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

COURSE DESCRIPTION

Department	COMPUTER SCIENCE AND ENGINEERING				
Course Title	ENGINEERING CHEMISTRY				
Course Code	AHSB03				
Program	B.Tech				
Semester	I				
Course Type	FOUNDATION				
Regulation	R-18				
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 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.

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
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:

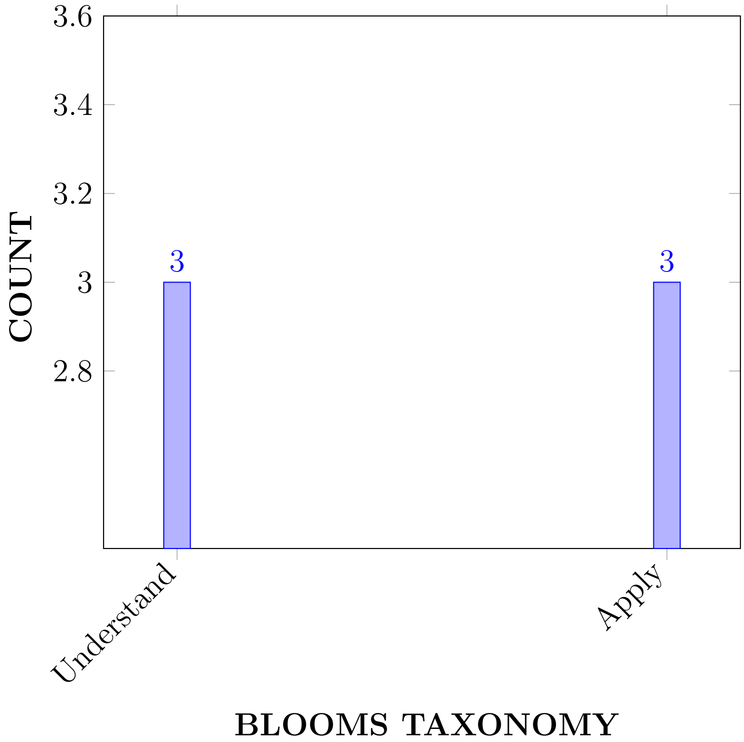
I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The microscopic chemistry 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:

MODULE 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.
MODULE II	**WATER AND ITS TREATMENT**
	Introduction: Hardness of water, Causes of hardness; Types of hardness: temporary and permanent, expression and units of hardness; Estimation of hardness of water by complexometric method; Potable water and its specifications, Steps involved in treatment of water, Disinfection of water by chlorination and ozonization; Boiler feed water and its treatment, Calgon conditioning, Phosphate conditioning and Colloidal conditioning; External treatment of water; Ion-exchange process; Desalination of water: Reverse osmosis, numerical problems.
MODULE III	**MOLECULAR STRUCTURE AND THEORIES OF BONDING**
	Atomic and Molecular orbitals: Linear Combination of Atomic Orbitals LCAO), molecular orbitals of diatomic molecules; Molecular orbital energy level diagrams of N2, O2F2, CO and NO molecules. Crystal Field Theory (CFT): Salient Features of CFT-Crystal Field; Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries; Band structure of solids and effect of doping on conductance.
MODULE IV	**STEREOCHEMISTRY, REACTION MECHANISM AND SYNTHESIS OF DRUG MOLECULES**
	Introduction to representation of 3-dimensional structures: Structural and stereoisomers, configurations, symmetry and chirality; Enantiomers, diastereomers, optical activity and Absolute configuration; Conformation analysis of n- butane. Substitution reactions: Nucleophilic substitution reactions, Mechanism of SN1, SN2 reactions; Electrophilic and nucleophilic addition reactions; Addition of HBr to propene; Markownikoff and anti Markownikoff's additions; Grignard additions on carbonyl compounds; Elimination reactions: Dehydro halogenation of alkylhalides; Saytzeff rule; Oxidation reactions: Oxidation of alcohols using KMnO4 and chromic acid; Reduction reactions: Reduction of carbonyl compounds using LiAlH4 & NaBH4; Hydroboration of olefins; Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.
MODULE V	**FUELS AND COMBUSTION**

	Fuels: 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			
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Signature of Course Coordinator **HOD,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

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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:

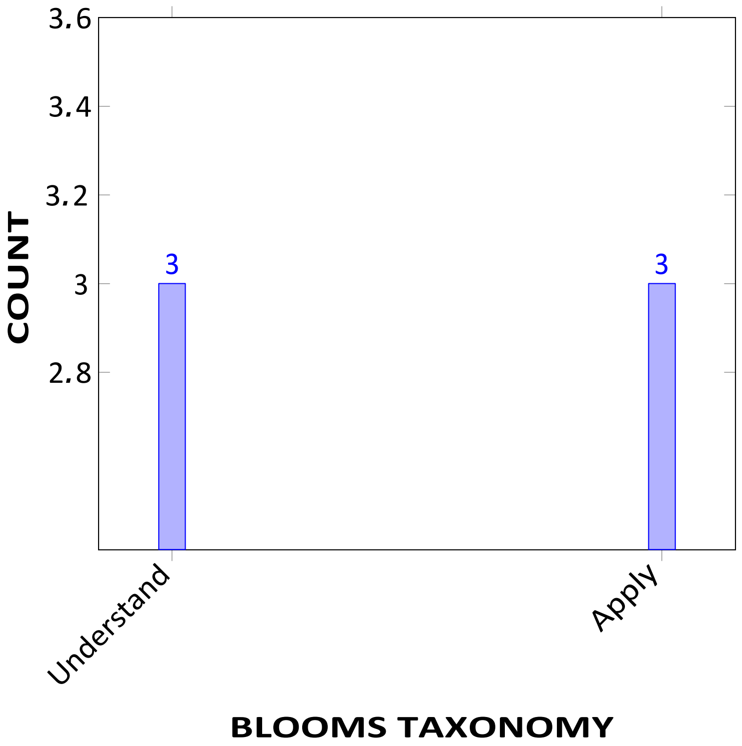
I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The microscopic chemistry 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 ≤ C≤ 5% – No correlation
1 -5 <C≤ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
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	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

<table>
<tr><td>Course Title</td><td colspan="5">ENGINEERING CHEMISTRY LABORATORY</td></tr>
<tr><td>Course Code</td><td colspan="5">AHSB09</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4">CSE</td></tr>
<tr><td>Course Type</td><td>FOUNDATION</td><td colspan="4"></td></tr>
<tr><td>Regulation</td><td>IARE – R18</td><td colspan="4"></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>-</td><td>-</td><td>3</td><td>2</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr G Mahesh Kumar, Assiatant Professor</td></tr>
</table>

I COURSE OVERVIEW:

The aim of this Engineering Chemistry laboratory is to develop the analytical ability of the students by better understanding the concepts experimental chemistry. The experiments carried out like preparation of aspirin, thiokol rubber, conductometry, potentiometry, physical properties like viscosity and surface tension of liquids. The volumetric analytical experiments like determination of hardness of water, dissolved oxygen and copper in brass can be carried out in the laboratory.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
10+2	-	-	Basic principles of chemistry laboratory	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Workshop Practice	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing Further Experiments

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the principal 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	**Laboratory**		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.

A. Experiment Based

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

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

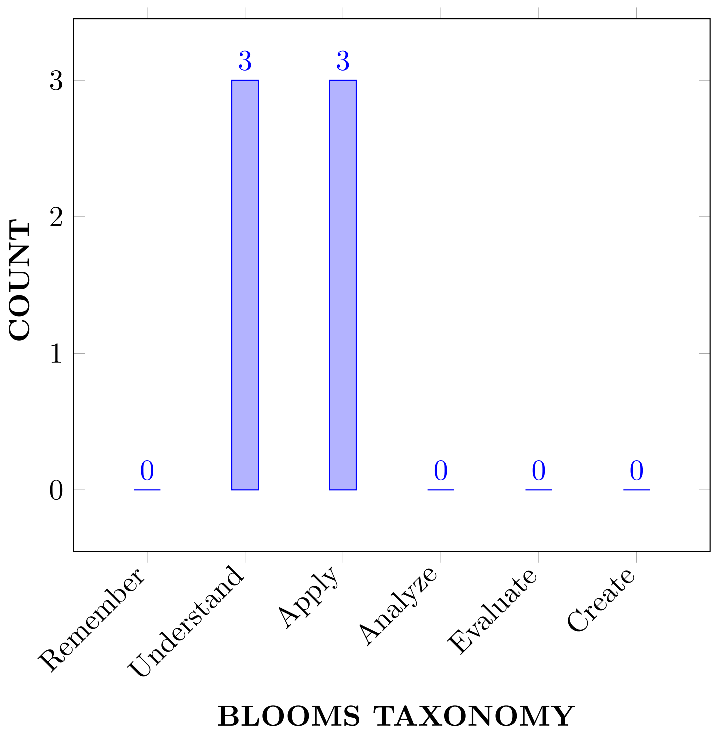
I	The basic principles involved in chemical analysis and mechanism of synthetic organic reactions. processes.
II	The need and importance of quality of water for industrial and domestic use..
III	The measurement of physical properties like surface tension and viscosity.
IV	The knowledge on existing future upcoming devices, materials and methodology.

VII COURSE OUTCOMES:

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

CO 1	**Identify** Explain the mechanism of chemical reactions for synthesizing drug molecules. for making a desired product with given work piece.	Understand
CO 2	**Determine** Identify the total hardness, dissolved oxygen in water by volumetric analysis for finding the hardness causing salts in water. to demonstrating proficiency with hand tools common in fitting.	Apply
CO 3	**Create** Make use of conductometric and potentiometric titrations for finding the concentration of unknown solutions.to convert given shape into useable elements using basic blacksmith techniques.	Apply
CO 4	**Organize** the moulding techniques along with suitable tools Choose different types of liquids for finding the surface tension and viscosity of lubricants.	Apply
CO 5	**Develop** Explain the preparation of synthetic rubbers for utilizing in industries and domestic purpose. for manufacturing the tin boxes, cans, funnels, ducts etc., from a flat sheet of metal.	Understand
CO 6	**Compare** various electrical circuits by using conduit system of wiring Relate the importance of different types of materials for understanding their composition and applications.	Understand

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.	-	SEE/CIE
PO 2	**Design/development of solutions:** 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	-	SEE/CIE
PO 7	**Modern tool usage:** 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.	-	SEE/CIE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Formulate and evaluate engineering concepts of design, thermal and production to provide solutions for technology aspects in digital manufacturing.	-	-
PSO 2	Focus on ideation and research towards product development using additive manufacturing, CNC simulation and high speed machining. .	-	-
PSO 3	Make use of computational and experimental tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	-	-

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	Explain the mechanism of chemical reactions for synthesizing drug molecules by applying mathematical expressions for finding the percentage of Aspirin by using principles of science for solving engineering problems.	3

CO 2	PO 1	Demonstrate the total hardness, dissolved oxygen in water by volumetric analysis for finding the hardness causing salts in water by applying mathematical expressions by using principles of science for solving engineering problems. .	3
	PO 2	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
	PO 7	Identify the dissolved oxygen content in raw water and reduce the pollutants in atmosphere to protect aquatic organisms and know the impact in socio economic and environmental contexts for sustainable development..	2
CO 3	PO 1	Choose different electrodes for finding pH of unknown solutions by applying mathematical expressions of cell potential by using principles of science for solving engineering problems.	3
	PO 2	Identify the problem formulation and abstraction for calculating the concentration of unknown solutions by applying normality of standard solution from the provided information.	2
CO 4	PO 1	Choose different types of liquids for finding the surface tension and viscosity of lubricants by applying mathematical expressions by using principles of science for solving engineering problems..	3
	PO 2	Identify the problem formulation and abstraction for calculating viscosity and surface tension of test liquids by applying viscosity and surface tension of standard liquids, density of liquids from the provided information.	2
CO 5	PO 1	Explain the preparation of synthetic rubbers for utilizing in industries and domestic purpose by using principles of science for solving engineering problems.	2
CO 6	PO 1	Demonstrate the percentage of copper in brass, manganese dioxide in pyrolusite by volumetric analysis using mathematical expressions by using principles of science for solving engineering problems. .	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 7		
CO 1	1				
CO 2	1	2	-	-	
CO 3	1	2	-	-	-
CO 4	1	2	-	-	-
CO 5	-	-	2	2	-
CO 6	1	-	2	2	2

3 = High; 2 = Medium; 1 = Low

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 2,	SEE Exams	PO 1,PO 2, PO 7,	Seminars	-
Laboratory Practices	PO 1,PO 2, PO 7,	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 1	**PREPARATIONS OF ORGANIC COMPOUNDS**
	Preparation of Aspirin
WEEK 2	**VOLUMETRIC ANALYSIS**
	Estimation of hardness of water by EDTA method
WEEK 3	**CONDUCTOMETRIC TITRATIONS**
	Conductometric titration of strong acid Vs strong base
WEEK 4	**POTENTIOMETRIC TITRATIONS**
	Potentiometric titration of strong acid Vs strong base
WEEK 5	**CONDUCTOMETRIC TITRATIONS**
	Conductometric titration of mixture of acid Vs strong base
WEEK 6	**POTENTIOMETRIC TITRATIONS**
	Potentiometric titration of weak acid Vs strong base .
WEEK 7	**PHYSICAL PROPERTIES**
	Determination of surface tension of a given liquid using stalagmometer
WEEK 8	**PHYSICAL PROPERTIES**
	Determination of viscosity of a given liquid by using Ostwald's viscometer
WEEK 9	**VOLUMETRIC ANALYSIS**
	Estimation of dissolved oxygen in water
WEEK 10	**PREPARATIONS OF RUBBER**
	Preparation of Thiokol rubber .

