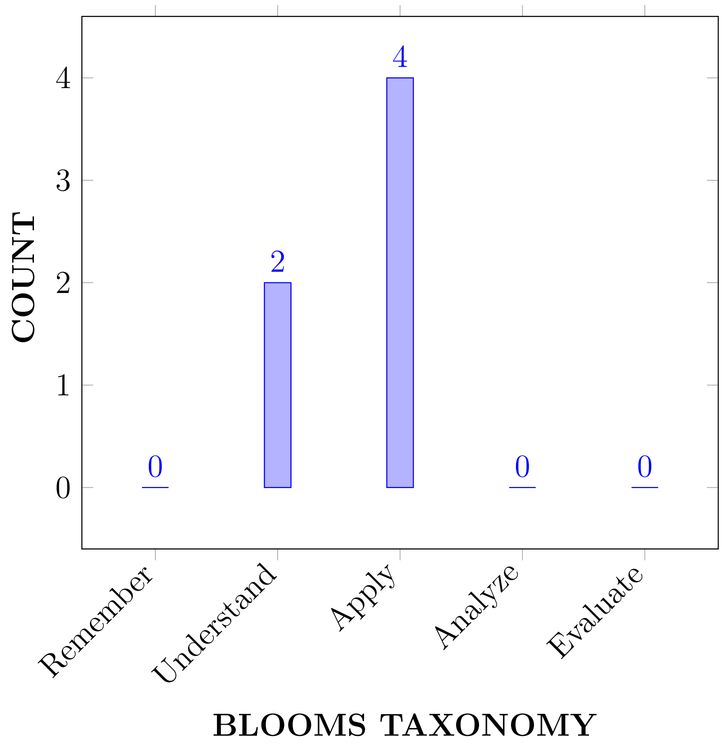
I	Understand security standards and practices. The scope and essentiality of threats, attacks to computers and networks associated to them
II	The symmetric and asymmetric key generation techniques used for providing message authentication, confidentiality and Integrity
III	The use cases on cryptography and security systems for server and client systems such as web, email and firewalls

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Outline** dmodel for network security and cryptographic algorithms to prevent attacks on computer and computer security.	Understand
CO 2	**Demonstrate** symmetric and asymmetric key ciphers for messaging end to end encryption used in different types of cryptographic algorithms	Understand
CO 3	**Make use of** tools and protocols used in message authentication and hashing functions for every day computing to remine secure	Apply
CO 4	**Choose** appropriate architecture and protocols used in email and IP security to protect against attackers and intruders	Apply
CO 5	**Select** firewalls to provide web security as case study in cryptography and network security	Apply
CO 6	**Utilize** cryptographic and security algorithms to enhance defence against cyber attacks and to improve organization working culture.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2.1	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2.3	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1.3	SEE / CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2.5	SEE / CIE / AAT
PO 6	**The engineer and society:** CApply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2.0	SEE / CIE / AAT
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	1.2	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	SEE / CIE / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1.7	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2.3	SEE/CIE/AAT
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	1.7	SEE/CIE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	✓	-	✓	-	✓	-	✓	-	✓	✓	-	✓
CO 2	✓	✓	✓	-	-	✓	-	✓	-	✓	-	✓	✓	-	✓
CO 3	✓	✓	✓	-	-	✓	-	✓	-	✓	-	✓	✓	-	✓
CO 4	✓	✓	✓	-	-	✓	-	✓	-	✓	-	✓	✓	-	✓
CO 5	✓	✓	✓	-	-	✓	-	✓	-	✓	-	✓	✓	-	✓
CO 6	✓	✓	✓	✓	-	✓	-	✓	-	✓	-	✓	✓	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Summarize the knowledge of **mathematics** to prevent attacks on computer using network security and cryptographic algorithms	1
	PO 2	Classify different network security and cryptographic algorithms by **problem identification, formulation, abstraction, data collection, design** and **provide solution** to prevent attacks on computer	6
	PO 3	Outline the **customer requirements, maintenance** and **engineering activities** to prevent attacks on computer using network and cryptography algorithms.	3
	PO 4	Interpret the **appropriate quantitative method, engineering principles,technology development, industry standards,equipment,processes** and **the ability** to apply them to develop the cryptographic and network security algorithms to prevent attacks on computer.	7

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 6	Outline the model for network security and cryptographic algorithms to prevent attacks on computer and computer security **understand of commerical, management techniques** and **understand of the need**.	3
	PO 8	Outline the model for network security and cryptographic algorithms to prevent attacks on computer and computer security**ability to make informed ethical choices**.	1
	PO 10	Security problems on computers will be solved with clear **applications of engineering network, security and cryptographic algorithms**	1
	PO 12	Use appropriate techniques and algorithms in **computer science related, current trends of computer science, on going learning** and **continuum education** industry oriented applications for preventing attacks on computers.	4
	PSO 1	Understand the **problem specific constraints** to prevent attacks on **computers by applying appropriate, network security** and cryptographic algorithms.	3
	PSO 3	Extend the **use of modern computer tools for creating innovative career paths** to prevent attacks on computer using network security and cryptographic algorithms.	1
CO 2	PO 1	Summarize the knowledge of **mathematics, Scientific** and **Engineering principals** to prevent attacks on computer using symmetric and asymmetric key ciphers for messaging end to end encryption.	3
	PO 2	Classify different network security and cryptographic algorithms by **problem identification, formulation, abstraction, data collection, design** and **provide solution** to prevent attacks on computer	6
	PO 3	Outline the **customer requirements, maintenance** and **engineering activities** to prevent attacks on computer using network and cryptography algorithms.	3
	PO 6	Demonstrate symmetric and asymmetric key ciphers for messaging end to end encryption used in different types of cryptographic algorithms **understand of commerical, management techniques** and **understand of the need.**	3
	PO 8	Demonstrate symmetric and asymmetric key ciphers for messaging end to end encryption used in different types of cryptographic algorithms **ability to make informed ethical choices**	1
	PO 10	Security problems on computers will be solved with clear **applications of engineering network, security and cryptographic algorithms**	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	BUse appropriate techniques and algorithms in computer science related, industry oriented applications for preventing attacks on computers **computer science related, current trends of computer science, on going learning**.	3
	PSO 1	Understand the **problem specific constraints to provide end to end** security by **applying, appropriate symmetric** and **asymmetric key ciphers** for messaging end to end encryption used in different types of cryptographic algorithms.	4
	PSO 3	Extend the use of **modern computer tools for creating innovative career paths** to prevent attacks on computer using symmetric and asymmetric key ciphers for messaging end to end encryption used in different types of cryptographic algorithms.	1
CO 3	PO 1	Apply the **knowledge of mathematics** and Engineering principals to use the tools and protocols used in message authentication and hashing functions for every day computing to remain secure.	1
	PO 2	Classify **different tools and protocols required for problem identification, formulation, abstraction, data collection, design** and **provide solution** to prevent attacks on computer using MAC and Hash Function.	7
	PO 3	Outline the **customer requirements, maintenance** and **engineering activities** to remain secure in every day computing using MAC and Hash Functions.	3
	PO 6	Make use of tools and protocols used in message authentication **understand of commerical, management techniques** and **understand of the need.**	3
	PO 8	Make use of tools and protocols used in message authentication and hashing functions for every day computing to remine secure **ability to make informed ethical choices**.	1
	PO 10	Security problems on computers will be solved with clear **applications of engineering network, security and cryptographic algorithms**	1
	PO 12	Use appropriate techniques and algorithms in **computer science related, current trends of computer science, on going learning** and **continuum education** for preventing attacks on computers.	4
	PSO 1	Understand **computers by applying appropriate, network security** and **cryptographic algorithms** network security and cryptographic algorithms.	3
‘	PSO 3	Make use of **modern computer tools** for creating innovative career paths for every day computing to remain secure using MAC and Hash functions.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 4	PO 1	Apply the **knowledge of mathematics** and Engineering principals to Choose appropriate architecture and protocols to provide security to email against attackers and intruders.	1
	PO 2	Make use of **appropriate architecture and protocols required for problem identification, formulation, abstraction, data collection, design** and to provide security to E-mail and IP.	6
	PO 3	Outline **the customer requirements, maintenance , engineering activities to provide security,to email** against attackers and intruders.	5
	PO 6	Choose appropriate architecture and protocols used in email and IP security to protect against attackers and intruders **understand of commerical, management techniques** and **understand of the need.**.	3
	PO 8	Choose appropriate architecture and protocols used in email and IP security to protect against attackers and intruders **ability to make informed ethical choices**.	1
	PO 10	Security problems on computers will be solved with clear **applications of engineering network, security and cryptographic algorithms.**	1
	PO 12	Use appropriate techniques and algorithms in **computer science related, current trends of computer science, on going learning**.for preventing attacks on computers.	3
	PSO 1	Understand the **problem specific constraints** to prevent attacks on E-mail and IP by choosing **appropriate architecture** and protocols.	2
	PSO 3	Extend the **use of modern computer tools** for creating innovative career paths to prevent attacks on E-mail using appropriate algorithms.	1
CO 5	PO 1	Apply the **knowledge of mathematics** and Engineering principals to Select firewalls to provide web security as case study in cryptography and network security	1
	PO 2	Classify different firewalls required for**different tools and protocols required for problem identification, formulation, abstraction, data collection, design** and **provide solution** and to provide web security.	7
	PO 3	Outline **the customer requirements, maintenance , engineering activities to provide security, web security** using appropriate firewalls.	5
	PO 6	Select firewalls to provide web security as case study in **understand of commerical, management techniques** and **understand of the need.** cryptography and network security.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 8	Select firewalls to provide web security as case study in **ability to make informed ethical choices** cryptography and network security.	1
	PO 10	Security problems on computers will be solved with clear **applications of engineering network**, security and cryptographic algorithms .	1
	PO 12	Use appropriate techniques and algorithms in **computer science related, current trends of computer science, on going learning** and **continuum education**for preventing attacks on computers.	4
	PSO 1	Understand the **computers by applying appropriate, network security** and **cryptographic algorithms** web security by using appropriate firewall.	3
	PSO 3	Extend the **use of modern computer tools** for creating innovative career paths to to provide web security by using appropriate firewall.	1
CO 6	PO 1	Apply the knowledge of **mathematics** and Engineering principals to to enhance defence against cyber-attacks and to improve organization working culture using cryptographic and security algorithms.	1
	PO 2	Classify different **cryptographic and security algorithms required for problem identification, formulation, abstraction, data collection, design and provide solution** to enhance defence against cyber-attacks and to improve organization working culture.	6
	PO 3	Outline the **customer requirements, maintenance and engineering activities** to enhance defence against cyber-attacks and to improve organization working culture using cryptographic and security algorithms	3
	PO 4	Interpret **the appropriate quantitative method, engineering principles, the ability,to enhance defence** against cyber-attacks and **to improve organization working culture**	5
	PO 6	Utilize cryptographic and security algorithms to enhance defence against cyber attacks and to **understand of commerical, management techniques** and **understand of the need.**	3
	PO 8	Utilize cryptographic and security algorithms to enhance defence against cyber attacks and **to improve organization working culture**	1
	PO 10	Security **problems on computers will be solved with clear applications of engineering network**, security and cryptographic algorithms	1
	PO 12	Use **appropriate techniques , algorithms in computer science related, industry oriented applications** for preventing attacks on**computers.**	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Understand **the problem, specific constraints and to prevent attacks** on computers by applying appropriate network security and cryptographic algorithms.	3
	PSO 3	Extend the **use of modern computer tools** for creating innovative career paths to prevent attacks on computer using network security and cryptographic algorithms.	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	6	3	7	-	3	-	1	-	1	-	4	3	-	1
CO 2	3	6	3	-	-	3	-	1	-	1	-	3	4	-	1
CO 3	1	7	3	-	-	3	-	1	-	1	-	4	3	-	1
CO 4	1	6	5	-	-	3	-	1	-	1	-	3	2	-	1
CO 5	1	7	5	-	-	3	-	1	-	1	-	4	3	-	1
CO 6	1	6	3	5	-	3	-	1	-	1	-	4	3	-	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	43.3	60	30	63.3	-	60	-	33.3	-	20	-	50	50	-	33.3
CO 2	100	60	30	-	-	60	-	33.3	-	20	-	37.5	66.6	-	33.3
CO 3	43.3	70	30	-	-	60	-	33.3	-	20	-	50	50	-	43.3
CO 4	43.3	60	50	-	-	60	-	33.3	-	20	-	37.5	33.3	-	43.3
CO 5	43.3	70	50	-	-	60	-	33.3	-	20	-	50	50	-	43.3
CO 6	43.3	60	30	45.4	-	60	-	33.3	-	20	-	50	50	-	43.3

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	3	-	2	-	1	-	1	-	2	2	-	1
CO 2	3	2	1	-	-	2	-	1	-	1	-	1	3	-	1
CO 3	2	3	1	-	-	2	-	1	-	1	-	2	3	-	2
CO 4	2	2	2	-	-	2	-	1	-	1	-	1	1	-	2
CO 5	2	3	2	-	-	2	-	1	-	1	-	2	3	-	2
CO 6	2	2	1	2	-	2	-	2	-	1	-	2	2	-	2
TOTAL	13	14	8	5	-	12	-	7	-	6	-	10	14	-	12
AVERAGE	2.1	2.3	1.3	2.5	-	2.0	-	1.2	-	1	-	1.7	2.3	-	1.7

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**ATTACKS ON COMPUTERS AND COMPUTER SECURITY**
	Attacks on computers and computer security: Introduction, the need for security, security approaches, principles of security, types of security attacks, security services, security mechanism, a model for network security; Cryptography concepts and techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.
MODULE II	**SYMMETRIC KEY CIPHERS**
	Symmetric key ciphers:Block cipher principles andalgorithms (DES,AES,Blowfish), differential and linear cryptanalysis, block cipher modes of operation, stream ciphers,RC4 location, and placement of encryption function, key distribution; Asymmetric key ciphers: Principles of public key cryptosystems, algorithms (RSA Diffie-Hellman, ECC) key distribution.