WEEK 11	**VOLUMETRIC ANALYSIS**
	Determination of percentage of copper in brass. .
WEEK 12	**VOLUMETRIC ANALYSIS**
	Estimation of MnO 2 in pyrolusite .

TEXTBOOKS

1. Vogel's, "Quantitative Chemical Analaysis", Prentice Hall, 6th Edition, 2000.

2. Gary D.Christian, "Analytical Chemistry",Wiley India, 6th Edition, 2007.

REFERENCE BOOKS:

1. A text book on experiments and calculation Engg. S.S. Dara.

2. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications

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	Preparation of Aspirin.	CO 1, CO 2	R1, R2
2	Estimation of hardness of water by EDTA method.	CO 2	R1, R2
3	Conductometric titration of strong acid Vs strong base	CO 3,	R1, R2
4	Potentiometric titration of strong acid Vs strong base.	CO 3	R1, R2
5	Conductometric titration of mixture of acid Vs strong base	CO 3	R1, R2
6	Potentiometric titration of weak acid Vs strong base	CO 3	R1, R2
7	Determination of surface tension of a given liquid using stalagmometer	CO4	R1, R2
8	Determination of viscosity of a given liquid by using Ostwald's viscometer	CO4	R1, R2
9	Estimation of dissolved oxygen in water	CO 2	R1, R2
10	Preparation of Thiokol rubber	CO 5	R1, R2
11	Determination of percentage of copper in brass.	CO 6	R1, R2
12	Estimation of MnO 2 in pyrolusite	CO6	R1, R2

Signature of Course Coordinator **HOD,CSE**
Mr G Mahesh Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**ENGLISH**				
Course Code	AHSB01				
Program	B. Tech				
Semester	II				
Course Type	Foundation				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	-	2	-	-
Course Coordinator	Dr. M.Sailaja, Associate Professor				

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:

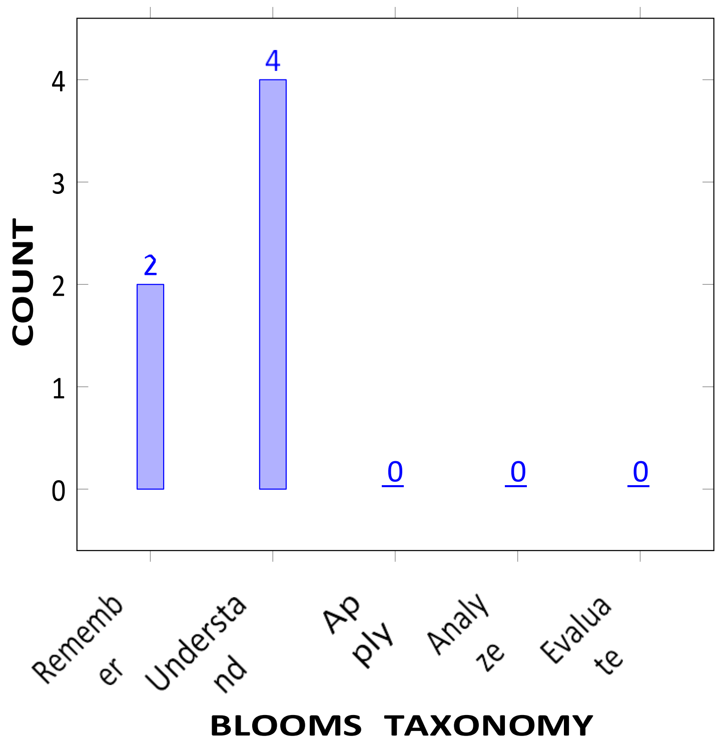
I	Communicate in an intelligible English pronunciation to meet the global standards.
II	Effectively use of four language skills (listening skill, speaking skill, reading skill and writing skill) in day-to-day affairs.
III	A critical aspect of speaking and reading for interpreting in-depth meaning between 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, 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	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-

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	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	

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 ≤ C≤ 5% – No correlation

1 -5 <C≤ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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	-	-	-	-	
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	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	PROGRAMMING FOR PROBLEM SOLVING USING C				
Course Code	ACSB01				
Program	B.Tech				
Semester	II				
Course Type	FOUNDATION				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. P Ravinder, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	-	-	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 CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	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). 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
20%	Remember
30%	Understand
50%	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		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:

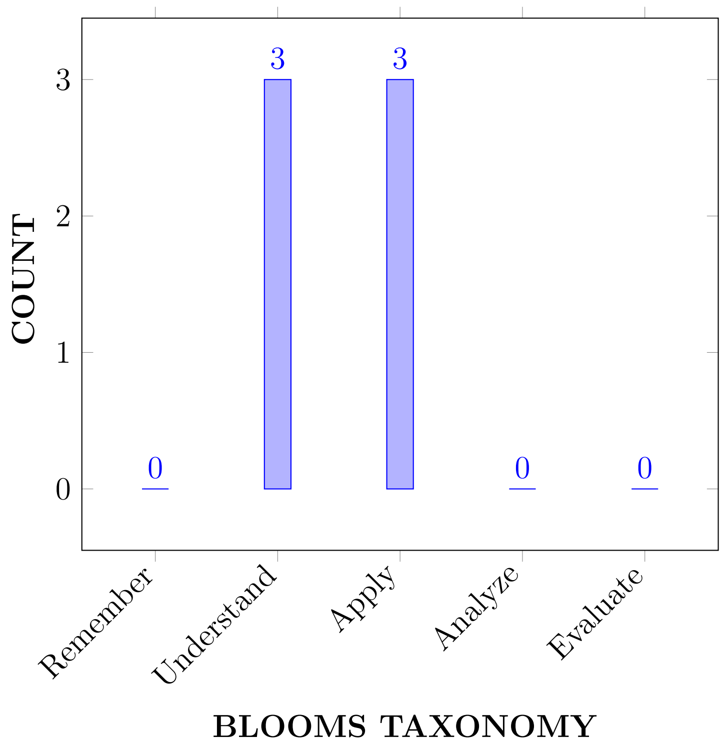
I	Learn adequate knowledge by problem solving techniques.
II	Understand programming skills using the fundamentals and basics of C Language.
III	Improve problem solving skills using arrays, strings, and functions.
IV	Understand the dynamics of memory by pointers.
V	Study files creation process with access 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.	Understanding
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** arious types of functions, parameters, and return values for complex problem solving.	Understand
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.	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/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	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	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	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 problem solving through programming.	2	Tech talk/Open ended experiments
PSO 2	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	Tech talk/Open ended experiments

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	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 **draw** a flowchart, **identify** the appropriate symbols to solve a problem, then **formulate** the solution, and **interpret** the result for the **improvement** of the **solution.**	6
	PSO 1	Understand the features of procedural programming for **designing** and **analyzing** computer programs for **problem-solving.**	3
CO 2	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 **analyze** the same to **validate** the results in a program to solve **complex** engineering problems.	6
	PO 3	**Recognize** an appropriate control structure to **design** and **develop** a solution for a **real-time** scenario, and **communicating** effectively with engineering community.	5
CO 3	PO 1	Recognize the importance of recursionfor developing programs in real-time scenarios using principles of **mathematics**, and **engineering fundamentals**.	3
	PO 2	Understand the various kinds of **functions**, **identify** the suitable type of function to **solve** a problem, **formulate** the solution, and **interpret** the result for the **improvement** of the solution.	6
	PO 5	Apply techniques of **structured decomposition** to dividea problem into smaller pieces with an understanding of its limitations.	1

CO 4	PO 1	Extend the focus on the usage of heterogeneous data types as a **basic building block** in problem solving using principles of **science**, and **engineering** fundamentals.	3
	PO 2	**Recognize** the representation of the structure, **assess** in solving a problem, **express the solution**, and **analyze** the result for **solution enhancement**.	5
	PO 5	Understand pointers conceptually and apply them in modeling a **complex engineering** activity.	1
CO 5	PO 1	Make a use of an appropriate type of file to store a large volume of **persistent data** and give solution to **engineering problems**.	2
	PO 5	To identify appropriate mode to access a file and run the same **program** multiple times.	1
CO 6	PO 12	**Realize** the need and the desire to **train** and **invest** in autonomous and **lifelong learning** in the widest sense of **technical transition** to achieve **employability expertise** and excel advanced **engineering concepts**.	7
	PSO 3	Attain the **knowledge** and **skills** for employability and to succeed in national and international level **competitive examinations**.	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	6	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	3	6	5	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	6	-	-	1	-	-	-	-	-	-	-	-		-
CO 4	3	5	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	7	-	-	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	60	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 2	100	60	50	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	60	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 4	100	50	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 5	66	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	58	-	-	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	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	3	-	-	-	-	-	-	-	-		-
CO 4	3	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
TOTAL	15	11	2	-	9	-	-	-	-	-	-	2	2	-	2
AVERAGE	3	2.7	2.5	-	3	-	-	-	-	-	-	2	2	-	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:

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

XVIII SYLLABUS:

MODULE I	INTRODUCTION
	Introduction to components of a computers: Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, algorithms, flowcharts;**Introduction to C Language:** Computer languages, 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.

MODULE II	**CONTROL STRUCTRES**
	Conditional Control structures: Decision statements; Simple if, if-else, else if ladder, Nested if and Case Statement-switch statement; **Loop control statements:** while, for and do while loops. jump statements, break, continue, goto statements;
MODULE III	**ARRAYS AND FUNCTIONS**
	Arrays: 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; **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 directive.
MODULE IV	**STRUCTURES, UNIONS AND POINTERS**
	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; **Pointers:**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:**Basic concepts, library functions.
MODULE V	**FILE HANDLING AND BASIC ALGORITHMS**
	Files: Streams, basic file operations, file types, file opening modes, input and output operations with files, special functions for working with files, file positioning functions, command line arguments. Searching, basic sorting algorithms (bubble, insertion, selection), algorithm complexity through example programs (no formal definitions required).

TEXTBOOKS

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, 2nd Edition, 1988.
2. Yashavant Kanetkar, “Exploring C”, BPB Publishers, 2nd Edition, 2003.
3. Schildt Herbert, “C: The Complete Reference”, Tata McGraw Hill Education, 4th Edition, 2014.
4. R. S. Bichkar, “Programming with C”, Universities Press, 2 nd Edition, 2012.
5. Dey Pradeep, Manas Ghosh, “Computer Fundamentals and Programming in C”, Oxford University Press, 2nd Edition, 2006.
6. Stephen G. Kochan, “Programming in C”, Addison-Wesley Professional, 4th Edition, 2014.