MODULE III	**MESSAGE AUTHENTICATION ALGORITHM AND HASH FUNCTIONS**
	Message authentication algorithm and hash functions: Authentication requirements, functions, message, authentication codes, hash functions, secure hash algorithm, whirlpool, HMAC, CMAC, digital signatures, knapsack algorithm. Authentication application: Kerberos, X.509 authentication service, public – key infrastructure, biometric authentication.
MODULE IV	**E-MAIL SECURITY**
	E-mail Security: Pretty Good Privacy; S/MIMI IP Security: IP security overview, IP security architecture, authentication header, encapsulating security payload, combining security associations, key management.
MODULE V	**WEB SECURITY**
	Web security: Web security considerations, secure socket layer and transport layer security, secure electronic transaction intruders; Virus and firewalls: Intruders, intrusion detection password management, virus and related threats, countermeasures, firewall design principles; Types of firewalls Case Studies on Cryptography and security: Secure inter-branch payment transactions, cross site scripting vulnerability, virtual electronics.

TEXTBOOKS

1. William Stallings, —Cryptography and Network Security‖, Pearson Education, 4th Edition, 2005.
2. Atul Kahate, —Cryptography and Network Security‖, McGraw-Hill, 2nd Edition, 2009.

REFERENCE BOOKS:

1. C K Shymala, N Harini, Dr. T R Padmanabhan, —Cryptography and Network Security‖, Wiley India, 1st Edition, 2016.
2. Behrouz A. Forouzan Debdeep Mukhopadhyay, —Cryptography and Network Security‖, McGraw- Hill, 2nd Edition, 2010.

WEB REFERENCES:

1. http://bookboon.com/en/search?q=INFORMATION+SECURITY
2. https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0 C
3. https://books.google.co.in/books/about/Information_Security.html?id=Bh45pU0_E_4C
4. www.technofest2u.blogspot.com

COURSE WEB PAGE:

https://lms.iare.ac.in/index ?route=course/details& course id=84

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Introduction, the need for security	CO 1	T1:1.1-1.4
3	security approaches, principles of security	CO 1	T1:1.5
4	types of security attacks, security services	CO 1	T2:2.2
5	security mechanism, a model for network security	CO 1	T2:2.2
6	Cryptography concepts and techniques: Introduction, plain text and cipher text,	CO 1	T2:2.1-2.2
7	substitution techniques	CO 1	T2:2.3-2.5
8	transposition techniques,	CO 1	T1:2.6
9	encryption and decryption	CO 1	T1:2.7-2.8
10	symmetric and asymmetric key cryptography,	CO 1	T1:3.1-3.2
11	steganography, key range and key size	CO 1	T1:3.2-3.4
12	possible types of attacks.	CO 1	T1:5.2
13	Symmetric key ciphers:Block cipher principles andalgorithms (DES,AES,Blowfish)	CO 2	T1:5.3
14	differential and linear cryptanalysis,	CO 2	T1:5.3
15	block cipher modes of operation,	CO 2	T1:5.3
17	stream ciphers,RC4 location, and placement of encryption function	CO 2	T1:5.4-5.5
18	key distribution; Asymmetric key ciphers: Principles of public key cryptosystems	CO 2	T1:5.6, 21.4
19	algorithms (RSA Diffie-Hellman, ECC) key distribution.	CO 2	T1:6.1
20	Message authentication algorithm and hash functions	CO 3	T1:6.2-6.3
21	Authentication requirements, functions, message	CO 3	T1:6.4
22	authentication codes, hash functions	CO 3	T1:6.5
23	secure hash algorithm	CO 3	T1:6.6-6.7
24	whirlpool, HMAC	CO 3	T1:8.1
26	CMAC	CO 3	T1:8.2
27	digital signatures,	CO 3	T1:8.3

29	knapsack algorithm	CO 3	T1:8.4-8.5
30	Authentication application: Kerberos	CO 3	T1:8.6
31	X.509 authentication service,	CO 3	T1:8.6
33	public – key infrastructure, biometric authentication.	CO 3	T1:9.5
34	E-mail Security: Pretty Good Privacy;	CO 4	T1:9.6
35	S/MIMI IP Security	CO 4	T1:10.1-10.2
36	IP security overview	CO 4	T1:10.3
37	IP security architecture	CO 4	T1:10.5
38	authentication header	CO 4	T1:10.6
39	encapsulating security payload	CO 4	T1:10.6
40	combining security associations	CO 4	T1:11.3
41	key management.	CO 4	T1:11.4
43	Web security: Web security considerations,	CO 5	T1:11.5
44	secure socket layer and transport layer security,	CO 5	T1:11.6
45	secure electronic transaction intruders	CO 5	T1:12.1-12.3
46	Virus and firewallst	CO 5	T1:12.4-12.6
48	Intruders, intrusion detection password management	CO 5	T1:12.7-12.8
49	virus and related threats, countermeasures	CO 6	T1:7.1-7.2
50	firewall design principles;	CO5	T1:8.1
51	Types of firewalls Case Studies on Cryptography and security	CO 5	T1:8.2
52	Secure inter-branch payment transactions	CO 6	T1:8.3
55	cross site scripting vulnerability	CO 6	T2:27.8
56	Secure inter-branch payment transactions	CO 6	T2:27.9
57	virtual electronics.	CO 6	T1:8.2-8.3
PROBLEM SOLVING/ CASE STUDIES			
16	Problems on Substitution techniques	CO 1	T1:5.3-5.3
25	Problems on transposition techniques	CO 1	T1:8.1-8.3
28	Problems on RSA algorithm	CO 2	T1:8.4-8.6 T1:9.1-9.2
32	Problems on encryption and decryption methods	CO 3	T1:9.4-9.6
42	Problems on ceaser cipher method	CO 1	T1:11.3-11.6

47	Problems on Hill Ciphermethod	CO 2	T1:12.1-12.6
53	Problems on performance issues	CO 2	T1:8.1-8.3
54	Problems on DES Algorithm	CO 2	T1:8.1-8.3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
58	Definitions on information security terminologies	CO 1	T1:1.2
59	Definitions on symmetric and asymmetric cipher	CO 2	T1:1.5
60	Definitions on MAC and Hash functions	CO 3	T1:8,9
61	Definitions on E-mil and PGP	CO 4	T1:10,11
62	Definitions on Intruders, Firewalls	CO 5, CO 6	T1:9.1
DISCUSSION OF QUESTION BANK			
1	Tyoes of security attacks	CO 1	T1:1.2
2	Symmetric and asymmetric algrorthims	CO 2	T1:1.5
3	Authentication and hashing algorithms	CO 3	T1:8,9
4	Email security algorithms	CO 4	T1:10,11
5	Intrusion Detection system and firewalls	CO 5,6	T1: 9.1

Signature of Course Coordinator **HOD, IT**
Mr. N BASWANTH, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">INFORMATION TECHNOLOGY</td></tr>
<tr><td>Course Title</td><td colspan="5">MACHINE LEARNING</td></tr>
<tr><td>Course Code</td><td colspan="5">ACS014</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Course Type</td><td colspan="5">CORE</td></tr>
<tr><td>Regulation</td><td colspan="5">R16</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>-</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr. N BASWANTH, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB12	II	Probability and statistics

II COURSE OVERVIEW:

The main emphasis of this course is to provide systems the ability to automatically learn and improve from experience without being explicitly programmed.The course includes the fundamental concepts to build, train, and predict data models using machine learning (ML) algorithms. This course provides a clear understanding on concepts ofsupervised learning through decision trees, advanced techniques like neural networks, Naive Bayes and k-nearest neighbor algorithmandintroduction tounsupervised and reinforcement learning.Machine Learning has revolutionized industries like medicine, healthcare, manufacturing, banking, and several other industries.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Machine Learning	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	✓	Seminars	x	Mini Project	x	Quiz
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
70 %	Understand
20 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz .

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course

is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

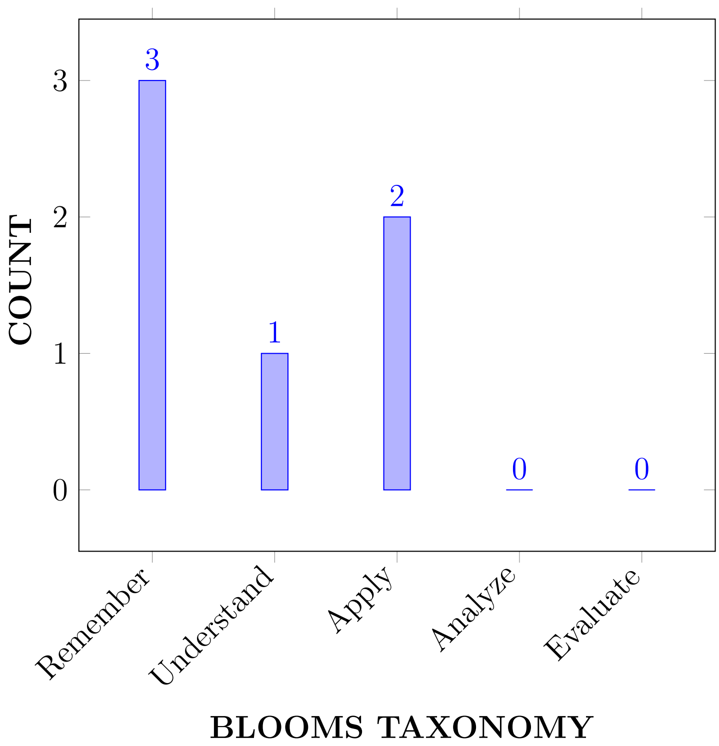
I	The fundamental concepts, issues and challenges of machine learning associated to data for model selection.
II	The supervised learning methods such as decision trees, Naïve Bayes classifier, k-nearest neighbor learning for building data models and basics of unsupervised learning methods.
III	The knowledge used for making predictions or decisions without human intervention on real-world problems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** machine learning concepts with decision trees in data classification for smart and automated applications.	Understand
CO 2	**Make** use of support vector machine and multilayer perceptrons to control learning rate in high dimensionality data classification.	Apply
CO 3	**Select** probabilistic classifiers with Naivebayes and graphical models for temporal data classification.	Remember
CO 4	**Outline** evolutionary algorithms to solve optimization problems in stochastic manner in machine learning.	Remember
CO 5	**Utilize** data clustering algorithms to perform cluster analysis with large categorical datasets in real life data mining applications.	Apply
CO 6	**Identify** appropriate machine learning techniques and suitable computing environment for real time applications.	Remember

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / Quiz / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE / Quiz / AAT
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Seminar/ AAT

PO 10	**Communication:** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	AAT
PO 12	**Life - Long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	2	Research papers/ Group discussion
PSO 3	Practical experience in shipping real world software, using industry standard tools and collaboration techniques will equip to secure and succeed in first job upon graduation in IT industry.	2	Research papers/ Group discussion / Short term courses

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓
CO 2	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓
CO 4	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 5	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 6	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO1	**Demonstrat**e machine learning concepts with decision trees in data classification for **smart and automated applications, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**	4
	PO2	**Characteristics** of machine learning that make it useful to **identify** real-world data, **research, formulate** and **analyze complex engineering problems** using **principles of mathematics and engineering sciences.**	5
	PO3	**Design** machine learning concepts with decision trees in data classification for smart and automated applications and **design system components or processes and safety, and the cultural, societal, and environmental considerations.**	5
	PO10	**Determine** machine learning concepts with decision trees in data classification for being able to comprehend and **write effective reports and design documentation,** make effective presentations.	1
	PSO1	**Indicate** machine learning concepts with decision trees in data classification for **networking devices, search engines, soft computing and knowledge discovery tools.**	4
	PSO3	**Demonstrate** machine learning concepts with decision trees in data classification for **real world software, using industry standard tools and collaboration techniques.**	3
CO 2	PO1	**Make use** of support vector machine and multilayer perceptrons to control learning rate in high dimensionality data classification, **engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**	3
	PO2	**Accept** support vector machine and multilayer perceptrons to control learning rate in high dimensionality to **Identify, formulate, review research literature, and analyze complex engineeringproblems in data classification .**	5