WEB REFERENCES:

1. https://www.nptel.ac.in/courses/108106073/
2. https://www.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	PSO'S Course Description on Outcome Based Education (OBE): Course Objectives,Course Outcomes (CO), ProgramOutcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Understand components of a computer	CO 1	T2: 1.1-1.2,R4: 1.1-1.3
3	Identify and apply algorithms and flowcharts for problem solving	CO 1	T2: 2.1-2.2,R4: 1.4
4	Understand pseudo code for a given problem	CO 1	T2: 2.1-2.2
5	Understand the basic structure, process of compiling and running a C program	CO 1	T2: 2.1-2.2,
6	Understand keywords, identifiers, constants, strings, special symbols, variables	CO 1	T2: 1.4 -1.5, R4: 2.1 - 2.4
7	Define the data types, and operators to write C Program	CO 1	T2: 2.1-2.2
8	Understand precedence of operators, expression evaluation	CO 1	T2: 2.3-2.6
9	Understand formatted input/output functions, Type Conversion and type casting in C Programming	CO 1	T2:2.3-2.7
10	Identify and apply decision making statements in C programming	CO 2	T2: 3.1-3.5
11	Identify and apply loop control structures in C programming	CO 2	T2: 5.2-5.3
12	Identify and apply unconditional control structures in C programming	CO 2	T2: 6.1-6.6
13	Understand single dimensional array and multi-deimensional array: declaration, initialization, accessing	CO 3	T2: 6.7
14	Operations on arrays: traversal, reverse, insertion	CO 3	T2: 8.1-8.2, R4: 15.1
15	Operations on arrays: deletion, merge, search	CO 3	T2: 8.3, R4: 15.1

16	Arrays of characters, Reading and writing strings, String handling functions	CO 3	T2: 11.1-11.5
17	Operations on strings: array of strings	CO 3	T2: 4.1-4.5
18	Concept of user defined functions, Function declaration	CO 3	T1: 7
19	return statement, Function prototype	CO 3	T2: 6.9
20	Types of functions, Inter function communication	CO 3	T1: 10, T2:10.1-10.2
21	Function calls, Parameter passing mechanisms, Recursion	CO 3	T2: 10.3-10.4, R4:8.3-8.4
22	Passing arrays to functions, passing strings to functions	CO 3	T2:10.5
23	Storage classes	CO 3	T1: 8.9, R4:8.6.3
24	Basics of pointers, Pointer arithmetic	CO 4	T2: 3.1, R4:11.1
25	Pointer to pointers	CO 4	T2: 3.2
26	Array of pointers	CO 4	T2: 3.2
27	Generic pointer, Null pointers	CO 4	T2: 3.3
28	Pointers as function arguments, Functions returning pointers	CO 4	T2: 3.4-3.5
29	Dynamic memory allocation	CO 4	T2: 6.1-6.6
30	Structure definition, initialization, structure members	CO 4	T2: 12.3-12.4, R4:13.4
31	Nested structures	CO 4	T2: 12.3-12.4, R4:13.4
32	Arrays of structures, structures and functions	CO 4	T2: 2.1-2.2, R4:13.2
33	Structures and pointers, self-referential structures	CO 4	T2: 2.1-2.2
34	Union, bit fields, typedef	CO 4	T2: 12.4
35	Enumerations, Preprocessor directives	CO 4	T1: 8.9, T2: 2.3-2.5
36	Concept of a file, text files and binary files, streams	CO 5	T2: 10.4, R4:14.1-14.4
37	Standard I/O, formatted I/O, file I/O operations	CO 5	T2: 10.4, R4:14.1-14.4
38	Error handling	CO 5	R3: 12.1 - 12.3

39	Line I/O, miscellaneous functions	CO 5	R3: 12.1 - 12.3
40	Applications of C	CO 6	R4: 17
PROBLEM SOLVING/ CASE STUDIES			
1	Write a program in C that takes minutes as input, and display the total number of hours and minutes.	CO 1	T2:2.3-2.6
2	Write a program in C that reads a forename, surname and year of birth and display the names and the year one after another sequentially.	CO 1	T2:2.3-2.7
3	Write a C program to find the third angle of a triangle if two angles are given.	CO 2	T2:3.1-3.5
4	Write a program in C to display the such a pattern for n number of rows using a number which will start with the number 1 and the first and a last number of each row will be 1.	CO 2	T2:5.2-5.3
5	Write a program in C to find the prime numbers within a range of numbers.	CO 2	T2:5.2-5.3
6	Write a program in C to display the n terms of harmonic series and their sum.	CO 2	T2:6.1-6.6
7	Write a program in C to display the pattern like right angle triangle using an asterisk.	CO 2	T2:5.2-5.3
8	Program to accept N integer number and store them in an array AR. The odd elements in the AR are copied into OAR and other elements are copied into EAR. Display the contents of OAR and EAR	CO 3	T2: 6.7
9	Write a C program to illustrate how user authentication is made before allowing the user to access the secured resources. It asks for the user name and then the password. The password that you enter will not be displayed, instead that character is replaced by '*'	CO 3	T2: 8.3, R4:15.1
10	Write a C program to accept a matric and determine whether it is a sparse matrix. A sparse martix is matrix which has more zero elements than nonzero elements	CO 3	T2: 8.1-8.2, R4: 15.1
11	Write a C program to accept a amtric of order MxN and sort all rows of the matrix in ascending order and all columns in descendng order	CO 3	T2: 6.7
12	Write a C program to accept a set of names and sort them in an alphabetical order, Use structures to store the names	CO 4	T2:12.3-12.4, R4:13.4
13	Write a C program to find the sum of two one-dimensional arrays using Dynamic Memory Allocation	CO 4	T2:6.1-6.6
14	Write a program in C to find the content of the file and number of lines in a Text File.	CO 5	T2:10.4, R4:14.1-14.4
15	Write a program in C to replace a specific line with another text in a file.	CO 5	T2:10.4, R4:14.1-14.4
DISCUSSION OF DEFINITION AND TERMINOLOGY			

1	Module I- Components of computers, C programming language	CO 1	T2:1.1-2.6, R4:1.1-2.4
2	Module II- Control structures	CO 2	T2:3.1-6.6
3	Module III- Arrays, Strings and Functions	CO 3	T1:7, T2:6.7-11.5
4	Module IV- Pointers and Structures	CO 4	T2:3.1-6.6, R4:11.1-13.4
5	Module V- File handling functions	CO 5	T2:10.4, R4:14.1-14.4, R3:12.1-12.3
DISCUSSION OF QUESTION BANK			
1	Module I- Components of computers, C programming language	CO 1	T2:1.1-2.6, R4:1.1-2.4
2	Module II- Control structures	CO 2	T2:3.1-6.6
3	Module III- Arrays, Strings and Functions	CO 3	T1:7, T2:6.7-11.5
4	Module IV- Pointers and Structures	CO 4	T2:3.1-6.6, R4:11.1-13.4
5	Module V- File handling functions	CO 5	T2:10.4, R4:14.1-14.4, R3:12.1-12.3

Signature of Course Coordinator **HOD,CSE**
Mr. P Ravinder, 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">SEMICONDUCTOR PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">AHSB13</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">FOUNDATION</td></tr>
<tr><td>Regulation</td><td colspan="5">R-18</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>4</td><td>3</td><td>1.5</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr A. Chandra Prakash, Assistant Professor.</td></tr>
</table>

I COURSE PRE-REQUISITES:

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

II COURSE OVERVIEW:

This course is structured specifically to make the students understand some of the core topics in physics essential for further studies in engineering. It focuses on illustrating and developing an understanding of the interplay between problem solving and their practical applications which include experimental techniques and modern equipment. The topics include quantum mechanics, semiconductors, opto-electronic devices, magnetism, dielectrics, LASER and fiber optics. At the end, this course helps students to appreciate the diverse real-time applications in technological fields in respective branches.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Applied Physics	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>x</td><td>Assignments</td><td>x</td><td>MOOC</td></tr>
<tr><td>✓</td><td>Open Ended Experiments</td><td>x</td><td>Seminars</td><td>x</td><td>Mini Project</td><td>✓</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). 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 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), 10 marks for Alternative Assessment Tool (AAT) (Table 3).

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

Table 2: Assessment pattern for CIA

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 3.

Concept Video	Tech-talk	Complex Problem Solving
50%	50%	-

Table 3: Assessment pattern for CIA

VI COURSE OBJECTIVES:

The students will try to learn:

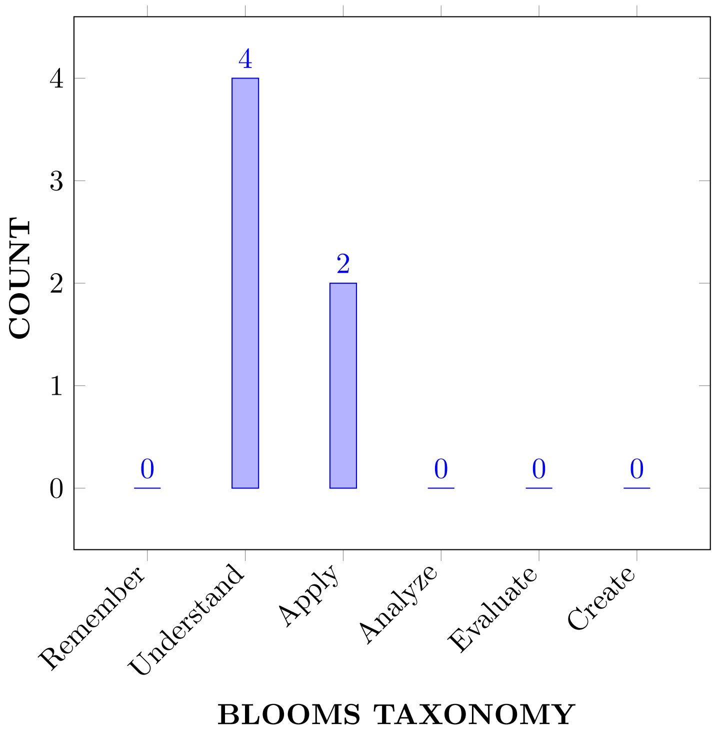
I	Basic formulations in wave mechanics for the evolution of energy levels and quantization of energies for a particle in a potential box with the help of mathematical description.
II	Fundamental properties of semiconductors including the band gap, charge carrier concentration, doping and transport mechanisms.
III	The metrics of optoelectronic components, LASER, optical fiber communication and be able to incorporate them into systems for optimal performance.
IV	The appropriate magnetic and dielectric materials required for various engineering applications.

VII COURSE OUTCOMES:

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

CO 1	**Apply** the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.	Apply
CO 2	**Demonstrate** the classification of Solids and important aspects of semiconductors in terms of carrier concentration and Fermi level.	Understand
CO 3	**Make use of** the key concepts of semiconductors to explain the basic working mechanism of optoelectronic device characteristics of light-emitting diodes, photodetectors and solar cells.	Apply
CO 4	**Illustrate** the properties of dielectric and magnetic materials suitable for engineering applications.	Understand
CO 5	**Compare** the concepts of LASER and normal light in terms of mechanism and working principles for applications in different fields and scientific practices.	Understand
CO 6	**Explain** functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.	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	CIE/SEE/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/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.	2	CIE/SEE/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	**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 2	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

Course Outcomes	POs PSOs	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
CO 3	PO 1	**Acquire** detailed **knowledge** of fundamental and applied aspects of optoelectronic device physics, **analyze** key parameters and **apply** them to the functioning of electronic devices.	3
	PO 2	**Illustrate** the given **problem statement** and **formulate** light interaction aspects of direct band gap materials from the provided **information** and **data** by the **interpretation of carrier generation and recombination** in opto-electronic devices	4
CO 4	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
	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** modern computer tools to determine remnant magnetization and coercivity values from B-H curve and gain knowledge helpful for **higher studies**.	1
CO 5	PO 1	**Compare** the concepts of LASER and normal light in terms of mechanism and **working principle** for applications in different fields and scientific practices.	3
CO 6	PO 1	**Explain** functionality of components in optical fiber communication **system** by using the **basics** of signal propagation, attenuation and dispersion.	3
	PO 2	**Identify the given problem** and **formulate** expressions for acceptance angle and numerical aperture with the given **information** and **data** by applying principles of information propagation through optical waveguides.	4

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

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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	40	-	20	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	20	-	-	-	-	-	-	-	-	-	-	30
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-

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

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 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	10	-	2	-		-	-	-	-	-	-	-	-	-
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

XVIII SYLLABUS:

MODULE I	**QUANTUM MECHANICS**
	Introduction to quantum physics,black body radiation,planck's law,photo-electric effect,compton effect, de broglie hypothesis, Wave-particle duality, Davisson and Germer's experiment, Time-independent Schrödinger equation for wave function, born's interpretation of the wave function, Schrödinger equation for one dimensional problems - particle in a box.
MODULE II	**ELECTRONIC MATERIALS AND SEMICONDUCTORS**
	free electron theory, Bloch's theorem for particles in a periodic potential , Kronig-Penney model (Qualitative treatment),Origin of energy bands,types of electronic materials : metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Carrier concentration, Dependence of Fermi level on carrier-concentration and temperature, Hall effect.
MODULE III	**LIGHT-SEMICONDUCTOR INTERACTION**
	Carrier generation and recombination,carrier transport:diffusion and drift, Direct and indirect band gaps, p-n junction, V-I characteristics, Energy Band diagram, Biasing of a junction.Photo voltaic effecct Zener diode. Construction and working of LED, Photo detectors, PIN, Avalanche photodiode, Solar cell.
MODULE IV	**ENGINEERED ELECTRIC AND MAGNETIC MATERIALS**
	Polarisation, Permittivity, Dielectric constant, Internal field in solids, Clausius Mosotti equation, Ferroelectricity ,piezo electricity,pyroelectricity;Magnetisation, Permeability, Susceptibility, 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.