	PO3	**Apply** support vector machine and multilayer perceptrons to control learning rate for the specified needs with appropriate consideration for the **safety, cultural, societal, and environmental considerations**.	4
	PO10	**Exploit** of support vector machine and multilayer perceptrons to control learning rate in write effective reports.	5
	PSO1	**Utilize** the support vector machine and multilayer perceptrons to d esign next-generation computer systems, networking devices, and knowledge discovery tools	4
	PSO3	Make use of support vector machine and multilayer perceptrons to control learning rate in high dimensionality data classification using industry standard tools.	5
CO 3	PO1	Select probabilistic classifiers with Naïve bayes and graphical models to analyze the underlying mathematical relationships within and across machine learning algorithms to find solutions for complex engineering problems.	3
	PO2	Elect probabilistic classifiers with Naïve bayes and graphical models t o Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using engineering sciences	4
	PO3	Discriminate probabilistic classifiers with Naïve bayes and graphical models f o r the public health and safety, and the cultural, societal, and environmental considerations.	2
	PO10	Select probabilistic classifiers with Naïve bayes and graphical models for design documentation.	5
	PSO1	Discriminate probabilistic classifiers with Naivebayes and graphical models for networking devices, search engines, soft computing and knowledge discovery tools	5
	PSO3	Elect probabilistic classifiers with Naivebayes and graphical models for using industry standard tools	5
CO 4	PO 1	Outline evolutionary algorithms to solve optimization problems in science, engineering fundamentals to relate the hypothesis space using machine learning.	3

	PO 2	Layout evolutionary algorithms to solve optimization problems in machine learning to Identify, formulate, review research literature, and analyze complex engineeringproblems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3
	PO 3	D e f i ne evolutionary algorithms to solve optimization problems instochastic manner in machine learning for the public health and safety, cultural, societal, and environmental considerations.	1
	PO10	Summarize evolutionary algorithms to solve optimization problems instochastic manner in machine learning to communicate effectively on complex Engineering.	2
	PSO1	Brief evolutionary algorithms to solve optimization problems instochastic manner in machine learning to design next-generation computer systems, networking devices, and knowledge discovery tools.	5
CO 5	PO1	**Identify** best **models using algorithms** for reasoning with uncertainty as well as the use of unreliable information using **natural sciences and engineering sciences.**	5
	PO2	Use **research-based knowledge and methods for reasoning models** with uncertainty as well as the use of unreliable information.	3
	PO3	Characteristics of machine learning that make it useful to **identify** real-world data, **research, formulate** and **analyze complex engineering problems** using **principles of mathematics and engineering sciences.**	5
	PO10	**Communicate effectively** on real world problems reasoning with uncertainty as well as the use of unreliable information by **writing effective reports** discussing with the **engineering community.**	3
	PSO1	**Recognize** models for reasoning with uncertainty as well as the use of unreliable information used in **life-long learning in the broadest context of technological change.**	3
CO 6	PO1	Apply the **knowledge of mathematics** and engineering **fundamentals** to identify appropriate learning functions as activation function for **neural network design.**	3
	PO2	**Identify** appropriate activation function to solve **complex engineering problems** using single or multilayer **neural networks.**	3

	PO3	Characteristics of machine learning that make it useful to **identify** real-world data, **research, formulate** and **analyze complex engineering problems** using **principles of mathematics and engineering sciences.**	5
	PO10	Characteristics of machine learning that make it useful to **identify** real-world data, **research, formulate** and **analyze complex engineering problems** using **principles of mathematics and engineering sciences.**	5
	PSO1	Identify appropriate **learning functions** as activation function for **designing next generation computer systems, intelligent systems and knowledge discovery tools.**	4
	PSO3	Characteristics of machine learning that make it useful to **identify** real-world data, **research, formulate** and **analyze complex engineering problems** using **principles of mathematics and engineering sciences.**	5

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	5	5	-	-	-	-	-	-	1	-	-	4	-	1
CO 2	3	5	4	-	-	-	-	-	-	1	-	-	3	-	1
CO 3	3	5	4	-	-	-	-	-	-	1	-	-	4	-	1
CO 4	3	7	4	-	-	-	-	-	-	1	-	-	3	-	-
CO 5	1	5	5	-	-	-	-	-	-	1	-	-	3	-	-
CO 6	3	7	7	-	-	-	-	-	-	1	-	-	4	-	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	50	50	-	-	-	-	-	-	20	-	-	66.6	-	43.3
CO 2	100	50	40	-	-	-	-	-	-	20	-	-	50	-	43.3
CO 3	100	50	40	-	-	-	-	-	-	20	-	-	66.6	-	43.3
CO 4	100	70	40	-	-	-	-	-	-	20	-	-	50	-	-
CO 5	66.6	50	50	-	-	-	-	-	-	20	-	-	50	-	-
CO 6	100	70	70	-	-	-	-	-	-	20	-	-	66.6	-	66.6

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0≤ C≤ 5% – No correlation
2 - 40 % <C < 60% –Moderate
1-5 <C≤ 40% – Low/ Slight
3 - 60% ≤ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	1	-	-	3	-	2
CO 2	3	2	1	-	-	-	-	-	-	1	-	-	2	-	2
CO 3	3	2	1	-	-	-	-	-	-	1	-	-	3	-	2
CO 4	3	2	1	-	-	-	-	-	-	1	-	-	2	-	-
CO 5	2	2	2	-	-	-	-	-	-	1	-	-	2	-	-
CO 6	3	2	3	-	-	-	-	-	-	1	-	-	3	-	3
TOTAL	17	14	10	-	-	-	-	-	-	6	-	-	15	-	9
AVERAGE	2.8	2.3	1.6	-	-	-	-	-	-	1	-	-	2.5	-	2.25

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	✓	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**TYPES OF MACHINE LEARNING**
	Introduction: Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.
MODULE II	**DECISION TREE LEARNINGS**
	Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.
MODULE III	**ARTIFICIAL NEURAL NETWORKS**
	Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm. Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, Generalapproach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.
MODULE IV	**BAYESIAN LEARNING**
	Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks,EM algorithm.
MODULE V	**INSTANCE BASED AND REINFORMENT LEARNING**
	Instance Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning. Reinforcement Learning: Introduction, Learning Task, Q Learning.

TEXTBOOKS

1. Tom M. Mitchell, "Machine Learning ", McGraw-Hill, 1st Edition,2013.
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 1st Edition,2009.

REFERENCE BOOKS:

1. RajjalShinghal, "Pattern Recognition and Machine Learning", Springer-Verlag, New York, 1st Edition, 2006..

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students,Parents, Industry Personnel and Recruiters. OBE is all about feedback and outcomes.In this we will discuss about the course outcomes and program outcomes and their attainment		
CONTENT DELIVERY (THEORY)			
1	Introduction to machine Learning	CO1	T1:1
2	Understanding Well posed learning problems	CO1	T1:1.1
3-4	Discuss the steps involved in Designing a Learning system	CO1	T1:1.2
5	Interpreting Issues in MachineLearning.	CO1	T1:1.3
6	Explain Concept learning task and Concept learning as search	CO1	T1:2.1,2.2
7	Explain Find-S algorithm	CO1	T1:2.4
8-9	Construct Version space using Candidate Elimination algorithm	CO1	T1:2.5,2.6
10	How to use Inductive Bias for different algorithms	CO1	T1:2.7
11	Decision tree representationusing attributes and values	CO2	T1:3.1,3.2
12	Appropriate problems for decision tree learning	CO2	T1:3.3
13	Basic decision tree learning algorithm advantages and disadvantages	CO2	T1:3.4
14-15	Construct decision tree by finding best attribute using ID3 Algorithm	CO2	T1:3.4
16	Explain how Hypothesis space search is used for prediction in decision tree learning	CO2	T1:3.5
17	How Inductive bias helps in reducing hypotheses space searching indecision tree learning	CO2	T1:3.6
18	Discussing Issues like overfitting in decision tree learning	CO2	T1:3.1
19	Introduction to Artificial Neural Networks	CO3	T1:4.1
20	Neural Network representation using inputs, output, weights and perceptron.	CO3	T1:4.2
21	Appropriate problems for neural network learning with different characteristics	CO3	T1:4.3
22-23	Representing single layer neural network and multilayer neural network using perceptrons	CO3	T1:4.4,4.5

24-25	Demonstration of Back propagation algorithm to update the weights.	CO3	T1:4.5,4.6
26	Evaluating accuracy of Hypothesis.	CO 3	T1:5.1
27	Finding sample error and true error to estimating hypothesis accuracy.	CO3, CO4	T1:5.2
28	Using basics of sampling theory to find the probability of predicting using binomial distribution.	CO4	T1:5.3
29	Understand the general approach for deriving confidence intervals used in finding true error.	CO4	T1:5.4
30	Observing the difference in error of two hypothesis so that prediction is accurate based on hypotheses.	CO4	T1:5.5
31	Comparing learning algorithms based on target functions considering the same training examples.	CO4	T1:5.6
32	Introduction to Bayesian Learning	CO5	T1:6.1
33	Design a concept learning algorithm based on Bayes theorem.	CO5	T1:6.2,6.3
34	Learning methods to minimize Least Squared error and maximize likelihood hypothesis.	CO5	T1:6.4
35	Using maximum likelihood hypotheses for predicting probabilities.	CO5	T1:6.5
36-37	Discussing Minimum Description Length principle and Bayesian learning method Naive Bayes classifier.	CO6	T1:6.6,6.7
38	Understand EM algorithm to train Bayesian belief networks used to describe the probability distribution.	CO6	T1:6.11,6.12
39	Introduction to Instance Based Learning	CO6	T1:8.1
40	k-nearest neighbor learning	CO6	T1:8.2
41	Locally weighted regression	CO6	T1:8.3
42	Radial basis function	CO6	T1:8.4
43	Cased-based reasoning	CO6	T1:8.5
44	Introduction to Reinforcement Learning	CO6	T1:13.1
45	Learning Task and Q Learning	CO6	T1:13.2,13.3
PROBLEM SOLVING/ CASE STUDIES			
1	Cartoonifyimage with machine learning	CO 1	T1:11.2.1
2	Loan prediction using machine learning	CO 1	T1:11.2.2
3	Stock price prediction using machine learning	CO 2	T1:11.2.18
4	Predicting wine quality using wine quality dataset	CO 2	T1:11.2.25
5	Handwritten character recognition	CO 3	T1:11.4.1
6	Credit card fraud detection project	CO 3	T1:11.4.2
7	Enron investigation project	CO 4	R2:7.5
8	Online grocery recommendation using collaborative filtering	CO 4	R2:7.5
9	Rainfall prediction using linear regression	CO 5	R2:7.5
10	Voting classifier using sklearn	CO 5	R2:7.5
11	Fake news detection	CO 6	T1:11.4.1

12	Fake currency detection with machine learning	CO 6	T1:11.4.2
13	software architecture	CO 6	T1:11.5.1
14	system representation in architectural context	CO 6	T1:11.5.2
15	Coupling and Cohesion in designing class based components. s	CO 6	T2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	What is Perceptron in machine learning?	CO 1	R1:2.1-2.11
2	Define hypothesis?	CO 2, 3	R1:4.2-4.11
3	Define Gradient Descent?	CO 4	R2:5.6-5.9
4	Define hypothesis?	CO 5	R4:8.1-8.9
5	What are clustering techniques?	CO 6	R2:12.1-12.16
DISCUSSION OF QUESTION BANK			
1	What is reinforcement learning?	CO 1,	R1:2.1-2.11
2	What is Pruning?	CO 2, 3	R1:4.2-4.11
3	Define Gradient Descent?	CO 4	R2:5.6-5.9
4	Define MDL Principle?	CO 5	R4:8.1-8.9
5	Define case-based reasoning	CO 6	R2:12.1-12.16

Signature of Course Coordinator **HOD, IT**
Mr. N BASWANTH, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	INFORMATION TECHNOLOGY				
Course Title	SOFTWARE PROCESS AND PROJECT MANAGEMENT				
Course Code	AIT512				
Program	B. Tech				
Semester	VII				
Course Type	Elective				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	E. Sunil Reddy, Assistant Professor, IT				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS008	IV	Software Engineering

II COURSE OVERVIEW:

This course is aimed at introducing the primary important concepts of project management related to managing software development projects. They will also get familiar with the different activities involved in software process and project management. The course includes analyze, prioritize, and manage requirements, estimate efforts required and track the plans, configuration and quality management techniques.Further, they will also come to know how to successfully plan and implement a software process and project management activities and to complete a specific project in time.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Software Process and Project Management	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	✓	Seminars	x	Mini Project	✓	Quiz
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could

be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
50%	Understand
25%	Apply
15%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

VI COURSE OBJECTIVES:

The students will try to learn:

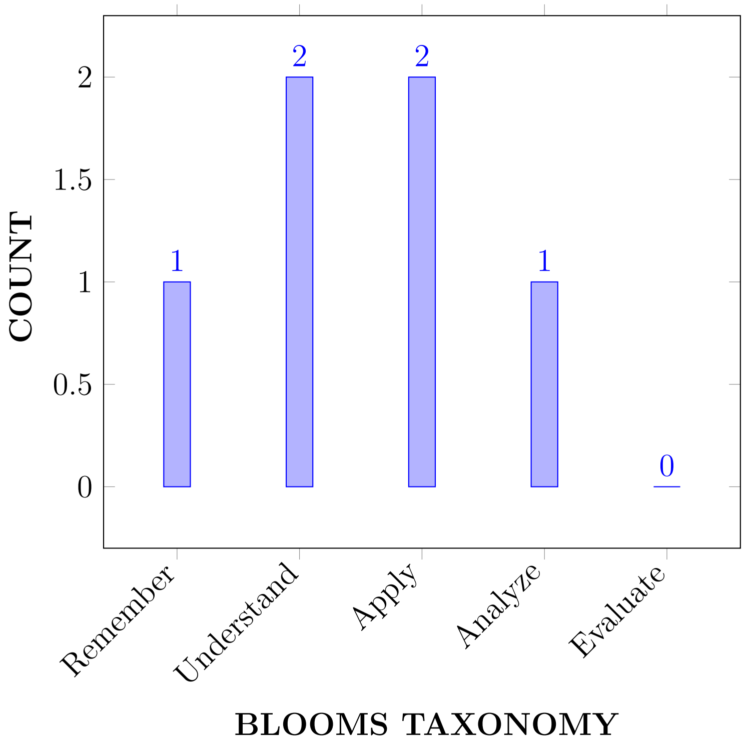
I	The fundamental knowledge on overall software development life cycle and adopt suitable processes.
II	The software process to analyze, prioritize and manage both functional and quality requirements of the software system.
III	The development of the software requires estimate efforts, plans and track the plans of the software development process.
IV	The good quality software process to apply configuration and quality management techniques.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** The concepts of software development life cycle, unified process and its phases to be used for development life cycle processes.	Remember
CO 2	**Summarize** the specific functional requirements and quality attributes of requirements management in quality attribute workshop.	Understand
CO 3	**Memorize** different types of estimation techniques, work break down structure, macro and micro plans in development of the projects.	Analyze
CO 4	**Explain** different configuration control and quality assurance techniques to be configured for quality management of the system.	Apply
CO 5	**Demonstrate** different naming conventions, version control for test data in test cases into bug tracking for configuration and quality management.	Understand
CO 6	**Apply** the relationship between elements, process modeling and process definition techniques for process assessment and improvement.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**EngineeringKnowledge:** Applytheknowledgeofmathematics,science, engineering fundamentals and an engineering specialization to the solution of complex Engineering problems.	2	CIE/SEE
PO 2	**ProblemAnalysis:**Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences.	3	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	CIE/SEE
PO 5	**Modern Tool Usage:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2	Assignments/ AAT
PO 9	**Individual and Teamwork:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	CIE / Quiz / AAT
PO 10	**Communication:**Communicate effectively on complex Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Tech talk

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Seminar
PSO 2	**Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	3	Presentation on real-world problems
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become technocrats.	2	Seminar

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	-	-	-	-	-	-	-	✓	-	-	-	✓	-	-
CO 2	✓	-	-		-	-	-	-	-	-	-	-	✓	-	-
CO 3	✓	-	-		-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	-	-	-	-	-	-	-	-	✓	-		-	-	-
CO 5	✓	-	-		-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	-		-	-	-	-	-	-	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Understand the basic concepts of software development life cycle and thephases to be used for development life cycle processes by understanding **fundamentals of computer engineering specialization and scientific principles**	2
	PO9	Recall The Function of each concepts of software development life cycle, unified process and its phases to be used for development **life cycle processes, effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary.**	5
	PSO1	Understand the basic difference between **various phases of life cycle processes with reference to software development.**	2

CO 2	PO 1	Describe the role of personal software process by applying **engineering fundamentals and provide solutions to engineering problems.**	2
	PSO1	Understand the basic **functional requirements** with reference to planning and tracking.	2
CO 3	PO 1	Understand the components contribution in different processes modelsusing mathematical principles, **fundamental of computer engineering specialization and scientific principles.**	2
	PSO1	Understand the different **processes models in real-world problems.**	1
CO 4	PO 1	Describe the role of process definition techniques in Software engineeringby **understanding mathematical principles and scientific principles.**	2
	PO 10	Understanding the scope of software processfor choosing the right quality process of **critical success factors.**	2
CO 5	PO 1	Understand the functional requirements and quality attributes of requirements management by apply the **knowledge of computer engineering fundamentals and mathematical principles**	2
	PSO1	Understand the requirements and attributes with reference to **quality attribute workshop.**	1
CO 6	PO 1	Describe the architecture centric development method for prioritization and requirements by apply the **knowledge of computer engineering fundamentals and scientific principles.**	2
	PSO1	Understand the requirements management for construction of **architecture centric development method.**	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	3	2	2
CO 1	2								5				2		
CO 2	2												2		
CO 3	2												1		
CO 4	2									2					
CO 5	2												1		
CO 6	2												1		

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	1	3	2
CO 1	66.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.66	0.0	0.0	0.0	66.66	0.0	0.0
CO 2	66.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.66	0.0	0.0
CO 3	66.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.33	0.0	0.0
CO 4	66.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0
CO 5	66.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.33	0.0	0.0
CO 6	66.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.33	0.0	0.0

XV COURSE ARTICULATION MATRIX (CO-PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq$ C$\leq$ 5% – No correlation ***1*** -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate ***3*** - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
TOTAL	18	-	-						2	2			9		
AVERAGE	3	-	-						2	2			1.8		

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-		x	Open Ended Experiments	-
Assignments	x				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**DEVELOPMENT LIFE CYCLE PROCESSES**
	Overview of Software Development Life Cycle, introduction to processes, Personal Software Process(PSP), Team Software Process(TSP), unified processes, agile processes, choosing the right process.
MODULE II	**REQUIREMENTS MANAGEMENT**
	Functional requirements and quality attributes, elicitation techniques, Quality Attribute Workshop (QAW), analysis, prioritization, and trade off, Architecture Centric Development Method (ACDM), requirements, documentation, and specification, change management, traceability of requirements.
MODULE III	**ESTIMATION, PLANNING, AND TRACKING**
	Identifying and prioritizing risks, risk mitigation plans, estimation techniques, use case points, function points, COCOMO II, top down estimation, bottom up estimation. Work break down structure, macro and micro plans, planning poker, wideband Delphi, documenting the plan, tracking the plan, Earned Value Method (EVM).
MODULE IV	**CONFIGURATION AND QUALITY MANAGEMENT**
	Identifying articrafts to be configured, naming conventions and version control, configuration control, quality assurance techniques, peer reviews, Fegan inspection, unit, registration, system, and acceptance testing, test data and test cases, bug tracking, casual analysis.
MODULE V	**SOFTWARE PROCESS DEFINITION AND MANAGEMENT**
	Process elements, process architecture, relationship between elements, process modeling, process definition techniques, ETVX (Entry-Task-Validation-exit), process baselining, process assessment and improvement, CMMI, six sigma.

TEXTBOOKS

1. PankajJalote, "Software Process Management in Practice", Pearson, Illustrated, 2002.
2. Walker Royce, "Software Project Management – A Unified Framework", Pearson Education, 1st Edition, 2002.

REFERENCE BOOKS:

1. Watts S.Humphrey, "PSP: A Self Improvement Process for Software Engineers", Addison Wesley, 1st Edition, 2005.
2. Chris F. Kemerer, "Software Project Management- Readings and Cases", McGraw-Hill, Illustrated Edition, 1997.
3. Watts S. Humphrey, "Introduction to the Team Software Process", Addison-Wesley, Illustrated Reprint, 2000.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	References
OBE DISCUSSION			
1	Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students,Parents, Industry Personnel and Recruiters. OBE is all about feedback and outcomes.In this we will discuss about the course outcomes and program outcomes and their attainment		
CONTENT DELIVERY (THEORY)			
1	Describe the basic concepts of software development life cycle.	CO1	T1:1.1-1.3
2-3	Summarize the concept of processes.	CO1	T1:2.2-2.3
4-5	Analyze the concepts of personal software process (PSP), team software process (TSP)	CO1	T1:2.1,2-3-2.6
6-7	Use the concept of agile processes in real-world problems.	CO1	T1:3.4-3.9
8-9	Determine the functional requirements and quality attributes.	CO2	T2:4.1-4.3
10-11	Understand elicitation techniques, quality attribute workshop (QAW).	CO2	T2:4.1-4.3
12-13	Determine the analysis, prioritization, and trade off	CO2	T2:4.4-4.7
14-15	Use Architecture centric development method (ACDM).	CO2	T2:8.1-8.4
16-18	Illustrate the documentation, and specification.	CO2	T2:11.3-11.4
19-20	Describe the change management and traceability of requirements.	CO3	T2:10.2-10.5
21-22	Explain software risks.	CO3	T2:17.6-17.8
23	Understand the concept of function points, COCOMO II, estimations	CO3	T2:18.1-18.6
24-25	Understand the work break down structure, macro and micro plans	CO3	T2:10.1-10.3
26-27	Understand theplanning poker ,wideband delphi	CO3	T2:26.1-26.3
28	Summarize the tracking the plan ,earned value method (EVM)	CO4	T2:26.4-26.6
29	Identifying articrafts to be configured, naming conventions	CO4	T2:28.1-28.7
30	Understand the version control, configuration control, quality assurance techniques.	CO4	T2:27.1-27.3
31-33	Summarize the concept of peer reviews, fagan inspection	CO4	T2:27.4-27.6
34	Apply testing of unit, registration, system, and acceptance, test data and test cases..	CO5	T2:25.1-25.3

35	Understand the bug tracking, casual analysis.	CO5	T2:25.4-25.6
36	Use process elements, process architecture.	CO5	T1:5.1-5.3
37	Usage ofProcess relationship between elements, process modeling.	CO6	T1:5.4-5.6
38	Use of the process definition techniques ETVX,CMMI and six sigma.	CO6	T1:6.1-6.5
39	Describe the basic concepts of software development Life cycle.	CO6	T1:6.7-6.8
40-41	Summarize the concept of processes.	CO6	T1:7.1-7.3
42	Analyze the concepts of personal software process (PSP), team software process (TSP).	CO6	T1:7.4:7.8
43	Use the concept of agile processes in real-world problems.	CO6	T1:7.4:7.8
44-45	Determine the functional requirements and quality attributes.	CO6	T1:7.4:7.8
PROBLEM SOLVING/ CASE STUDIES			
1	Analyze how an engineer responsible for drawing up a system Knowledge 4 requirements specification might keep track of the relationship between functional and non-functional requirements?	CO 5	T1:11.2.1
2	Why it is almost inevitable that the requirements of different stakeholders will conflict in some way?	CO 5	T1:11.2.2
3	What process adaptations are required if the prototype will evolve into a deliverable system or product?	CO 1	T1:11.2.18
4	Suppose you have been given the responsibility to elicit requirements from a customer who tells you he is too busy to meet with you. What should you do?	CO 2	T1:11.2.25
5	Select the three that you believe are most important, and make an argument that explains why each should be emphasized in Web Application design work.	CO 2	T1:11.4.1
6	Use the COCOMO II model to estimate the effort required to build software for a simple ATM that produces 12 screens, 10 reports, and will require approximately 80 software components. Assume average complexity and average developer/environment maturity. Use the application composition model with object points.	CO 3	T1:11.4.2
7	ETVX is a simple model used to define the requirements. ETVX stands for Entry Criteria, Tasks, Verification/Validation and Exit Criteria. while developing functional requirement for login process what are the steps to be followed for each page using ETVX model for a login screen.	CO 6	T2:7.5
8	Suppose a project manager or program manager want to canvas opinion and then reach a consensus on how our product can be the most successful product in the marketplace. The company invites the top 100 people within the organization to participate. Using the Wideband Delphi Method construct a questionnaire and agree on to the best possible way forward.	CO 3	T2:7.5

9	Which of the following is an example of the Perform Quality Assurance process? 1.Pareto chart 2.Quality Audits 3.Inspection 4.Cost of quality	CO 4	T2:7.5
10	Nowadays, patients look out for quality as a requirement choosing a healthcare service. In addition, patients can make more informed decisions about their treatments based on their experiences and level of satisfaction. Justify the Six Sigma method plays a vital role in healthcare.	CO 6	T2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define Team Software Process principles.	CO 1	T1:2.1-2.11
2	Define Quality Attribute Workshop (QAW).	CO 2, 3	T1:4.2-4.11
3	Define COCOMO II.	CO 4	T2:5.6-5.9
4	Define Quality Assurance.	CO 5	T2:8.1-8.9
5	Define process improvement.	CO 6	T2:12.1-12.16
DISCUSSION OF QUESTION BANK			
1	What is Agile development? Discuss in detail about Agile development process.	CO 1,	T1:2.1-2.11
2	Requirement Analysis and Specification	CO 2, 3	T1:4.2-4.11
3	Discuss in detail about different elicitation techniques with examples.	CO 4	T2:5.6-5.9
4	Explain the activities of Planning Poker effort estimation.	CO 5	T2:8.1-8.9
5	State and explain Quality Assurance Techniques.	CO 6	T2:12.1-12.16

Signature of Course Coordinator **HOD,IT**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**Information Technology**				
Course Title	**E-COMMERCE**				
Course Code	AIT514				
Program	B. Tech				
Semester	Seven				
Course Type	Elective				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms.LAKSHMI ATLURI, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS015	V	Business Economics and financial analysis

II COURSE OVERVIEW:

This course encompasses the marketing of products using the internet. It provides ultimate knowledge and skills to become an e-commerce whizz and resolve the organizational problems to succeed as an entrepreneur. The concepts include anatomy of e-commerce applications, electronic payment mechanisms, inter and intra organizational networks, resource discovery paradigm and multimedia involvement in e-commerce.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
E-COMMERCE	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Chalk & Talk	✓	Quiz	✓	Assignments	x	MOOC
✓	LCD / PPT	✓	Seminars	x	Mini Project	x	Videos
x	Open Ended Experiments						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
%	Remember
%	Understand
%	Apply
%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

I	The foundations and importance of E-commerce and its technology for business.
II	The steps, tools, and network mechanisms needed to start selling online.
III	The techniques and principles in Electronic Payment System and its environment.
IV	The main business and marketplace models for Electronic Communications and Trading.