MODULE V	LASERS AND FIBER OPTICS
	Characteristics of LASER, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby LASER, semiconductor diode laser and applications of LASER.Principle and construction of an optical fibre, Acceptance angle, Numerical aperture, Types of optical fibers (Single mode, multimode, step index, graded index),Attenuation in optical fibers, Optical fibre communication system with block diagram .

TEXTBOOKS

1. Dr. K Vijay Kumar and Dr. S Chandralingam — Modern Engineering Physics‖ Volume-1 & 2, S Chand. Co, 2018.
2. Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar —A Text Book of Engineering Physics‖, S. Chand.
3. B. K Pandey and S. Chaturvedi —Engineering physics‖, Cengage learning.

REFERENCE BOOKS:

1. J. Singh, —Semiconductor Optoelectronics: Physics and Technology‖, McGraw-Hill Inc. (1995).
2. P. Bhattacharya, —Semiconductor Optoelectronic Devices‖, Prentice Hall of India (1997).
3. Monica Katiyar and Deepak Gupta on NPTEL.Online course: ”Optoelectronic Materials and Devices”.

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

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details & course_id=17

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 THEORY(DELIVERY)			
2	Introduction to Quantum Physics	CO 1	T2:5.15; R1:1.16

3	Black body radiation	CO 1	T2:5.17; R1:1.13.1
4	planck's law	CO 1	T2:5.17; R1:1.13.1
5	Photo-electric effect	CO 1	T2:5.17; R1:1.13.1
6	Compton effect	CO 1	T2:5.18; R1:1.13.2
7	De-broglie hypothesis and de-broglie wavcelength	CO 1	T2:5.18; R1:1.13.2
8	Wave particle duality	CO 1	T2:5.18; R1:1.13.2
9	Davisson and Germer's experiment	CO 1	T2:5.19 R1:1.13.3,
10	Schrödinger time independent wave equation	CO 1	T2:5.24; R1:1.17.3
11	Born's interpretation of the wavefunction	CO 1	T2:6.1; R1:2.3
12	Schrodinger equation for Particle in a one dimensional problems - Particle in a box	CO 1	T2:6.3; R1:2.6.1
13	Free electron theory	CO 2	T2:6.5; R1:2.6.2
14	Bloch's theorem for particle in a periodic potential	CO 2	T2:6.5; R1:2.6.2
15	Kronig-Penney model	CO 2	T2:7.3; R1:2.8
16	Origin of energy bands in solids	CO 2	T2:7.5,7.6; R1:2.9.2
17	Types of electronic materials : insulators, conductors and semiconductors	CO 2	T2:7.5,7.6; R1:2.9.2
18	intrinsic and extrinsic semiconductors	CO 2	T2:7.7; R1:2.10
19	Carrier concentration	CO 2	T2:7.7; R1:2.10
20	Depends of Fermi level on Carrier concentration and temperature	CO 2	T2:7.11; R2:2.10.2
21	Hall effect	CO 2	T2:7.11; R2:2.32
22	carrier generation and recombination	CO 3	T2:7.11; R2:2.10
23	carrier transport: diffusion and drift	CO 3	T2:7.11; R2:2.10
24	Direct and indirect band gaps	CO 3	T2:7.11; R2:2.10
25	p-n junction, V-I characteristics	CO 3	T2:7.12; R2:2.10.3

26	Energy Band diagram of PN Junction	CO 3	T2:7.12; R2:2.10.3
27	Biasing of PN junction	CO 3	T2:7.13; R1:2.10.4
28	photo voltaic effect	CO 3	T2:7.14 R1:2.10.6
29	Construction and working of LED	CO 3	T2:7.15; R1:2.10.7
30	photo detectors	CO 3	T2:7.15; R1:2.10.7
31	Construction and working of Photodiode, PIN and Avalanche Photodiode	CO 3	T1:7.15; R2:2.10.7
32	Construction and working of Solar cell	CO 3	T1:7.15; R2:2.10.7
33	Introduction to dielectric materials, Polarization, Permittivity, Dielectric constant	CO 4	T1:7.15; R2:2.10.7
34	Internal fields in solids	CO 4	T1:16.9 R2:8.11.1
35	Clausius – Mosotti equation	CO 4	T1:16.9; R2:8.11.2
36	piezo electricity	CO 4	T1:15.2; R4:8.2
37	pyro electricity	CO 4	T1:15.2; R4:8.2
38	Ferroelectricity	CO 4	T2:15.7; R4:8.3.3
39	Magnetic materials, Magnetization, Permeability, Susceptibility	CO 4	T2:15.13 R4:8.7.2
40	classification of Diamagnetic and Paramagnetic and ferromagnetic on the basis of magnetic moment	CO 4	T2:15.13; R4:8.7.2
41	domain theory of ferro magnetism on the basis of Hysteresis curve	CO 4	T1:11.9; R2:12.24
42	Characteristics of LASER, Spontaneous and Stimulated emission of radiation	CO 5	T1:11.9; R3:12.25
43	Metastable state, Population inversion, Lasing action	CO 5	T1:3.2; R3:3.2
44	Ruby LASER	CO 5	T1:3.3.1; R3:3.2
45	semi-conductor diode LASER and Applications of LASER	CO 5	T2:16.5; R3:8.10
46	Principle and construction of optical fibers	CO 6	T2:16.5; R3:8.10
47	Acceptance angle, Numerical Aperture	CO 6	T1:3.3.1; R3:3.2
48	Types of optical fibers	CO 6	T2:16.5; R3:8.10

49	Attenuation in optical fibers	CO 6	T2:16.5; R3:8.10
50	Optical fiber communication systemwith block diagram	CO 6	T2:16.5; R3:8.10
	PROBLEM SOLVING		
1	De-broglie wavelength	CO 1	T1:3.3.1; R3:3.2
2	Energies associated with one dimensional potential box	CO 1	T2:16.5; R3:8.10
3	Intrinsic carrier concentration, Fermi level in semiconductors	CO 2	T2:16.5; R3:8.10
4	Carrier concentration based on Hall coefficient	CO 2	T1:3.3.1; R3:3.2
5	Mobility and conductivity based on Hall coefficient	CO 2	T2:16.5; R3:8.10
6	Diffusion and drift	CO 3	T2:16.5; R3:8.10
7	Energy gap in indirect bandgap semiconductors	CO 3	T1:3.3.1; R3:3.2
8	Dielectric constant, capacitance, permittivity	CO 4	T2:16.5; R3:8.10
9	Electric susceptibility, Polarization vector	CO 4	T2:16.5; R3:8.10
10	Polarizability	CO 4	T1:3.3.1; R3:3.2
11	Magnetic moment, Magnetic induction, Permeability	CO 4	T2:16.5; R3:8.10
12	Intensity of magnetization, Magnetic susceptibility	CO 4	T2:16.5; R3:8.10
13	Wavelength and Energy bandgap, Divergence	CO 5	T2:16.5; R3:8.10
14	Relative population of two states, Number of photons emitted	CO 5	T1:3.3.1; R3:3.2
15	Acceptance angle and Numerical Aperture	CO 6	T2:16.5; R3:8.10
	DISCUSSION OF DEFINITION AND TERMINOLOGY		
1	Quantum Mechanics	CO 1	T2:16.5; R3:8.10
2	Electronic materials and Semiconductors	CO 2	T1:3.3.1; R3:3.2
3	light Semiconductor interaction	CO 3	T2:16.5; R3:8.10
4	Engineered electric and magnetic materials	CO 4	T2:16.5; R3:8.10
5	LASER, Fiber optics	CO 5, CO 6	T2:16.5; R3:8.10

DISCUSSION OF QUESTION BANK			
1	Quantum Mechanics	CO 1	T1:3.3.1; R3:3.2
2	Electronic materials and Semiconductors	CO 2	T2:16.5; R3:8.10
3	Light Semiconductor interaction	CO 3	T2:16.5; R3:8.10
4	Engineered electric and magnetic materials	CO 4	T1:3.3.1; R3:3.2
5	LASER, Fiber optics	CO 5, CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD, FE**
Mr A.Chandra Prakash , Assistant Professor

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

COURSE DESCRIPTION

Department	**COMPUER SCIENCE AND ENGINEERING**				
Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHSB12				
Program	B.Tech				
Semester	II	CSE			
Course Type	Foundation				
Regulation	R- 18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. P. Srilatha, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Fundamentals of Statistics

II COURSE OVERVIEW:

Probability theory is the branch of mathematics that deals with modelling uncertainty. Inferential Statistics and regression analysis together with random variate distributions are playing an exceptional role in designing data driven technology which is familiarly known as data centric engineering. They also have wide variety applications in telecommunications and other engineering disciplines. The course covers advanced topics of probability and statistics with applications over real-world engineering problems.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Probability and Statistics	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
10%	Remember
30 %	Understand
60%	Apply
0 %	Analyze

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:

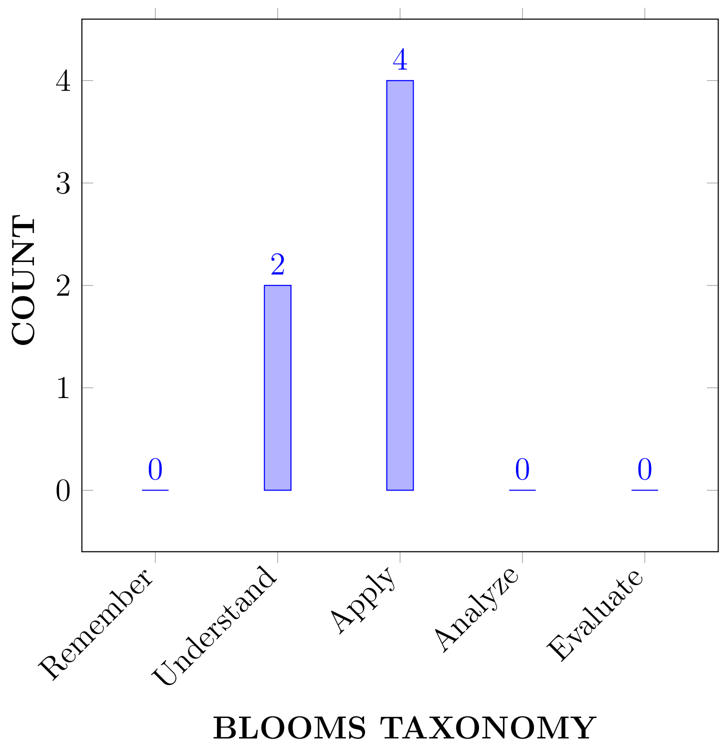
I	The Principles of probability, the theory of random variables, basic random variate distributions and their applications.
II	The Methods and techniques for quantifying the degree of closeness among two or more variables and linear regression analysis.
III	The Estimation statistics and Hypothesis testing which play a vital role in the assessment of the quality of the materials, products and ensuring the standards of the engineering process.
IV	The statistical tools which are essential for translating an engineering problem into probability model.

VII COURSE OUTCOMES:

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

CO 1	**Explain** the concepts of Baye's theorem, discrete and continuous random variables under randomized probabilistic conditions.	Understand
CO 2	**Interpret** the parameters of random variate Probability distributions such as Binomial, Poisson and Normal distribution by using their probability functions, expectation and variance.	Understand
CO 3	**Apply** Bivariate Regression as well as Correlation Analysis for statistical forecasting.	Apply
CO 4	**Make Use of** estimation statistics in computing confidence intervals, Regression analysis and hypothesis testing.	Apply
CO 5	**Identify** the role of statistical hypotheses, types of errors, confidence intervals, the tests of hypotheses for large sample in making decisions over statistical claims in hypothesis testing	Apply
CO 6	**Identify** the tests of hypothesis for small sample 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.