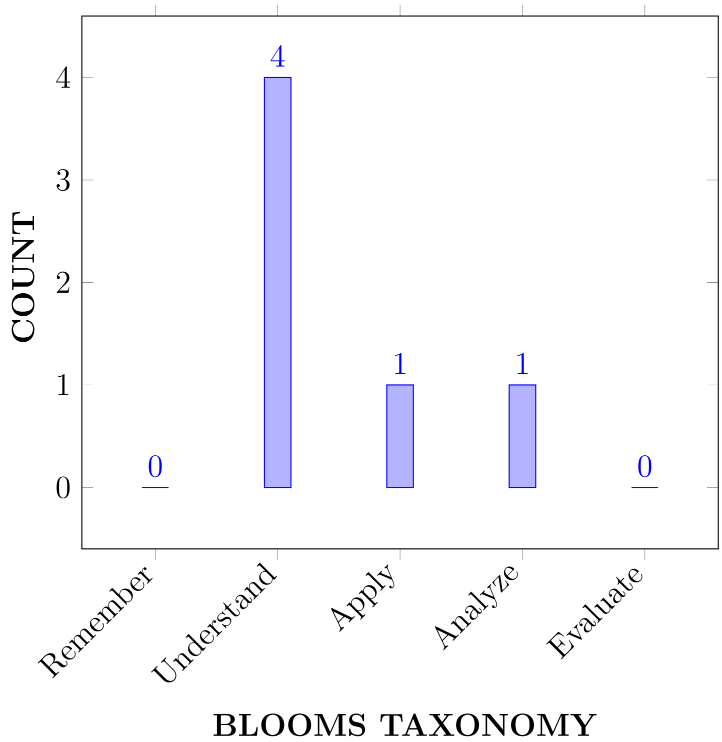
VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** Explain business-to-consumer, business-to-business, and intra organizational models to develop an internet trading relationships.	Understand

CO 2	**Demonstrate** the retailing procedure in E-commerce to expertise in market research effectively	Understand
CO 3	**List** out the key features of internet, intranets and extranets to explain the use network systems in e-commerce business.	Analyze
CO 4	**Explain** digital library and supply chain management concepts to develop best management practices	Understand
CO 5	**Make** use of the major E-commerce revenue models to evaluate existing websites	Apply
CO 6	**Explain** theoretical and practical issues of conducting business over the internet and the Web to understand the multimedia effects on e- commerce .	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	CIE / Quiz / AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE / Quiz / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Design next-generation computer systems, networking devices, search engines, soft computing and intelligent systems, web browsers, and knowledge discovery tools.	3	Quiz
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	2	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓	-
CO 2	✓	✓	✓	-	-	-	-	-	-	✓	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 4	✓	-	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
CO 5	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain Business to Consumer, Business-to-Business, and Intra organizational on Internet trading relationships by Applying the **knowledge** of science, **engineering** fundamentals	2
	PSO 2	Focus on **mobile applications** and explain the components in the construction, operation and types of insulators and underground cables.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 1	Understand the key issues and applications effectiveness of market research by applying **mathematical principles** and **computer science methodologies**	2
	PO 2	Understand the key issues in **problems identification**and **analyse complex Engineering problems** in optimizing business decisions like **Information and data collection** and **Interpretation of results**	5
	PO 3	Make use of retailing procedure in E-commerce to expertise in market research effectively **define a problem identify constraints including environmental** and **risk assessment issues** and**Manage the design process innovative solutions**and **environmental and sustainability limitations**	7
	PO 10	Classify the key issues in terms of defining various problems, customer and user needs, **cost effective** and **creative solutions**, **design process**, **economic context** and **management techniques**.	5
CO 3	PO 1	List out the key features of Internet, Intranets and Extranets and explain how they relate to each other using **computer science methodologies**	1
	PO 2	Make use of internet information and **data collected** from various sources and **perform model translation** and **validation** by **Experimental design** and check **Interpretation of results**	5
	PO 10	Make use of different internet components for developing applications based on technical literature and quality issues. **Identify, classify** and describe the performance of systems through analytical methods and **techniques.**	5
CO 4	PO 1	discuss modern computing infrastructures from the perspective of the internet and organizations **computer science methodologies, mathematical** and **scientific principles.**	3
	PO 3	make use of digital library and supply chain management concepts to develop best management practices **safety** and **risk assessment issues Identify and manage cost drivers** and **Manage the design process and evaluate outcomes**	5
	PO 4	discuss modern computing infrastructures from the perspective of the internet and organizations**Conduct Investigations of Complex Problems** for Understanding of appropriate codes of practice and industry standards and Ability to work with technical uncertainty and the use of analytical methods and modeling techniques	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Make use of **next-generation computer systems** and **networking devices** to develop management practices for **knowledge discovery tools**	4
CO 5	PO 1	Make use of the major e-commerce revenue models to evaluate existing websites **mathematical** and **scientific principles** by integrating **computer science knowledge.**	3
	PO 3	Major e-commerce revenue models to evaluate existing websites by **investigating** and defining various **problems**, **understanding** customer and user needs, with cost effective and creative solutions by managing the **design process**, **knowledge** on **economic context, management techniques.**	7
	PSO 1	Make use of **networking devices, search engines** and E-Commerce revenue models for existing websites to develop **web browsers**	4
CO 6	PO 4	make use of theoretical and practical issues of conducting business over the internet and the multimedia effects on e- commerce **Knowledge of management** and **Understanding of commercial** and **economic context** of **engineering processes including personnel**, **health**, **safety**, and **risk issues**	7

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO 2	2	5	7	-	-	-	-	-	-	5	-	-	-	-	-
CO 3	1	5	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 4	3	-	5	5	-	-	-	-	-	-	-	-	4	-	-
CO 5	3	-	7	-	-	-	-	-	-	-	-	-	4	-	-
CO 6	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50	0.0	0.0
CO 2	66.7	50	70	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0
CO 3	33.3	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0
CO 4	100	50	0.0	0.0	45.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0
CO 5	100	0.0	70	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	40	0.0	0.0
CO 6	0.0	0.0	0.0	63.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.
0 - 0$\leq$ C$\leq$ 5% – No correlation
2 - 40 % <C < 60% –Moderate
1-5 <C$\leq$ 40% – Low/ Slight
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	3	2	3	-	-	-	-	-	-	3	-	-	-	-	-
CO 3	1	2	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 4	3	-	2	2	-	-	-	-	-	-	-	-	3	-	-
CO 5	3	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO 6	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
TOTAL	13	4	8	5	-	-	-	-	-	6	-	-	6	2	-
AVERAGE	2.6	2.0	2.6	2.5	-	-	-	-	-	3.0	-	-	3.0	2.0	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	x
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	x	Open Ended Experiments	-
Assignments	x				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO ELECTRONIC COMMERCE**
	Electronic Commerce: Frame work, media coverage; anatomy of e-commerce applications: E-commerce Consumer applications, E-ecommerce organization applications
MODULE II	**ELECTRONIC PAYMENT SYSTEMS**
	Types of electronic payment systems; Digital token based electronic payment system: E-cash, properties of e-cash, electronic cash in action, business issues and electronic cash, operational risk and electronic Cash, electronic checks; smart cards and electronic payment system; Credit card based electronic payment system; Risk and electronic payment system; Designing electronic payment system
MODULE III	**PERFORMANCE OF TRANSMISSION LINES**
	Inter organizational commerce: Electronic data interchange, electronic data interchange implementation, and value added networks; Intra organizational commerce: Work flow, automation customization and internal commerce, supply chain management. Corporate digital library: Document library, digital document types, corporate data warehouses; Advertising and marketing: Information based marketing, advertising on internet, on-line marketing Process, market research.
MODULE IV	**CONSUMER SEARCH AND RESOURCE DISCOVERY**
	Search and resource discovery paradigms, information search and retrieval, commerce catalogues, Information filtering.
MODULE V	**MULTIMEDIA**
	Multimedia: Key multimedia concepts, digital video and electronic commerce, desktop video processing, desktop video conferencing.

TEXTBOOKS

1. Ravi Kalakata, Whinston Andrew B, Frontiers of Electronic Commerce, Pearson, 1st Edition, 1996.

REFERENCE BOOKS:

1. David Whitley, E-Commerce-Strategy, Technologies and Applications, Tata McGraw-Hill, 2nd Edition, 2000.

2. Kamlesh K. Bajaj, E-Commerce the Cutting Edge of Business, Tata McGraw-Hill, 1st Edition, 2005
3. Christopher Westland, Theodore H. K Clark, Global Electronic Commerce- Theory and Case Studies, University Press, 1st Edition, 1999.

WEB REFERENCES:

1. www.engr.sjsu.edu/gaojerry/course/cmpe296u/296z/introduction.pdf

COURSE WEB PAGE:

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
	OBE DISCUSSION		
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
	CONTENT DELIVERY (THEORY)		
1	Electronic Commerce: Frame work, media coverage anatomy of e-commerce	CO 1	R1:1.1
2	anatomy of e-commerce	CO 1	R1:1.1
3	consumer applications E-ecommerce organization applications	CO 2	T1:1.2
4	E-ecommerce organization applications	CO 2	T1:1.2
5	Types of electronic payment systems.	CO 3	T1:1.3
6	Digital token based electronic payment system: E-cash.	CO 3	T1:1.3
7	Electronic Cash In Action	CO 4	R1:1.5
8	Business Issues And Electronic Cash	CO 4	R1:1.5
9	operational risk and electronic Cash, electronic checks	CO 4	R1:1.5
10	Smart cards and electronic payment system.	CO 5	T1:3.2
11	Credit card based electronic payment system.	CO 5	T1:3.2
12	Risk and electronic payment system	CO 3	T1:3.5
13	Designing electronic payment system	CO 3	T1:3.5
14	PERFORMANCE OF TRANSMISSION LINES	CO 3	T1:4.3
15	Inter organizational commerce: Electronic data Interchange	CO 3	T1:4.3
16	Electronic Data Interchange Implementation	CO 8	T1:5.2
17	And Value Added Networks	CO 3	T1:5.2
18	Intra organizational commerce	CO 3	T1:5.2
19	Work flow, automation customization	CO 3	T1:5.2
20	internal commerce, supply chain management	CO 3	T1:5.2
21	Corporate digital library: Document library, digital document types, corporate data warehouses	CO 4	T1:6.2
22	digital document types, corporate data warehouses	CO 4	T1:6.2
23	Advertising and marketing: Information based marketing	CO 6	T1:6.5

24	advertising on internet, on-line marketing process, market research	CO6	T1:6.5
25	Search and resource discovery paradigms	CO 5	T1:10.2
26	information search and retrieval	CO 5	T1:10.2
27	Commerce Catalogues, Information Filtering	CO 2	T1:10.2
28	Information Filtering	CO 2	T1:10.2
29	MULTIMEDIA	CO 3	T1:10.4
30	Multimedia: Key Multimedia Concepts	CO 3	T1:10.4
31	Digital Video and Electronic Commerce	CO 3	T1:10.4
32	Desktop Video Processing, Desktop Video Conferencing.	CO 3	T1:10.4
PROBLEM SOLVING/ CASE STUDIES			
1	how to develop the data processing technology of Big Data banking systems improve the credit risk management process?	CO 1	R1:1.5
2	what are the tools and techniques of Artificial Intelligence (AI) that can help in improving electronic commerce (E-commerce)?	CO 1	R1:1.5
3	Will the social aspects of interpersonal contacts be a barrier to the creation of electronic banks without staff?	CO 1	R1:1.5
4	Write use of electronic brokerages?	CO 1	T1:3.2
5	List the New forms of organizational structures?	CO 4	T1:3.2
6	What are the main characteristics of cash payment in contrast with cheque payment?	CO 4	T1:3.2
7	Why is a certifying authority required in E Commerce?	CO 4	T1:4.3
8	Define Trade cycle and describe the different stages of a Trade cycle.	CO 5	T1:4.3
9	What are the necessary conditions a hash function used in digital signature should satisfy?	CO 1	T1:4.3
10	Why is security important in E-Commerce?	CO 3	T1:6.2
11	how should merchants promote their ecommerce sites?	CO 1	T1:6.2
12	what security risk does ecommerce involve?	CO 1	T1:6.2
13	what are Internet Security Services? explain each one of them with an example	CO 5	T1:6.5
14	Write about the security service that are to be offered in E-Payment system in detail.	CO 5	T1:6.5
15	Once a company has acquired customer, the key to maximizing revenue is keeping them. explain how e-commerce is helpful in customer retention?	CO 5	T1:6.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Discussion of definition and terminology on Introduction to electronic commerce	CO 1	R1:1.5
2	Discussion of definition and terminology on Electronic payment systems	CO 2	T1:3.2
3	Discussion of definition and terminology on Performance of transmission lines	CO 3	T1:5.2
4	Discussion of definition and terminology on Consumer Search and Resource discovery	CO 4,5	T1:6.2,6.5

5	Discussion of definition and terminology on Multimedia	CO 5,6	T1:10.2,4
DISCUSSION OF QUESTION BANK			
1	Discussion of Question on Introduction to electronic commerce	CO 1	R1:1.5
2	Discussion of Questionon Electronic payment systems	CO 2	T1:3.2
3	Discussion of Question on Performance of transmission lines	CO3	T1:5.2
4	Discussion of Question on Consumer Search and Resource discovery	CO 4,5	T1:6.2,6.5
5	Discussion of Question on Multimedia	CO 5,6	T1:10.2,4

Signature of Course Coordinator **HOD,IT**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	Electronics and Communication Engineering				
Course Title	Research Methodologies				
Course Code	AHS552				
Program	B.Tech				
Semester	VII				
Course Type	Core				
Regulation	R-16				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr.Mohd.Khadir, Assistant Prfoessor,ECE				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course imparts research methodology including basic concepts employed in quantitative and qualitative research methods. It provides the research framework, research methodology research design, and formulation hypothesis, sampling techniques, data analysis and report writing. It focuses on research skills to improve the quality of research in any area.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Research Methodologies	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
5%	Remember
50%	Understand
20 %	Apply
15%	Analyze
10%	Evaluate
0%	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	AAT	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours / classes, techtalk, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), concept video, MOOCs etc. The AAT chosen for this course is given in table.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

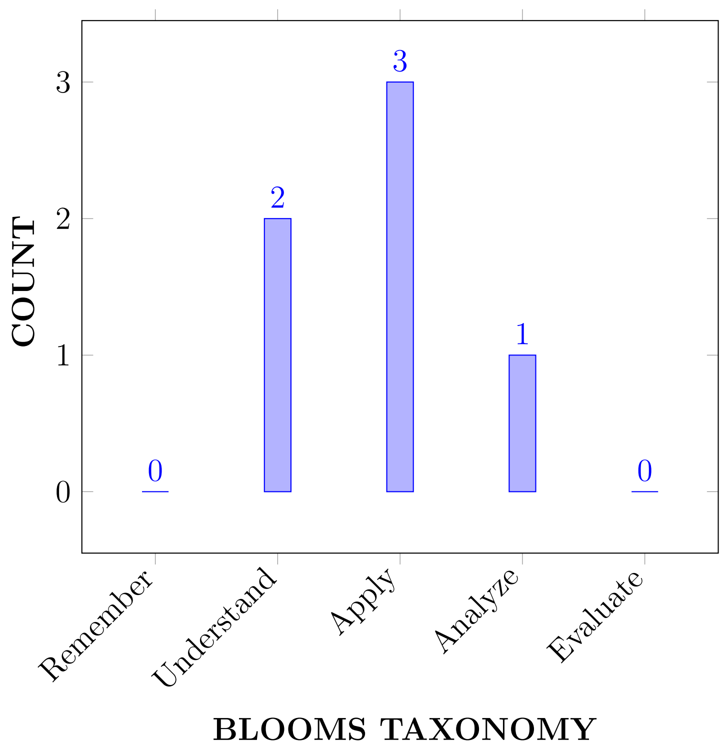
I	The fundamental concepts of research frame work and its methodologies to conduct research work.
II	The design and implementation of quantitative and qualitative research methods given the nature of the research problem.
III	The ethical issues in educational research, including data analysis in using quantitative and qualitative research.
IV	The knowledge and ideas through writing well-developed research reports.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Describe** the role of research and research frame work in several fields of applied economics, scientific, business and industry.	Understand
CO 2	**Illustrate** the formulation of the research hypotheses using dependent and independent variables for testing of research identified problem.	Understand
CO 3	**Build** a suitable research design, selecting appropriate research method and resources to analysis the data of specified research problem.	Apply
CO 4	**Analyze** the scaling and sampling techniques for measurement of data in the research for quantitative and qualitative data.	Analyze
CO 5	**Classify** the various techniques of data processing and data analysis which includes statistical tools and graphical methods for present the results.	Apply
CO 6	**Utilize** the American Psychological Association format, ethical issues through knowledge and ideas for writing well-developed research reports	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	SEE / CIE / AAT
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	2	SEE / CIE / AAT
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	1	Tech Talk/ Conept VideosT
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	Tech Talk/ Conept Videos
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	Tech Talk/ Conept Videos

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 2	Focus on the practical experience of ASIC prototype designs, Virtual Instrumentation and SOC designs	1	AAT
PSO 3	Build the Embedded hardware design and software programming skills for entry level job positions to meet the requirements of employers.	1	AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 3	✓	✓	✓	✓	-	-	-	-	✓	✓	-	-	-	-	✓
CO 4	✓	✓	✓	✓	-	-	-	-	✓	✓	-	-	-	✓	-
CO 5	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	-	✓	-	✓	-	-	-	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT :

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Describe the role of research in several fields of applied economics, scientific, business and industry by applying the principles of engineering, science to complex engineering problems	3
	PO 2	Problem or opportunity identification, problem definition, formulation the hypothesis to determining a problem using Information and data collection.	3
	PO 3	Design solutions for complex Engineering problems and use techniques of research process and data collection that meet the specified needs with appropriate consideration for the purpose for all aspects of the problem constraints and apply economics, scientific, business and industry	4
	PO 4	Ability to work with technical uncertainty and Identify the problem in several fields of applied economics, scientific, business and industry using methods and techniques Understanding of appropriate codes of practice and industry standards and Awareness of quality issues and ability to identify, classify	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Effective presentation and Speaking Style on Research process in research problem and write Subject Matter Effectively the research problem identification.	4
CO 2	PO 1	Demonstrate the formulation of the research hypotheses using principles of Scientific principles and methodology	2
	PO 2	Problem or opportunity identification, problem definition, formulation the research hypothesis and methodology to determining a problem using Information and data collection	3
	PO 10	Formulation of the research hypotheses using Reference , Speaking Style	3
CO 3	PO 1	Discuss the various types of resources for the data collection (knowledge) by applying the scientific principles and methodology , other disciplines to support the study of engineering discipline to collection the data	2
	PO 2	Understand the given the research problem statement and problem definition finding the solution implementation of research design using literature review by problem formulation and abstraction.	4
	PO3	Research design is the arrangement of conditions Using creativity to establish innovative solutions for collection and analysis of data and apply economics, scientific, business and industry.	4
	PO 4	Ability to work with technical uncertainty and find the Methods of data collection using literature review and information resources in research design using particular materials understand and approach to research problem.	4
	PO 10	Research design is the arrangement of conditions using. Reference , Speaking Style and clarity and for collection and analysis of data	3
	PSO 3	Make use of research methods and techniques for the research design to meet the requirements and desire for higher studies in the field of research design process	2
CO 4	PO 1	Demonstrate the scaling and sampling measurement using principles of Scientific principles and methodology	3
	PO 2	Understand the given the research problem statement identification, definition and finding the solution implementation of scaling measurement, sampling design using literature review by problem formulation and abstraction.	4
	PO 3	Questionnaire in survey Using creativity to establish innovative solutions for open- and- closed- ended questions and apply economics, scientific, business and industry.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	Ability to work with technical uncertainty and find the Questionnaire in survey using technical literature review and sampling design , open- and- closed- ended questions using particular materials.	3
	PO 10	Questionnaire in survey using Reference , Speaking Style and clarity and open- closed- ended questions	3
CO5	PO1	concepts of processing and analysis using principles of Scientific principles and methodology editing, coding, classification and tabulation methods using science and methodology	3
	PO 2	Problem or opportunity identification, problem definition, formulation and data collection ,translation of the data processing and validation of data analysis	6
	PO 4	Ability to work with technical uncertainty and find the results data using data processing and data analysis using particular materials(statistical tools)	3
CO6	PO 1	Demonstrate the report generation and APA format using engineering discipline to support study of engineering discipline.	3
	PO2	Interpretation of results and documentation while generating a report based on APA format.	2
	PO 3	Professional codes of ethics, high degree of trust and integrity, believing to follow ethical issues in conducting research	3
	PO8	Identification of ethical issues related to conduct research and a commitment to protecting the rights for research studies.	1
	PO 9	Teams are used during the classroom periods; in the hands- on labs on report generation and Instruction on effective teamwork and project management and while generating a report based on APA format.	3
	PO 10	Effective presentation and Speaking Style, Reference on report generation and write Subject Matter Effectively on validity and reliability evidence in report writing using APA format.	3
	PO12	Ongoing learning feasibility and practicality of research methodology Project management professional certification and Continued personal development for a proposed project.	3
	PSO3	Feasibility and practicality of research methodology entry level job positions to meet the requirements of employers.	2

Note:For Key Competencies refer Annexure - I

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	2	3	4	4	-	-	-	-	-	2	-	-	-	1	-
CO 2	2	3	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 3	2	4	4	4	-	-	-	-	-	3	-	-	-	0	2
CO 4	3	4	2	3		-	-	-	-	3	-		-	2	-
CO 5	3	6	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 6	3	2	3	-	-	-	-	1	3	3	-	3	-	-	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	30	40	36.3	-	-	-	-	-	40	-		-	50	-
CO 2	66.7	30	40	-	-	-	-	-	-	60	-	-	-	0	-
CO 3	66.7	40	40	36.3	-	-	-	-	-	60	-	-	-	0	100
CO 4	100	40	20	27.7		-	-	-	-	60	-		-	100	-
CO 5	100	60	30	-	-	-	-	-	-	40	-	-	-	100	-
CO 6	100	20	30	-	-	-	-	33.3	30	60	-		-	-	100

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $< C \leq 40\%$ – Low/ Slight
2 - 40 % $< C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	2	1	0	0	0	0	0	2	0	0	0	2	0
CO 2	3	1	2	0	0	0	0	0	0	3	0	0	0	0	0
CO 3	3	2	2	1	0	0	0	0	0	3	0	0	0	0	2
CO 4	3	2	1	1	0	0	0	0	0	3	0	0	0	3	0
CO 5	3	3	1	0	0	0	0	0	0	3	0	0	0	2	0
CO 6	3	1	1	0	0	0	0	1	1	3	0	0	0	0	2
TOTAL	18	10	9	4	0	0	0	1	1	17	0	0	0	7	4
AVERAGE	3	1.7	1.5	1	0	0	0	1	1	2.8	0	0	0	2.8	2

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	-
Quiz	-	Tech - Talk	✓	Certification	-
Term Paper	-	Seminars	-	Student Viva	-
Laboratory Practices	-	5 Minutes Video / Concept Video	✓	Open Ended Experiments	✓
Micro Projects	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✓	Assessment of activities / Modeling and Experimental Tools in Engineering by Experts		

XVIII SYLLABUS:

UNIT I	**INTRODUCION TO RESEARCH AND PHILOSOPHIES**
	Introduction to research: The role of research, research process overview; Philosophies and the language of research theory building: Science and its functions, what is theory, the meaning of methodology.
UNIT II	**A RESEARCHER PROBLEMS AND HYPOTHESES**
	Thinking like a researcher: Understanding concepts, constructs, variables, and definitions; Problems and hypotheses: Defining the research problem, formulation of the research hypotheses, the importance of problems and hypotheses.
UNIT III	**RESEARCH DESIGN AND DATA COLLECTION**
	Research design: Experimental and no experimental research design, field research, and survey research. Methods of data collection: Secondary data collection methods, qualitative methods of data collection, and survey methods of data collection.
UNIT IV	**ATTITUDE MEASUREMENT , SCALING AND SAMPLING TECHNIQUES**
	Attitude measurement and scaling: Types of measurement scales; Questionnaire designing, reliability and validity; Sampling techniques: The nature of sampling, probability sampling design, non-probability sampling design, and determination of sample size.
UNIT V	**PROCESSING AND ANALYSIS OF DATA,ETHICAL ISSUES**
	Processing and analysis of data ; Ethical issues in conducting research; Report generation, report writing and APA format; Title page, abstract, introduction, methodology, results, discussion, references, and appendices.

TEXTBOOKS

1. Bryman, Alan, Bell, Emma, "Business Research Methods", Oxford University Press, 3rd Edition, 2011.
2. C R Kothari,"Research Methodology", New Age International Publishers, 2nd Edition, 2004.