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	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

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.	1	Seminar/ Conferences/ Research Papers

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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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
	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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	**PROBABILITY AND RANDOM VARIABLES**
	Probability, Conditional Probability, Baye's Theorem; Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation.
MODULE II	**PROBABILITY DISTRIBUTION**
	Binomial distribution; Mean and variances of Binomial distribution, Recurrence formula for the Binomial distribution; Poisson distribution: Poisson distribution as a limiting case of Binomial distribution, mean and variance of Poisson distribution, Recurrence formula for the Poisson distribution; Normal distribution; Mean, Variance, Mode, Median, Characteristics of normal distribution.
MODULE III	**CORRELATION AND REGRESSION**
	Correlation: Karl Pearson's Coefficient of correlation, Computation of correlation coefficient, Rank correlation, Repeated Ranks; Properties of correlation. Regression: Lines of regression, Regression coefficient, Properties of Regression coefficient, Angle between two lines of regression; Multiple correlation and Regression.

MODULE IV	**TEST OF HYPOTHESIS - I**
	Sampling: Definitions of population, Sampling, Parameter of statistics, standard error; Test of significance: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two-sided test. Large sample test: Test of significance for single mean, Test of significance for difference between two sample means, Tests of significance single proportion and Test of difference between proportions.
MODULE V	**TEST OF HYPOTHESIS - II**
	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; Chi-square test of goodness of fit.

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. N. P. Bali, "Engineering Mathematics", Laxmi Publications, 9th Edition, 2016.& Co., 6th Edition, 2014.
2. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand & Co., 10th Edition, 2000.
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	CO 1	T2:26.3
3	conditional probability	CO 1	R2:21.48
4	Baye's law	CO 1	T2:26.6 R2:21.50
5	Discrete Random variables	CO 1	T2:26.7 R2:21.51
6	Mean and variance, probability distribution of discrete Random variables.	CO 1	T2:26.8
7	Continuous Random variables	CO 1	T2:26.10
8	Mean and variance, probability distribution of continuous Random variables.	CO 1	T2:26.14 R2:21.55
9	Properties of random variables	CO 1	T2:26.15 R2:21.58
10	Binomial distribution	CO 2	T2:26.16 R2:21.61
11	Mean and variances of Binomial distribution	CO 2	T2:25.12 R2:21.24
12	Recurrence formula for the Binomial distribution	CO 2	T2:25.16 R2:21.29
13	Poisson distribution	CO 2	T2:25.14 R2:21.31
14	Mean and variance of Poisson distribution	CO 2	T2:25.14 R2:21.33
15	Recurrence formula for the Poisson	CO 2	R2:21.33
16	Normal distribution.	CO 2	T2:27.2 R2:21.64
17	Mean, Variance, Mode, Median, Characteristics of normal distribution	CO 2	T2:27.2

18	Correlation	CO 3	T2:27.2 R2:21.67
19	Karl Pearson's Coefficient of correlation	CO 3	T2:27.2
20	Rank correlation	CO 3	T2:27.3 R2:21.71
21	Properties of correlation	CO 3	T2:27.4 R2:21.68
22	Regression coefficients	CO 4	T2:27.7 R2:21.74
23	Properties of Regression coefficients	CO 4	T2:27.12 R2:21.75
24	Angle between two lines of regression	CO 4	T2:27.8 R2:21.72
25	Lines of regression,	CO 4	T2:27.8 R2:21.73
26	Sampling: Definitions	CO 5	T2:27.14 R2:21.78
27	Types of sampling	CO 5	T2:27.19 R2:21.814
28	Parameter vs. statistics, standard error.	CO 5	T2:27.12 R2:21.82
29	Type I and type II errors, 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	CO 6	T2:27.2
36	Test of significance difference between sample mean and population mean.	CO 6	T2:26.16 R2:21.61
37	difference between means of two small samples	CO 6	T2:25.12 R2:21.24
38	Snedecor's F-distribution properties.	CO 6	T2:25.16 R2:21.29
39	F-distribution properties	CO 6	T2:27.14 R2:21.78
40	Chi-square distribution and it's properties	CO 6	T2:27.19 R2:21.814
41	Applications of Chi-square –Distribution	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 mathematical expectation	CO 1	T2:26.6 R2:21.50
45	Problem solving session on Binomial distribution	CO 1	T2:26.7 R2:21.51
46	Problem solving session on Poisson distribution	CO 2	T2:26.8
47	Problem solving session on Normal distribution	CO 2	T2:26.10
48	Problem solving session on Karl Pearson's correlation	CO 3	T2:26.14 R2:21.55
49	Problem solving session on Spearman's rank correlation	CO 3	T2:26.15 R2:21.58
50	Problem solving session on linear regression	CO 4	T2:26.16 R2:21.61
51	Problem solving session on sampling distribution of means	CO 5	T2:25.12 R2:21.24
52	Problem solving session on central limit theorem	CO 5	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	CO 6	R2:21.33
56	Problem solving session on Chi-square - test	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 probability distributions.	CO 2	T2:26.7 R2:21.51
59	Definitions & terminology discussion on correlation and regression.	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.	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 probability distributions.	CO 2	T2:26.7 R2:21.51
64	Question bank discussion on correlation and regression.	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..	CO 6	R2:21.33

Course Coordinator:
Ms. P. Srilatha

HOD CSE

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

COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

<table>
<tr><td>Course Title</td><td colspan="5">ENGINEERING PHYSICS LABORATORY</td></tr>
<tr><td>Course Code</td><td colspan="5">AHSB10</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4">CSE</td></tr>
<tr><td>Course Type</td><td>FOUNDATION</td><td colspan="4"></td></tr>
<tr><td>Regulation</td><td>IARE - r18</td><td colspan="4"></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>-</td><td>-</td><td>3</td><td>1.5</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr. K Saibaba, Assistant Professor</td></tr>
</table>

I COURSE OVERVIEW:

This lab course provides hands on experience in a number of experimental techniques and developscompetenceintheinstrumentationtypicallyusedinphysics.This also develops student's expertise in applying physical concepts to practical problem and in learning about experimental techniques with advanced equipments. This laboratory includes experiments involving electromagnetism and optoelectronics.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	Basic principles of physics	1.5

III MARKS DISTRIBUTION:

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

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing Further Experiments

V EVALUATION METHODOLOGY:

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

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the principal 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	**Laboratory**		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.

A. Experiment Based

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

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

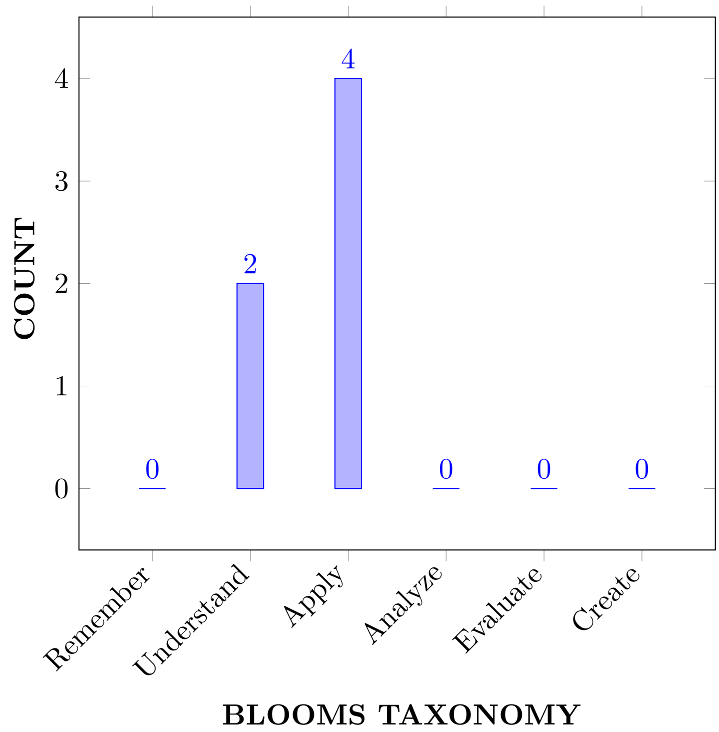
I	To familiarize with the lab facilities, equipment, standard operating procedures.
II	About the different kinds of functional electric and magnetic materials which paves a way for them to use in various technical and engineering applications.
III	The analytical techniques and graphical analysis to study the experimental data for optoelectronic devices.
IV	The applications of variation in the intensity of light due to natural phenomena like interference and diffraction.

VII COURSE OUTCOMES:

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

CO 1	**Identify** the type of semiconductor using the principle of Hall Effect and also determine the energy gap of a semiconductor diode.	Apply
CO 2	**Illustrate** principle, working and application of wave propagation and compare results with theoretical harmonics and overtones.	Understand
CO 3	**Investigate** the energy losses associated with a given Ferro magnetic material and also magnetic field induction produced at various points along the axis of current carrying coil.	Apply
CO 4	**Examine** launching of light through optical fiber from the concept of light gathering capacity of numerical aperture.	Understand
CO 5	**Utilize** ththe phenomena of interference and diffraction for the determination of various parameters like radius of curvature of convex lens, wavelength of laser light and width of single slit.	Apply
CO 6	**Investigate** V-I/L-I characteristics of various optoelectronic devices like Light Emitting Diode, Photodiode to understand their basic principle of functioning as well as to infer the value of Planck's constant.	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	Laboratory experiments, internal and external lab examinations.
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	Laboratory experiments, internal and external lab examinations.
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	Laboratory experiments, internal and external lab examinations.

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	1	Laboratory experiments and Surveys

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 basic principle of Hall effect and make use of mathematical expression for Hall coefficient to deduce the type of semiconductor.	2
	PO 2	Understand the given problem statement of identification of type of semiconductor and formulate Hall coefficient from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 1	Determine the energy gap of a semiconductor diode by making use of graphical analysis of current versus temperature curve.	2

CO 2	PO 1	Recall the theory of propagation of longitudinal and transverse waves and make use of number of loops formation in string to determine frequency of an electronically maintained tuning fork.	2
	PO 2	Understand the given problem statement of stationary wave propagation and formulate harmonics and overtones of fundamental frequency from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
CO 3	PO 1	Explain the variation of magnetic field at various points along the axis of current carrying coil and make use of mathematical expression of Tangent's law using Stewart Gee's apparatus.	2
	PO 2	Understand the given problem statement of current loop and formulate magnetic field induction at various points along the axis of current loop from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 1	Investigate the energy losses associated with a given ferromagnetic material and make use of graphical representation of hysteresis loop exhibited by magnetic material.	2
	PO 2	Understand the given problem statement of energy losses associated with a given ferromagnetic material and formulate hysteresis loop from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 4	Apply simulation tool to get hysteresis curve of a ferromagnetic material and understand energy losses associated with material.	1
	PSO 3	Make use of modern simulation tool to get information about energy losses associated with a ferromagnetic material.	1
CO 4	PO 1	Interpret launching of light through optical fiber and make use of mathematical expression for analyzing light gathering capacity through numerical aperture.	2
	PO 4	Make use of optical fiber trainer kit and understand conversion of electrical to light energy..	1
CO 5	PO 1	Explain the concept of interference in Newton's rings and make use of it to determine the radius of curvature of convex lens.	2
	PO 4	Make use of microscope to get Newton's rings and understand the phenomenon of interference in reflected light.	1
	PO 1	Recollect the phenomena of diffraction from N-slits and make use of it for the determination of wavelength of a given laser.	1

	PO 1	Understand the phenomenon of single slit diffraction and make use of it to determine the slit width by using laser light as monochromatic source.	1
CO 6	PO 1	Explain the V-I characteristics of light emitting diode and infer the value of planck's constant by plotting temperature versus current curve.	2
	PO 1	Understand the phenomenon of recombination of electron-hole pair and determine the value of threshold voltage of a given LED.	2
	PO 1	Illustrate the variation of photo current with light intensity in a photo diode.	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 3
CO 1	3	2	-	-
CO 2	3	2	1	-
CO 3	3	-	-	1
CO 4	3	2	1	-
CO 5	3	-	1	-
CO 6	3	2	1	-

3 = High; 2 = Medium; 1 = Low

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 1	**HAL LEFFECT (LORENTZFORCE)**
	Determination of charge carrier density.
WEEK 2	**MELDE'S EXPERIMENT**
	Determination of frequency of a given tuning fork
WEEK 3	**STEWART GEE'S APPARATUS**
	Magnetic field along the axis of current carrying coil – Stewart and Gee's method.
WEEK 4	**B-H CURVE WITH CRO**
	To determine the value of retentivity and coercivity of a given magnetic material.
WEEK 5	**ENERGY GAP OF A SEMICONDUCTOR DIODE**
	Determination of energy gap of a semiconductor diode.
WEEK 6	**PHOTO DIODE**
	Studying V-I characteristics of Photo Diode.
WEEK 7	**OPTICAL FIBER**
	Evaluation of numerical aperture of a given optical fiber.
WEEK 8	**WAVELENGTH OF LASER LIGHT**
	Determination of wavelength of a given laser light using diffraction grating.
WEEK 9	**PLANK'S CONSTANT**
	Determination of Plank's constant using LED.
WEEK 10	**LIGHT EMITTING DIODE**
	Studying V-I Characteristics of LED.
WEEK 11	**NEWTONS RINGS**
	Determination of radius of curvature of a given plano - convex lens.
WEEK 12	**SINGLE SLIT DIFFRACTION**
	Determination of width of a given single slit.