3. Rubin, Allen, Babbie, Earl,"Essential Research Methods for Social Work", Cengage Learning Inc., USA, 2009

REFERENCE BOOKS:

1. Chawla, Deepak, Sandhi, Neena, "Research Methodology: Concepts and Cases", Vikas Publishing House Pvt. Ltd. Delhi, 2011.
2. NeumanW.L., "Social Research Methods: Qualitative and Quantitative Approaches", Pearson Education, 2008.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/playercourse id=230section id=552lesson id=5559

XIX COURSE PLAN

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		W 1
CONTENT DELIVERY (THEORY)			
2	Block schematics of measuring systems, performance characteristics	CO 1	T1:1.1, 1.2. T2:1.2-1.7 R2:2.10
3	Static and Dynamic characteristics, types of errors	CO 1	T1:1.2.,T2:1.2-1.7 R2:2.10
4	D' Arsonval movement	CO 1	T1: 2.2., T2:2.3-2.7 R2:3.3
5	DC voltmeters	CO 1	T1: 4.2,4.3. ,T2:4.3-4.7
6	DC ammeters	CO 1	T1: 3.2,3.3. T2:3.3-3.4
7	AC voltmeters	CO 1	T1: 4.7-4.17, T2:4.7-4.17
8	AC current meters (Ammeters)	CO 1	T1: 3.5, 3.6.,T2:3.5-3.7
9	Ohmmeters ,Multimeters, meter protection, extension of range	CO 1	T1: 4.4,4.6,T2:4.7-4.17
10	Digital voltmeters, Ramp type, staircase	CO 1	T1:5.1-5.10, R2:5.1
11	Digital voltmeters dual slope integrating type, successive approximation type, specifications of instruments.	CO 1	T1:5.1-5.10, R2:5.3
12	Oscilloscopes: CRT, block schematic of CRO	CO 2	T1:7.1-7.13,R2:4.1-4.3
13	Time base circuits, delay lines	CO 2	T1:7.1-7.13,R2:4.1-4.3
14	high frequency CRO considerations, applications, specifications	CO 2	T1:7.1-7.13,R2:4.1-4.3

15	special purpose oscilloscopes: Dual trace, dual beam CROs	CO 2	T1:7.14-7.18,R2:4.7-4.13
16	sampling oscilloscopes, storage oscilloscopes	CO 2	T1:7.19-7.28,R2:4.7-4.13
17	Digital Storage CROs	CO 2	T1:7.19-7.28,R2:4.7-4.13
18	Lissajous figures, frequency measurement, phase measurement	CO 2	T1:7.19-7.28,R2:4.7-4.13
19	CRO probes	CO 2	T1:7.19-7.28,R2:4.7-4.13
20	Signal Generators: standard signal generators	CO 3	T1:8.1-8.2,R2:6.1-6.13
21	AF sine and square wave generators	CO 3	T1:8.1-8.18,R2:6.1-6.13
22	function generators, arbitrary waveform generator	CO 3	T1:8.1-8.18,R2:6.1-6.13
23	sweep frequency generators, video signal generators	CO 3	T1:8.1-8.18,R2:6.1-6.13
24	Signal Analyzers: AF, HF wave analyzers	CO 4	T1:9.1-9.8, R2:7.1-7.6
25	heterodyne wave analyzers, harmonic distortion wave analyzers	CO 4	T1:9.1-9.8, R2:7.1-7.6
26	spectrum analyzers, power analyzers	CO 4	T1:9.1-9.8, R2:7.1-7.6
27	Measurements using DC bridges: Wheat stone bridge	CO 5	T1:11.2 R2:10.4
28	Measurements using DC bridges: Kelvin bridge	CO 5	T1:11.3 R2:10.5
29	AC bridges: Maxwell bridge, Hay bridge	CO 5	T1:11.11-11.12 R2:10.8
30	AC bridges: Schering bridge, Wien bridge	CO 5	T1:11.13-11.14 R2:10.9-10.10
31	AC bridges: Anderson bridge	CO 5	T1:11.18,R2:10.13
32	Wagner & ground connection	CO 5	T1:11.15,R2:10.16
33	Transducers: Classification	CO 6	T1:13.1,R2:12.1
34	strain gauges	CO 6	T1:13.6,R2:12.6
35	resistance thermometers	CO 6	T1:13.7,R2:12.7
36	hotwire anemometers, thermocouples	CO 6	T1:13.8,R2:12.9
37	LVDT	CO 6	T1:13.11,R2:12.10
38	Piezoelectric transducers	CO 6	T1:13.15,R2:12.17
39	Magneto strictive transducers	CO 6	T1:13.16,R2:12.18
40	measurement of physical parameters: force and displacement	CO 6	T1:13.23-13.27, R2:12.24-12.28
41	measurement of physical parameters: Pressure, vacuum level, temperature measurements	CO 6	T1:13.23-13.27, R2:12.24-12.28
42	Problem solving on Voltmeters and ammeters	CO 1	T1: 4.2-4.13.
43	Problem solving on series and shunt ohmmeters, digital multimeters	CO 1	T1: 4.2-4.13.R2:4.13
44	Problem solving on electrostatic deflection sensitivity, Velocity of electron beam	CO 2	T1:7.1-7.13,R2:4.1-4.3
45	Problem solving on frequency and phase measurement	CO 2	T1:7.1-7.13,R2:4.1-4.3

46	Problem solving on minimum detectable signal of spectrum analyzer	CO 4	T1:9.1-9.8, R2:7.1-7.6
47	Problem solving on whetstone bridge	CO 5	T1:11.2 R2:10.4
48	Problem solving on Kelvin bridge	CO 5	T1:11.3 R2:10.5
49	Problem solving on wien bridge	CO 5	T1:11.11-11.12 R2:10.8
50	Problem solving on Maxwell bridge	CO 5	T1:11.13-11.14 R2:10.9-10.10
51	Problem solving on Schering bridge	CO 5	T1:11.18,R2:10.13
52	Problem solving on Anderson bridge	CO 5	T1:11.2 R2:10.4
53	Problem solving on hay's bridge	CO 5	T1:11.3 R2:10.5
54	Problem solving on strain gauges	CO 6	T1:13.6,R2:12.6
55	Problem solving on LVDT	CO 6	T1:13.11,R2:12.10
56	Problem solving on Thermistor	CO 6	T1:13.15,R2:12.17
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	UNIT-I: INTRODUCION TO RESEARCH AND PHILOSOPHIES	CO 1	T1:1.1-19,2.1-2.8,3.1-3.8,4.1-4.25,5.1-5.10
58	UNIT-II: A RESEARCHER PROBLEMS AND HYPOTHESES	CO 2	T1:7.1-7.32
59	UNIT-III: RESEARCH DESIGN AND DATA COLLECTION	CO 3,4	T1:8.1-8.10,9.1-9.6
60	UNIT-IV: ATTITUDE MEASUREMENT , SCALING AND SAMPLING TECHNIQUES	CO 5	T1:11.1.-11.18
61	UNIT-V: PROCESSING AND ANALYSIS OF DATA,ETHICAL ISSUES	CO 6	T1:13.1-13.25
DISCUSSION OF QUESTION BANK			
62	UNIT-I: INTRODUCION TO RESEARCH AND PHILOSOPHIES	CO 1	T1:1.1-19,2.1-2.8,3.1-3.8,4.1-4.25,5.1-5.10
63	UNIT-II: A RESEARCHER PROBLEMS AND HYPOTHESES	CO 2	T1:7.1-7.32
64	UNIT-III: RESEARCH DESIGN AND DATA COLLECTION	CO 3,4	T1:8.1-8.10,9.1-9.6
65	UNIT-IV: ATTITUDE MEASUREMENT , SCALING AND SAMPLING TECHNIQUES	CO 5	T1:11.1.-11.18
66	UNIT-V: PROCESSING AND ANALYSIS OF DATA,ETHICAL ISSUES	CO 6	T1:13.1-13.25

Course Coordinator **HOD,ECE**
Mr.Mohd.Khadir, Assistant Prfoessor

ANNEXURE - I

KEY COMPETENCIES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences (**Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions 5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	**10**

PO 4.	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**
PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**

PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability**). Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics**). 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork**). 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project. 6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	**12**

PO 10	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally" 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**
PO11	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**
PO12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COURSE DESCRIPTION

Department	**CIVIL ENGINEERING**
Course Title	ENERGY FROM WASTE
Course Code	AEE551
Program	B.Tech
Semester	VII
Course Type	Open Elective
Regulation	IARE R-16

<table>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>-</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr. Ch.Balakrishna, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS005	I	Engineering Chemistry
B.Tech	AHS009	II	Environmental Studies

II COURSE OVERVIEW:

The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course will discuss on the municipal solid waste composition, characteristics and to improve the methods to minimize municipal solid waste generation. This course deals with methods of disposal of solid waste by thermal biochemical processes and production of energy from different types of waste sand to know the environmental impacts of all types of municipal waste. This course will discuss the overall scenario of E-Waste management in India in comparison with other countries around the globe. This course will deals with E-waste legislation and government regulations on E-waste management.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Energy From Waste	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
60%	Understand
20%	Apply
0%	Analyze
0%	Evaluate

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Quiz \Alternative Assessment Tool (AAT).

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz \AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Open Ended Experiment
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

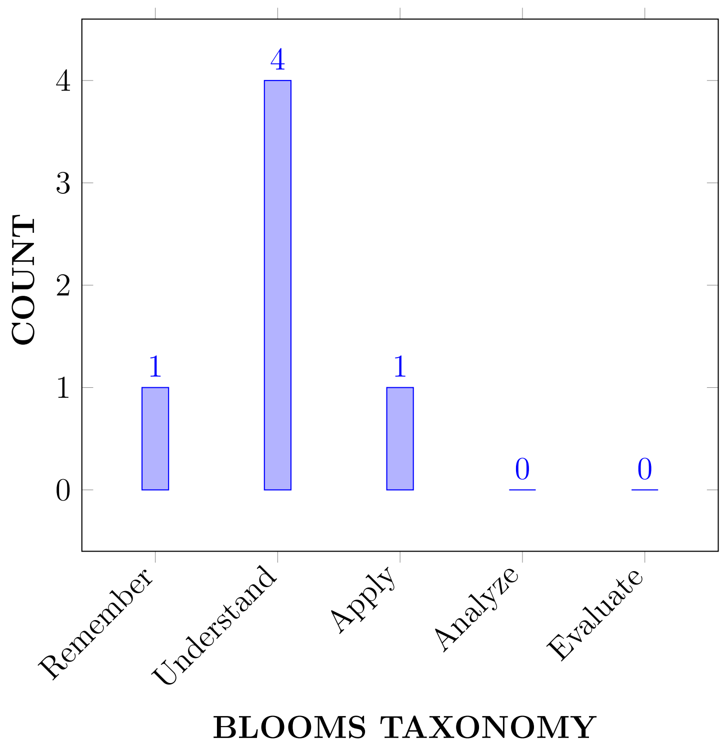
I	The principles of solid waste management in reducing and eliminating dangerous impacts of waste materials on human health and the environment to contribute economic development and superior quality of life.
II	The insight of the design and operations of a municipal solid waste landfill by collection, transfer and transportation of municipal solid waste for the final disposal.
III	The main operational challenges in operating thermal and biochemical energy from waste facilities and device processes involved in recovering energy from wastes.
IV	The scenario of E-Waste management in India and other countries around the globe and assess the impact of electronic waste on human, environment and society by informal recycling and management. The sustainable solution of E-Waste Management can be achieved by adopting modern techniques and Life-Cycle Analysis approach.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Identify** the different sources, types of solid waste by the properties of municipal solid waste for segregation and collection of waste.	Remember
CO 2	**Understand** the Composition, characteristics of leachate and preliminary design considerations of landfill to control the emission of gases and monitoring the movement of landfill leachate.	Understand
CO 3	**Outline** the Biochemical conversion of biomass for energy generation by anaerobic digestion of solid waste.	Understand
CO 4	**Illustrate** the thermo-chemical conversion of solid waste by using Gasification and pyrolysisprocess for energy generation.	Understand
CO 5	**Identify** the need to stringent health safeguards and environmental protection laws of India for the effective disposal of E-waste.	Apply
CO 6	**Interpret** the global scenario of environmental concerns and health hazards by the generation of E- waste.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Program Outcomes	
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE/AAT
PO 3	**Design/development of solutions:** : Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1	CIE/SEE/AAT
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1	CIE/SEE/AAT
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	CIE/Quiz/AAT