TEXTBOOKS

1. 1 CL Arora, "Practical Physics", S Chand and Co.,New Delhi, 3rd Edition,2012.

2. 2 Vijay Kumar, Dr. T. Radha krishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014.

REFERENCE BOOKS:

1. 1 CF Coombs,"Basic Electronic Instrument Handbook", McGraw - HillBookCo.,1972.

2. 2 CH Bernardand CD Epp, John Wiley and Sons, " Laboratory Experiments in College Physics" Inc.,NewYork,1995.

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	Determination of charge carrier density.	CO 1	T1:13.5
2	Determination of frequency of a given tuning fork.	CO 2	T1:13.5
3	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee's method.	CO 3, CO 4	TT1:14.7
4	Determination of the energy loss per unit volume of a given magnetic material per cycle by tracing the Hysteresis loop.	CO 3	T1:15.7
5	Determination of energy gap of a semiconductor diode.	CO 1	T1:16.8
6	Studying V-I Characteristics of Photo Diode.	CO 6	T1:16.9
7	Evaluation of numerical aperture of a given optical fiber.	CO 4	T1:17.9
8	Determination of wavelength of a given laser light using diffraction grating.	CO 5	T1:18.10
9	Determination of Plank's constant using LED.	CO 6	T1:19.10
10	Studying V-I characteristics of LED	CO 6	T1:19.9
11	Determination of radius of curvature of a given Plano-convex lens.	CO 5	T1:23.10
12	Determination of width of a given single slit.	CO 5	T1:23.10

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	To determine the wavelength of different colored light using white light source by Newton's ring method
2	To study the bending losses and transmission losses of an optical Fiber
3	To observe the dispersion of prism by using spectrometer.
4	Study the characteristics of Laser diode.
5	To illustrate the interference pattern produced from the air wedge.
6	To determine the voltage current characteristics of solar cell

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

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**DATA STRUCTURES**				
Course Code	ACSB03				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	3	1.5
Course Coordinator	Dr V Sitharamulu, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming for Problem Solving

II 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.

III MARKS DISTRIBUTION:

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

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	whiteboard		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 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:

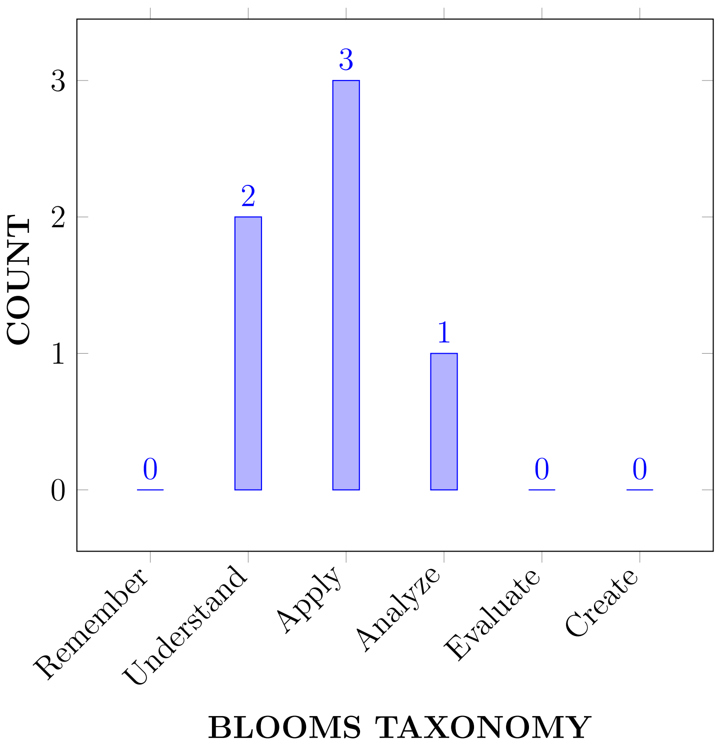
I	The skills needed to understand and analyze performance trade-offs of different algorithms implementations and asymptotic analysis of their running time and memory usage.
II	The knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and 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
	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
	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
	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
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: Stack ADT, definition and operations, Implementations of stacks using array, applications of stacks, Arithmetic expression conversion and evaluation; Queues: Primitive operations; Implementation of queues using Arrays, 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 tree variants, application of trees; Graphs: Basic concept, graph terminology, Graph representations-Adjacency matrix, Adjacency lists, graph implementation, Graph traversals-BFS,DFS, Application of graphs, Minimum spanning trees-Prims and Kruskal algorithms
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. 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. D. Samanta, —Classic Data Structures, PHI Learning, 2nd Edition, 2004.

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://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/datastructures
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	CO 1	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 comparison	CO 2, CO 6	T1:5.1
8	Sorting techniques: Bubble sort, selection sort and companding	CO 2 CO 6	R1:14.5

9	Sorting techniques: Insertion sort, Quick sort	CO 2, CO 6,	T1:5.2 R2 : 10.2
10	Merge sort ,comparison of sorting algorithms	CO 4, CO 6	T1:5.2 R2 : 10.2
13	Stacks: Primitive operations, implementation of stacks using Arrays	CO 3, CO 4	T1:7.1
14	Applications of stacks arithmetic expression conversion and evaluation	CO 4, CO 6	T1:7.2
16	Queues: Primitive operations; Implementation of queues using Array	CO 3, CO 4	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, CO 4	R2 : 5.4
19	Linked lists: Introduction, singly linked list, representation of a linked list in memory	CO 3, CO 4	T1:9.1
20	Operations on a single linked list :creation, insertion and deletion	CO 3, CO 4	T1:9.2
21	Applications of linked lists	CO 4,	T1:9.3
22	Operations on a double linked lists :creation, insertion and deletion	CO 3, CO 4	T1:9.4
23	Operations on a double linked lists : deletion ,traversal.	CO 3, CO 4	T1:9.4
24	single linked list :polynomial expression	CO 3, CO 4	T1:9.3
25	single linked list :Sparse matrix manipulation.	CO 3, CO 4	T1:9.3
26	Operations on a Circular linked lists: creation, insertion and deletion	CO 3, CO 4	T1:9
30	Operations on a Circular linked lists: deletion, traversal	CO 3, CO 4	T1:9
31	Linked list representation and operations of Stack	CO 3, CO 4	T1:9.7
32	Linked list representation and operations of queue	CO 3, 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, CO 4	T1:13.1
39	Binary tree representation using array	CO 3, CO 4	T1:13.2
40	Binary tree representation using linked list	CO 3, CO 4	T1:13.2
41	Binary tree traversal, binary tree variants	CO 3, CO 4	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 3	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 3	T1:13.2.3
52	AVL trees	CO 3	T1:14.3
53	M- Way search trees, B trees	CO 3	T1:14.3
54	Hashing, Collision	CO 5	R2 : 6.4
7	Problems on linear search, binary search and Fibonacci search.	CO 2	T1:5.1
11	Problems on bubble sort, selection and insertion sort	CO 3, CO 4	T1:5.2 R2 : 10.2
12	Problems on quick and merge sort	CO 3, CO 4	T1:5.2 R2 : 10.2
15	Problems on Arithmetic expression conversion and evaluation	CO 3, CO 4	T1:7.2
27	Problems on single linked list to add, delete element	CO 3, CO 4	T1:9.8
28	Problems on double linked list to add, delete element	CO 3, CO 4	T1:9.8
33	Problems on circular linked list to add, delete element	CO 3, CO 4	T1:9.4
34	Problems on double linked list to add, delete element	CO 3, CO 4	T1:9.3
35	Problems on stack using linked list	CO 3, CO 4	T1:9.7
36	Problems on queue using linked list	CO 3, CO 4	T1:9.8
43	Problems on Binary tree :creation ,insertion and deletion of a node	CO 3, CO 4	T1:13.2
47	Problems on Graph Traversal: DFS and BFS	CO 3, CO 4	T2:6.2

49	Problems on MST: Prim's and Kruskal's	CO 3, 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	CO 1,CO2,CO 3	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 II	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, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**OBJECT ORIENTED PROGRAMMING THROUGH PYTHON**				
Course Code	AITB01				
Program	B.Tech				
Semester	THREE				
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3		3	-	-
Course Coordinator	Ms. A Lakshmi, Assistant Professor				

I. COURSE OVERVIEW:

This course introduces students to writing computer programs. This course presents the principles of structured programming using the Python language, one of the most increasingly preferred languages for programming today. Because of its ease of use, it is ideal as a first programming language and runs on both the PC and Macintosh platforms. However, the knowledge gained in the course can be applied later to other languages such as C and Java. The course uses ipython Notebook to afford a more interactive experience. Topics include fundamentals of computer programming in Python, object-oriented programming and graphical user interfaces.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming for problem solving

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Object Oriented Programming Through Python	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	PPT	✔	Chalk & Talk	✔	Assignments	✗	MOOCs
✗	Open Ended Experiments	✔	Seminars	✗	Mini Project	✔	Videos
✔	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.

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

Percentage of Cognitive Level	Blooms Taxonomy Level
10 %	Remember
50 %	Understand
25 %	Apply
15 %	Analyze
0 %	Evaluate
0 %	Create

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 and 05 marks for Alternative Assessment Tool (AAT).

Table 2: Assessment pattern for CIA

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 8th and 16th 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 centre. 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.

Table 3: Assessment pattern for AAT

5 Minutes Video	Assignment	Tech-talk	Seminar	Open Ended Experiment
30%	30%	30%	10%	--

VI. COURSE OBJECTIVES:

The students will try to learn:	
I	Acquire programming skills in core Python.
II	Acquire Object-oriented programming skills in Python.
III	Develop the skill of designing graphical-user interfaces (GUI) in Python.
IV	Develop the ability to write database application in python
V	Acquire Python programming skills to move into specific branches - Internet of Things (IoT), Data Science, Machine Learning (ML), Artificial Intelligence (AI) etc.

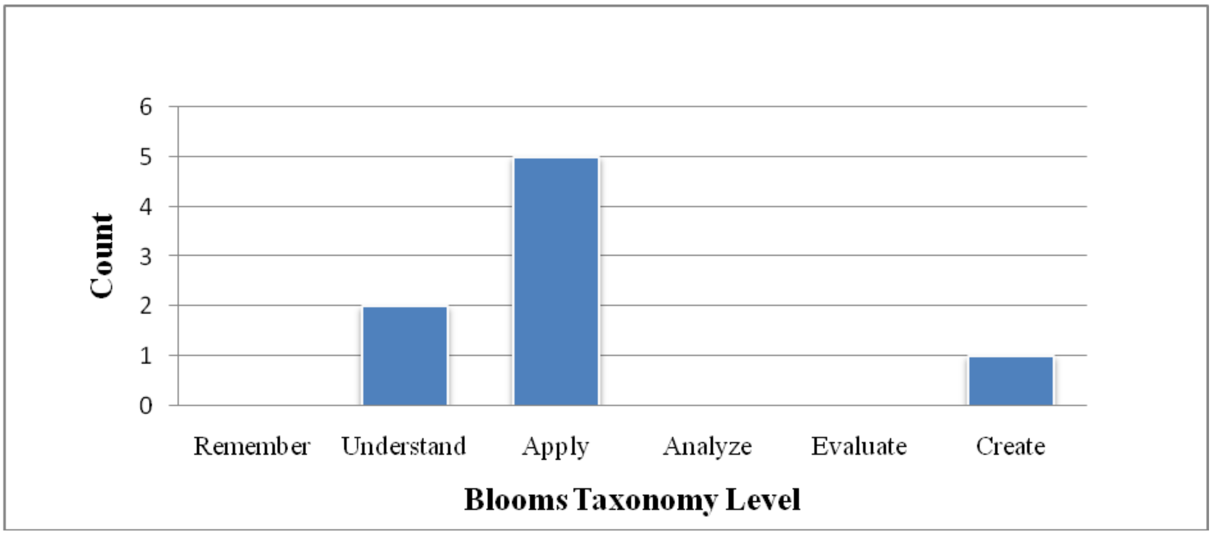
VII. COURSE OUTCOMES:

After successful completion of the course, Students will be able to:

CO No	Course Outcomes	Knowledge Level (Bloom's Taxonomy)
CO 1	**Setup** python to develop simple applications.	Apply
CO 2	**Make use of** the python programming language to construct basic programs.	Apply

CO 3	**Know** how to use collections such as list, tuple, range, dictionary and sets.	Understand
CO 4	**Make use of** functions, classes and objects from those classes.	Apply
CO 5	**Understand** the concepts of inheritance and polymorphism for code reusability and extensibility.	Understand
CO 6	**Write** robust code using exception handling.	Apply
CO 7	**Create** and animate a variety of shapes and develop an application with graphical user interface (GUI).	Create
CO 8	**Extend** the knowledge of python programming to build successful career in software development.	Apply

COURSE KNOWLEDGE COMPETENCY LEVELS



VIII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO1	**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
PO2	**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	Seminar/ Conferences
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	Assignments/ Discussion

Program Outcomes		Strength	Proficiency Assessed by
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	Short term courses

3 = High; 2 = Medium; 1 = Low

IX. 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
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/ Industry exposure

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

Course Outcomes	Program Outcomes												Program Specific 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	√	√											√		
CO 7	√		√		√								√		√
CO 8												√	√		√

XI. JUSTIFICATIONS FOR CO-PO MAPPING:

Course Outcomes	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	PO 1	Setup (apply) python and develop simple applications by applying the principles of **mathematics and** basic programming **engineering fundamentals**.	2
	PO 3	**Understand the customer needs** of installing python, **use creativity** in applying the methods of model **for innovative solutions**, **evaluate the outcomes** of the model for the performance of python applications, **and**	5

		understand the economic context of the python applications.	
CO 2	**PO 1**	Make use of the python programming language to construct basic programs in *solving (complex) engineering problems* by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 3	**Understand the customer needs** of python programming language **use creativity** in applying the control structures **for innovative solutions**, **evaluate the outcomes** of the model for the performance of applications, **and understand the economic context** of the python applications.	5
	PO 5	Make use of the python programming language to construct basic programs in **Computer software (**python).	1
	PSO 1	Make use of the python programming language to construct basic programs in **design next-generation computer systems, search engines, soft computing and intelligent systems, web browsers**.	4
	PSO 3	Make use of (apply) python programming language using **industry standard tools and collaboration techniques** in IT industry.	2
CO 3	**PO 1**	Know (understand) usage of collections such as list, tuple, range, dictionary and sets, among them in *solving (complex) engineering problems* by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Understand the given **problem statement** and **formulate** *(complex) specific engineering problems* related to collections such as list, tuple, range, dictionary and sets from the **information and data collection, develop solutions** based on the performance in reaching substantiated conclusions by the **interpretation of results.**	5
	PO 5	Know (understand) how to use collections such as list, tuple, range, dictionary and sets in **Computer software** (python).	1
CO 4	**PO 1**	Make use of (apply) functions, classes and objects from those classes among them in *solving (complex) engineering problems* by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 3	**Understand the customer needs** of functions, classes and objects **use creativity** in applying the methods of class **for innovative solutions**, **evaluate the outcomes** of the model for the performance of python applications, **and understand the economic context** of the python applications.	5
	PSO 1	Make use of (apply) functions, classes and objects from those classes in **design next-generation computer systems, search engines, web browsers**.	3
	PSO 3	Make use of (apply) functions, classes and objects from those classes using **industry standard tools and** in IT industry.	1

CO 5	**PO 1**	Understand the concepts of inheritance and polymorphism, among them in *solving (complex) engineering problems* by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 3	**Understand the customer needs** of inheritance and polymorphism **use creativity** in applying the methods of class **for innovative solutions**, **evaluate the outcomes** of the model for the performance of applications, **and understand the economic context** of the real time applications.	5
	PO 5	**Understand** the concepts of inheritance and polymorphism in **Computer software** (python).	1
	PO 12	Build strong foundation of inheritance and polymorphism for career **building by communicating effectively with engineering community.**	4
	PSO 3	**Understand** the concepts of inheritance and polymorphism using **industry standard tools and collaboration techniques** in IT industry.	2
CO 6	**PO 1**	Write(apply) robust code using exception handling in *solving (complex) engineering problems* by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 2	Understand the given **problem statement** and **formulate** *(complex) specific engineering problems* related to the exception handling from the **information and data collection, develop solutions** based on the performance in reaching substantiated conclusions by the **interpretation of results.**	5
	PSO 1	Write robust code using exception handling in **design next-generation computer systems, soft computing.**	2
CO 7	**PO 1**	Create and animate a variety of shapes and develop an application in *solving (complex) engineering problems* by applying the principles of **mathematics and engineering fundamentals**.	2
	PO 3	**Understand the customer needs** of graphical user interface, **use creativity** in applying the methods of animation **for innovative solutions**, **evaluate the outcomes** of the model for the performance of GUI applications, **and understand the economic context** of the web applications.	5
	PO 5	Create and animate a variety of shapes and develop an application in **Computer software** (python).	1
	PSO 1	Create and animate a variety of shapes and develop an application in **soft computing and intelligent systems, web browsers**.	2
	PSO 3	Create a variety of shapes and develop an application using **industry standard tools and collaboration techniques** in IT industry.	2
CO 8	**PO 12**	Build strong foundation of python programming for successful career in software development **by communicating effectively with engineering community.**	4

	PSO 1	Extend the knowledge of python programming in **design next-generation computer systems, search engines, soft computing and intelligent systems, web browsers**.	4
	PSO 3	Extend the knowledge of python programming using **industry standard tools and collaboration techniques** in IT industry.	2

XII. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING

Course Outcomes	**Program Outcomes / Number of Vital Features**												**PSOs/ No. of Vital Features**		
	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**	**1**	**2**
CO 1	2		5												
CO 2	2		5		1								4		2
CO 3	2	5			1										
CO 4	2		5										3		1
CO 5	2		5		1							4			2
CO 6	2	5											2		
CO 7	2		5		1								2		2
CO 8												4	4		2

XIII. PERCENTAGE FOR KEY COMPETENCIES FOR CO-PO MAPPING:

Course Outcomes	**Program Outcomes / Number of Vital Features**												**PSOs / No. of Vital Features**		
	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**	**1**	**2**
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	0.0	0.0	0.0
CO 2	66.7	0.0	50.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	100.0
CO 3	66.7	50.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 4	66.7	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0
CO 5	66.7	0.0	50.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	100.0
CO 6	66.7	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0
CO 7	66.7	0.0	50.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	100.0
CO 8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	66.7	0.0	100.0

XIV. 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≤ 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												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	2	-	3	-	-	-	-	-	-	-	3	-	3
CO 3	3	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	2	-	-	-	-	-	-	-	-	-	2	-	2
CO 5	3	-	2	-	3	-	-	-	-	-	-	2	-	-	3
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 7	3	-	2	-	3	-	-	-	-	-	-	-	1	-	3
CO 8	-	-	-	-	-	-	-	-	-	-	-	2	3	-	3
TOTAL	21	4	8		12							4	10		14
AVERAGE	**3.0**	**2.0**	**2.0**		**3.0**							**2.0**	**2.0**		**2.8**

XV. ASSESSMENT METHODOLOGY –DIRECT

CIE Exams	PO 1,PO 2, PO 3,PO 5	SEE Exams	PO 1,PO 2, PO 3, PO 5	Assignments	PO 3,PO 5	Seminars	PO 3,PO 5
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 5						

XVI. ASSESSMENT METHODOLOGIES–INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

XVII. SYLLABUS

Module-I	INTRODUCTION TO PYTHON AND OBJECT ORIENTED CONCEPTS
Introduction to Python: Features of Python, Data types, Operators, Input and output, Control Statements. Introduction to Object Oriented Concepts: Features of Object oriented programming system (OOPS) - Classes and Objects, Encapsulation, Abstraction, Inheritance, Polymorphism.	
Module-II	**PYTHON CLASSES AND OBJECTS**
Classes and Objects: Creating a class, The Self variable, Constructor, Types of Variable, Namespaces, Types of Methods, Inheritance and Polymorphism – Constructors in inheritance, The super() method, Types of inheritance, Polymorphism, Abstract classes and Interfaces.	
Module-III	**STRINGS AND FUNCTIONS**
Strings: Creating strings and basic operations on strings, String testing methods. Functions: Defining a function, Calling a function, Returning multiple values from a function, Functions are first class objects, Formal and actual arguments, Positional arguments, Recursive functions.	
Module-IV	**EXCEPTION HANDLING**
Exception: Errors in a Python program, Exceptions, Exception handling, Types of exceptions, The Except block, The assert statement, user-defined exceptions.	
Module-V	**GRAPHICAL USER INTERFACE**
GUI in Python: The Root window, Fonts and colors, Working with containers, Canvas, Frames, Widgets Button widget, Label Widget, Message widget, Text widget, Radio button Widget, Entry widget.	
Text Books:	
1. R Nageswara Rao, Core Python Programming, Dreamtech press, 2017 Edition. 2. Dusty Philips, Python 3 Object Oriented Programming, PACKT Publishing, 2nd Edition 2015.	
Reference Books:	
1. Michael H.Goldwasser, David Letscher, Object Oriented Programming in Python, Prentice Hall; 1st dition, 2007.	

XVIII. COURSE PLAN:

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

Lecture No	Topics to be Covered	COs	Reference
1	Describe the Features of Python, Data types.	CO 1	T1:1.2
2-3	Summarize the concept of Operators, Input and output, Control Statements.	CO 1	T1:4,5,6
4-5	Identify the features of Object Oriented Programming System (OOPS),	CO 2, CO 3	T12.3
6-7	Use the concept of Classes and Objects, Encapsulation.	CO 2, CO 3	T1:12.4,12.5
8-9	Describe Abstraction, Inheritance, and Polymorphism.	CO 2, CO 3	T1:12.6-12.8
10-11	Determine Creating a class, The Self variable.	CO 4	T1:13.1,13.2

Lecture No	Topics to be Covered	COs	Reference
12-13	Understand types of variable, Namespaces.	CO 4	T1:13.4,13.5
14-15	Determine types of Methods, Inheritance and Polymorphism.	CO 4, CO 5	T1:13.6,14
16-18	Use Constructors in inheritance, the super() method.	CO 5	T1:14.1,14.3
19-20	Illustrate types of inheritance, Polymorphism, Abstract classes and Interfaces.	CO 5	T1:14.4,14.6
21-22	Understand Creating strings and basic operations on strings.	CO 6	T1:8.1
23	Analyze the concept of String testing methods.	CO 6	T1:8.17
24-25	Defining a function.	CO 7	T1:9.2
26-27	Illustrate Calling a function.	CO 7	T1:9.3
28	Illustrate Returning multiple values from a function.	CO 7	T1:9.5
29	Contrast the Usage of Functions is first class objects.	CO 8	T1:9.6
30	Contrast the Usage of Formal and actual arguments.	CO 8	T1:9.8
31	Define Positional arguments, Recursive functions.	CO 8	T1:9.9,9.16
32-34	Discuss the concept of Errors in a Python program.	CO 9	T1:16.1
35	Understand Exceptions, Exception handling.	CO 9	T1:16.2,16.3
36	Summarize the concept of types of exceptions.	CO 9	T1:16.4
37	Discuss the Except block, the assert statement.	CO 9	T1:16.5,16.6
38	Understand the concept of user-defined exceptions.	CO 10	T1:16.7
39	Knowledge about the Root window, Fonts and colors.	CO 11	T1:22.2,22.3
40-41	Apply Working with containers, Canvas.	CO 11, CO 12	T1:22.4,22.5
42	Understand Widgets, Button widget, Label Widget.	CO 12	T1:22.7
43	Implement Message widget, Text widget.	CO 12	T1:22.11
44-45	Illustrate Radio button Widget, Entry widget.	CO 12	T1:22.8