PO 12	**Life-long learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 2	Focus on Improving Performance of Structures with reference to Safety, Serviceability and Sustainable Green Building Technology.	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	✓	-	-	✓	✓	-	-	-	-		-	-	-
CO 2	-	-	✓	-	-	✓	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	✓	✓	-	-	-	-	-	-	✓	-
CO 4	✓	-	✓	-	-	-	✓	-	-	-	-		-	-	-
CO 5	-	-	-	-	-	✓	-	-	-	-	-	✓	-	✓	-
CO 6	-	-	-	-	-	✓	-	-	-	-	-	✓	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of Key competencies matched.**
CO 1	PO 1	Apply the **Scientific principles** for energy generation by applying different technologies from waste management plants.	1
	PO 3	Identify the **constraints including environmental health and safety and risk assessment issues** of different methods of disposal of municipal solid waste by aerobic composting **to promote sustainable development.**	2
	PO 6	Apply the **knowledge of management techniques** by understanding the **requirement for engineering activities**of municipal solid waste for the **sustainable development**.	3
	PO 7	Interpret the discarding of solid waste and their impact on **socio economic, environment** is considered and energy generation activities by aerobic composting of waste.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 3	Identify **constraints including environmental and sustainability limitations, health and safety and risk assessment issues** for environmental monitoring system of land fill gases and composition of leachate and **Understanding commercial and economic context** of managing the land fill site	2
	PO 6	Understand the characteristics, generation and movement of leachate in landfills by the **management techniques** which uses for controlling the emission of gases in landfills **to promote sustainable development**	2
CO 3	PO 1	Explain the **Scientific principles** for Energy generation from waste bio-chemical conversion and **to integrate / support the engineering disciplines**	2
	PO 6	Apply the knowledge in planning and operations of waste to Energy plants **for sustainable development** by following **legal legislation** related to solid waste management for **high level of professional and ethical values.**	3
	PO 7	Identify the sources of energy generation by anaerobic digestion of sewage and municipal waste for **socio economic solutions** and direct combustion of municipal solid waste for environmental solutions.	2
	PSO 2	Identify the Energy generation processes from waste by bio-chemical conversion and help in **Sustainable** development and **Safety** of the public life.	2
CO 4	PO 1	Illustrate the methods of pyrolysis process by understanding **Scientific principles and methodology** and apply to **integrate / support study of their own engineering discipline** for solving environmental problems	2
	PO 3	Interpret thermo-chemical conversion sources of energy generation, gasification of waste and **identify constraints including environmental and sustainability limitations**	2
	PO 7	Understand the environmental benefits by using thermo-chemical process will decrease the emission of harmful gases and will attain **Environmental sustainability.**	1
CO 5	PO 6	Define the global scenario of environmental concerns by the increase in the generation of E-waste worldwide causing the **personnel, health, safety, and risk (including environmental risk) issues** and the problem can solved by imposing strong legal regulation for disposing of E-waste and help in **sustainable development**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	List out the health hazards by the generation of E-waste and their impact on environment will be solved by the proper management and formal disposal of E-waste and this can be achieved by long term learning process in **Professional certifications, advanced degree** for developing advanced technologies in recycling of E-waste.	2
	PSO 2	Apply strong environmental protection laws in India for the effective disposal of E-waste and constraints including environmental and **sustainability** development and while recycling the E-waste and problem including production, operation, maintenance and disposal with proper **safety**	2
CO 6	PO 6	Define the global scenario of environmental concerns by the increase in the generation of E-waste worldwide causing the **personnel, health, safety, and risk (including environmental risk) issues** and the problem can solved by imposing strong legal regulation for disposing of E-waste and help in **sustainable development**	2
	PO 12	List out the health hazards by the generation of E-waste and their impact on environment will be solved by the proper management and formal disposal of E-waste and this can be achieved by long term learning process in **Professional certifications, advanced degree** for developing advanced technologies in recycling of E-waste.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	2	-	-	3	2	-	-	-	-	-	-	-	-
CO 2	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	3	2	-	-	-	-	-	-	2	-
CO 4	2	-	2	-	-	-	1	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	2	-	-	-	-	-	2	-	2	-
CO 6	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	20.0	-	-	60.0	66.6	-	-	-	-	-	-	-	-
CO 2	-	-	20.0	-	-	40.0	-	-	-	-	-	-	-	-	-
CO 3	66.6	-	-	-	-	60.0	66.6	-	-	-	-	-	-	66.6	-
CO 4	66.6	-	20.0	-	-	-	33.3	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	40.0	-	-	-	-	-	25	-	66.6	-
CO 6	-	-	-	-	-	40.0	-	-	-	-	-	25	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -5 $< C \leq 40\%$ – Low/ Slight

2 - 40 % $< C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	-	-	2	3	-	-	-	-		-	-	-
CO 2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	2	3	-	-	-	-	-	-	3	-
CO 4	3	-	1	-	-	-	1	-	-	-	-		-	-	-
CO 5	3	-	-	-	-	1	3	-	-	-	-	1	-	3	-
CO 6	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-
TOTAL	10	-	3	-	-	7	10	-	-	-	-	2	-	6	-
AVERAGE	3.0	-	1.0	-	-	1.0	3.0	-	-	-	-	1.0	-	3.0	

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓	Tech talk	-	-	

XVII ASSESSMENT METHODOLOGY INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

UNIT - I	**INTRODUCTION TO WASTE AND WASTE PROCESSING**
	Solid waste sources solid waste sources, types, composition, properties, global warming; Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, segregation of waste, size reduction, managing waste, status of technologies for generation of energy from waste treatment and disposal aerobic composting, incineration, furnace type and design, medical waste / pharmaceutical waste treatment technologies, incineration, environmental impacts, measures to mitigate environmental effects due to incineration
UNIT - II	**WASTE TREATMENT AND DISPOSAL**
	Land fill method of solid waste disposal land fill classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.
UNIT - III	**BIO-CHEMICAL CONVERSION**
	Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel. Industrial waste, agro residues and anaerobic digestion.
UNIT - IV	**THERMO-CHEMICAL CONVERSION**
	Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo-chemical conversion
UNIT - V	**E-WASTE MANAGEMENT**
	E-waste: E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; Recycling e-waste: A thriving economy of the unorganized sector, global trade in hazardous waste, impact of hazardous e-waste in India; Management of e-waste: E-waste legislation, government regulations on e-waste management, international experience, need for stringent health safeguards and environmental protection laws of India.

TEXTBOOKS

1. Nicholas P Cheremisinoff, —Handbook of Solid Waste Management and Waste Minimization Technologie, An Imprint of Elsevier, New Delhi, 2003.

2. P AarneVesilind, William A Worrell and Debra R Reinhart, —Solid Waste Engineering, 2 nd edition 2002.

3. M Dutta , B P Parida, B K Guha and T R Surkrishnan, —Industrial Solid Waste Management and Landfilling practice, Reprint Edition New Delhi, 1999.

4. RajyaSabha Secretariat, —E-waste in India: Research unit, Reprint Edition, June, 2011.

REFERENCE BOOKS:

1. C Parker and T Roberts (Ed), —Energy from Waste, An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.

2. KL Shah,"Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, Reprint Edition, 2000.

3. M Datta, —"Waste Disposal in Engineered Landfill", Narosa Publishing House, 1997.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
	Outcome Based Education, CO PO attainment and Blooms Taxonomy		
CONTENT DELIVERY (THEORY)			
1	Sources of Municipal Solid waste	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Types of Municipal Solid waste	CO 1	T1:3.4, T2:1.4
3	Composition of Municipal Solid waste	CO 1	T1:3.5, R2:1.5
4	Effects of Global warming	CO 1	T1:3.7, R2:1.8
5	Segregation of waste, size reduction and managing waste	CO 1	T1: 3.9, R3: 1.10
6	Waste collection and transfer stations	CO 1	T1:5.5, T2:6.2, R3:4.8
7	Waste minimization and recycling of municipal waste	CO 1	T1:5.6, T2:6.3, R3:7.5
8	Properties of Municipal solid waste	CO 1	T1:4.3, T2:5.2, R2: 5.7

9	Incineration, furnace type and design	CO 1	T1: 4.4, R1:3.3
10	Measures to mitigate environmental effects due to incineration	CO 1	T1:4.5, T2: 5.4, R3: 7.3
11	Land fill methods and disposal of solid waste	CO 2	T1:4.6, T2:5.5
12	land fill classification	CO 2	T1: 4.5.2, T2: 5.6
13	Landfill sitting consideration	CO 2	T1:4.6, T2:5.5
14	Layout and preliminary design of landfills	CO 2	T1:4.6.2, T2:5.5.2
15	Characteristics and composition of landfill	CO 2	T1:4.7, T2:5.6
16	Movement and control of landfill leachate and gases	CO 2	T1:4.7, T2:5.8
17	Environmental monitoring system for land fill gases	CO 2	T1:4.7.2, T2:5.8.2
18	Energy generation from waste by bio-chemical conversion	CO 3	T1:4.8, T2:5.9
19	Sources of energy generation from bio solid waste	CO 3	T1:4.9, T2:5.7
20	Anaerobic digestion of sewage and municipal waste	CO 3	T1:6.2, T2:5.6
21	Direct combustion of MSW-refuse derived solid fuel	CO 3	T1:6.3, T2:5.7
22	Industrial waste, agro residues and anaerobic digestion	CO 3	T1:6.4, T2:5.8
23	Biogas production	CO 3	T1:6.5, T2:5.3
24	land fill gas generation and utilization	CO 3	T1:6..6, T2:5.2
25	Thermo-chemical conversion	CO 4	T1:6.7, T2:5.3
26	Sources of energy generation	CO 4	T1:6.5, T2:7.5
27	Gasification of waste using gasifies briquetting	CO 4	T1: 6.2, R2:7.9
28	Utilization and advantages of briquetting	CO 4	T1: 6.2
29	Environmental benefits of bio-chemical	CO 4	T1:6.2, T2:7.2
30	E-waste in the global context	CO 5	T1:6.3, T2:7.3

31	Growth of electrical and electronics industry in India	CO 5	T1:6.4, T2:7.5
32	Environmental concerns and health hazards	CO 5	T1: 6.2, T2: 5.6
33	Recycling e-waste	CO 5	T1:6.3, T2: 5.7
34	A thriving economy of the unorganized sector and global trade in hazardous waste	CO 5	T1:6.4, T2:5.8
35	Impact of hazardous e-waste in India	CO 5	T1:2.1, T2:9.1
36	Management of e-waste	CO 5	T1:2.2, T2:9.2
37	E-waste legislation	CO 5	T1: 2.1, R2: 9.1
38	Government regulations on e-waste management	CO 5	T1:2.6, R1:5.1
39	International experience in management of e-waste	CO 6	T1:2.7, R1:5.2
40	Need for stringent health safeguards and environmental protection laws of India.	CO 6	T1:2.8, R1:5.5
41	Summarize government regulations on E-waste management	CO 6	T1:2.1, R1:5.6
42	Outline international E-waste management and the guidelines imposed for formal disposal	CO 6	T1:2.2, R1:5.4
43	Explain the need for stringent health safeguards of human health and their effects	CO 6	T1:2.4,R1:5
44	Discuss the need for environmental protection laws and	CO 6	T1:2.4, R1:5.5
45	Outline environmental protection laws of India with respect to E-waste management.	CO 6	T1:2.4, R1:5.5
PROBLEM SOLVING/ CASE STUDIES			
1	Explain different Types of Municipal Solid waste	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Explain the Composition of Municipal Solid waste	CO 1	T1:3.4, T2:1.4
3	Effects of Global warming	CO 1	T1:3.5,R2:1.5
4	Illustrate the importance of Land fill classification	CO 2	T1:4.5, T2: 5.4, R3: 7.3
5	Landfill sitting consideration	CO 2	T1:4.6, T2:5.5
6	Layout and preliminary design of landfills	CO 2	T1: 4.5.2, T2: 5.6

7	Anaerobic digestion of sewage and municipal waste	CO 3	T1:4.6, T2:5.5
8	Direct combustion of MSW-refuse derived solid fuel	CO 3	T1:4.6.2, T2:5.5.2
9	Industrial waste, agro residues and anaerobic digestion	CO 3	T1:4.7, T2:5.6
10	Explain the Thermo-chemical conversion	CO 4	T1:4.7, T2:5.8
11	E-waste in the global context	CO 5	T1:4.7.2, T2:5.8.2
12	Growth of electrical and electronics industry in India	CO 5	T1:4.7.2, T2:5.8.2
13	E-waste legislation	CO 5	T1:4.8, T2:5.9
14	Government regulations on e-waste management	CO 6	T1:4.9, T2:5.7
15	International experience in management of e-waste	CO 6	T1:6.3, T2: 5.7
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Solid waste sources solid waste sources, types, composition, properties, Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, environmental impacts, measures to mitigate environmental effects due to incineration	CO 1	T1:1.5, T2: 5.4, R3: 7.3
2	Land fill method of solid waste, classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.	CO 2	T1:4.5, T2: 5.4, R3: 7.2
3	Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel. Industrial waste, agro residues and anaerobic digestion.	CO 3	T1:4.5, T2: 5.4, R3: 7.3
4	Biogas production, land fill gas generation and utilization, thermo-chemical conversion:gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion	CO 4	T1:4.5, T2: 5.4, R3: 7.3

5	E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; global trade in hazardous waste, Management of e-waste, legislation, government regulations on e-waste management, international experience and environmental protection laws of India	CO 5	T1:4.5, T2: 5.4, R3: 7.3
	DISCUSSION OF QUESTION BANK		
1	Introduction to Waste and Waste Processing	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Waste Treatment and Disposal	CO 2	T 1.4:7.3
3	Bio-Chemical Conversion	CO 3	T1:6.2, T2:5.6
4	Thermo-Chemical Conversion	CO 4	T1:6.7, T2:5.3
5	E-Waste Management	CO 5, CO 6	T1:2.4, R1:5.5

Signature of Course Coordinator **HOD, CE**
Mr. CH. Balakrishna, Assistant Professor