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COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**				
Course Code	AHSB14				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. S. Sivasankara Rao, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals of ratio analysis and interpretation of financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning. Ratio analysis gives an idea about financial forecasting, financial planning, controlling the business and decision making.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
BEFA	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 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
16%	Remember
17%	Understand
17%	Apply
50%	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:

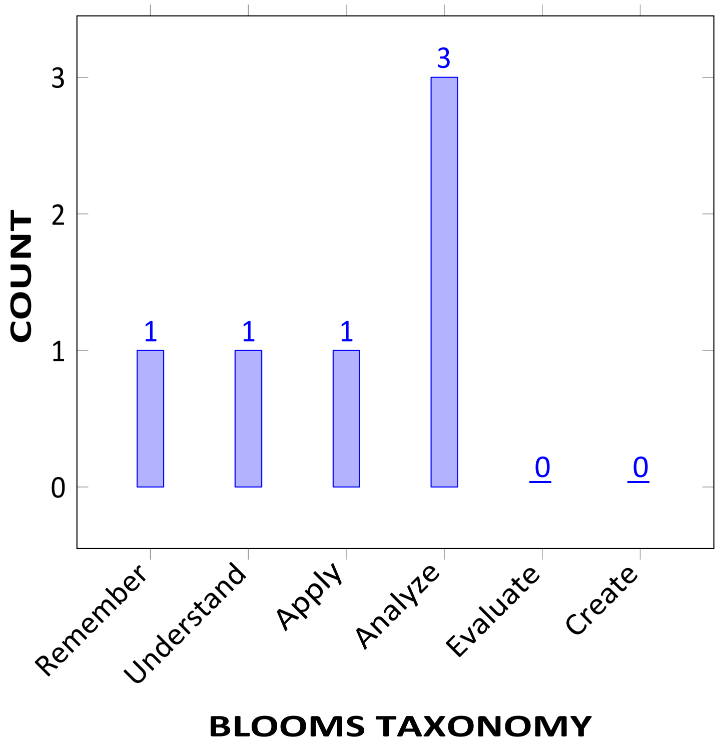
I	The concepts of business economics and demand analysis helps in optimal decision making in business environment
II	The functional relationship between Production and factors of production and able to compute breakeven point to illustrate the various uses of breakeven analysis.
III	The features, merits and demerits of different forms of business organizations existing in the modern business environment and market structures.
IV	The concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems for project management.
V	Various accounting concepts and different types of financial ratios for knowing financial positions of business concern.

VII COURSE OUTCOMES:

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

CO 1	**List** the basic concepts of managerial economics and analysis, measurement of demand and its forecasting to know the current status of goods and services.	Remember
CO 2	**Examine** to know the current status of goods and services. to know the economies and diseconomies of scale in manufacturing sector.	Analyze
CO 3	**Summarize** the four basic market models like perfect competition, monopoly, monopolistic competition, and oligopoly to know the price and quantity are determined in each model.	Understand
CO 4	**Compare** various types of business organizations and discuss their implications for resource allocation to strengthen the market environment.	Analyze
CO 5	**Analyze** different project proposals by applying capital budgeting techniques to interpret the solutions for real time problems in various business projects.	Analyze
CO 6	**Develop** the ability to use a basic accounting system along with the application of ratios to create (record, classify, and summarize) the data needed to know the financial position of the organization.	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 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

X 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	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-

XI 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	**Recall** (knowledge) the scientific fundamentals of economic activities performed by the businessmen in the business for profit earning.	2
	PO 2	**Interpret** and identify the demand and its analysis with the mathematical and natural principles of demand forecasting methods.	6
	PO 8	**Define** (knowledge) the responsibilities of the engineering practices by knowing the best economical practices.	1
	PO 9	**Match** (knowledge) the economical implication to effectively function as a team member, and as a member or leader in diverse teams.	5
	PO 11	**Relate** (knowledge) the knowledge and understanding of the economic principles 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.	6
CO 2	PO 1	**Recall** (Knowledge) the knowledge of mathematics, science in the production function through Different Combination of variable inputs with Economies of Scale.	2
	PO 2	**Demonstrate** the different cost concepts and determine the significance of Break Even Analysis.	5
	PO 8	**Relate** (Knowledge) (Knowledge) the ethical principles and commit to professional ethics and responsibilities and norms of the production management	2
	PO 9	**Show** (Fundamentals) the production function implications for effective implementation of gang compositions in a team work and in multidisciplinary settings.	6
	PO 11	**Define** the economies of scale in production function and Break Even Analysis knowledge applied in one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	5
CO 3	PO 8	**List** (Knowledge) (Knowledge) different structures of market and how price is determined under different market structures commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	**Match** the market structures and the market entry strategies as an individual, and as a member in diverse teams.	6
CO 4	PO 8	**Categorize** the ethical principles and commit to professional ethics and responsibilities belongs to different forms of business organizations existing in the modern business.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 9	**Classify** various business organizations and their functioning as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
CO 5	PO 1	**Explain** the ethical issues involved in the allocation of funds under the concept of capital budgeting.	1
	PO 11	**Summarize** the concept of capital budgeting and allocations of the resources through capital budgeting methods of the 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.	8
CO 6	PO 2	**Explain** the GAAP principles and ratios to analyse complex engineering problems reaching substantiated conclusions using first principles of accounts and profitability and efficiency of the organization.	6
	PO 11	**Illustrate**the accounting methods and procedures and accounting principles to manage the financial aspects in a project.	8

XII 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	6	-	-	-	-	-	1	5	-	6	-	-	-	-
CO 2	2	5	-	-	-	-	-	2	6	-	5	-	-	-	-
CO 3	-	-	-	-	-	-	-	2	6	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	2	6	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	8	-	-	-	-
CO 6	-	2	-	-	-	-	-	-	-	-	8	-	-	-	-

XIII 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	60.0	-	-	-	-	-	33.3	41.6	-	50.0	-	-	-	-
CO 2	66.7	50.0	-	-	-	-	-	66.7	50.0	-	41.6	-	-	-	-
CO 3	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 5	33.3	-	-	-	-	-	-	-	-	-	75.0	-	-	-	-
CO 6	-	20.0	-	-	-	-	-	-	-	-	75.0	-	-	-	-

XIV 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	-	-	-	-	-	1	2	-	2	-	-	-	-
CO 2	3	2	-	-	-	-	-	3	2	-	2	-	-	-	-
CO 3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO 6	-	1	-	-	-	-	-	-	-	-	3	-	-	-	-
TOTAL	7	7	-	-	-	-	-	10	8	-	-	-	-	-	-
AVERAGE	2.3	2.3	-	-	-	-	-	2.5	2	-	2.5	-	-	-	-

XV ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	SEE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	Seminars	PO8
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 1, PO 2, PO 8,PO 9 PO 11	Open Ended Experiments	-
Assignments	PO 9				

XVI ASSESSMENT METHODOLOGY-INDIRECT:

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

XVII SYLLABUS:

MODULE I	**INTRODUCTION&DEMAND ANALYSIS**
	Introduction to Business Economics: Definition, Nature and Scope of Managerial Economics – Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting

MODULE II	**PRODUCTION & COST ANALYSIS**
	Theory of Production and Cost Analysis: Production Function – Iso-quants and Iso-costs, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts; Break-even analysis, Determination of Break – Even point (Simple Problems) , Managerial Significance of BEA.
MODULE III	**MARKETS & NEW ECONOMIC ENVIRONMENT**
	LMarket structures: Types of competition, Features of perfect competition, Monopoly and monopolistic competition. Price determination & Price Statistics: Price Output determination in case of perfect competition and monopoly. Features and evaluation of different forms of Business organization: Sole proprietorship, partnership, Joint Stock Company, public enterprises and their types.
MODULE IV	**CAPITAL BUDGETING**
	Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising capital- Trading Forecast, Capital budget, Cash Budget. Features of capital budgeting proposals, methods of capital budgeting – payback method, Accounting rate of return(ARR), Net Present Value Method (simple problems).
MODULE V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**
	Financial accounting objectives, functions, importance; Accounting concepts and accounting conventions - double-entry book keeping, journal, ledger, trial balance; Final accounts: Trading account, profit and loss account and balance sheet with simple adjustments; Financial analysis: Analysis and interpretation of liquidity ratios, activity ratios, capital structure ratios and profitability ratios (simple problems), Du Pont chart.

TEXTBOOKS

1. Aryasri, “Managerial Economics and Financial Analysis”, TMH publications, 4thEdition,2012.
2. M. KasiReddy, Saraswathi, “Managerial Economics and Financial Analysis”, PHI Publications, New Delhi, 2ndEdition,2012.
3. Varshney, Maheswari, “Managerial Economics”, Sultan Chand Publications, 11thEdition,2009.

REFERENCE BOOKS:

1. D.N. Dwivedi, “Managerial Economics”, Vikas Publication House Pvt.Ltd, 2ndEdition,2012.
2. S.N. Maheshwari & S.K.Maheshwari, “Financial Accounting”, Vikas Publication House Pvt.Ltd,4thEdition, 2012.
3. R.NarayanaSwamy, “Financial Accounting- A managerial Perspective”, Pearson publications, 1stIndian Reprint Edition,2012.

WEB REFERENCES:

1. https://courses.lumenlearning.com/boundless-marketing/chapter/demand-analysis/
2. https://theintactone.com/2019/10/01/me-u3-topic-2-cost-output-relationship-in-short-run-long-run-cost-curves/

3. https://corporatefinanceinstitute.com/resources/knowledge/modeling/break-even-analysis/
4. https://corporatefinanceinstitute.com/resources/knowledge/economics/market-structure/#: :text=The%20four%20popular%20types%20of,monopoly%20market%2C%20and%20m
5. https://www.vedantu.com/commerce/various-forms-of-business-organisations
6. https://courses.lumenlearning.com/boundless-finance/chapter/introduction-to-capital-budgeting/
7. https://jkbhardwaj.com/20-transactions-with-their-journal-entries-ledger-and-trial-balance/
8. https://www.iedunote.com/write-accounting-ledger
9. https://opentextbc.ca/principlesofaccountingv1openstax/chapter/prepare-a-trial-balance/
10. https://caknowledge.com/how-to-prepare-final-accounts/
11. https://corporatefinanceinstitute.com/resources/knowledge/finance/ratio-analysis/

COURSE WEB PAGE:

https://lms.iare.ac.in/index?route=publicprofile&id=5201

XVIII 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	Discussion on Course Outcomes and how these COs mapped with POs and PSOs.		
CONTENT DELIVERY (THEORY)			
2-3	Explain about managerial economics according to the business	CO 1	T1- 1.3-1.8 R1-1.5-1.7
4-5	Describe about demand analysis, the Law of Demand and Demand Function.	CO 1	T1-2.2-2.11 R1-3.3-3.20
6-7	Understand elasticity of the demand of the product, different types, Measurement of Elasticity of Demand and Factors influencing on Elasticity of Demand.	CO 1	T1-3.3-3.20 R1- 5.29-6.8
8	State different methods of Demand Forecasting and the factors governing Demand Forecasting.	CO 1	T1-4.6-4.19
9-10	Demonstrate the Production function, features of Iso-Quants and Iso-Costs, different types of Internal Economies, External Economies and Law of Returns.	CO 2	T1- 5.3-5.18 R1- 5.29-6.8
11-13	Different types of Internal Economies, External Economies ad Law of Returns with appropriate examples.	CO 2	T1- 5.3-5.18
14-15	Illustrate different types of costs	CO 2	T1- 5.29-6.8
16-17	Explain the Significance and Limitations of Break-Even Analysis	CO 2	T1- 7.13-7.14
18-19	Calculate Break-Even Point (Simple Problems)	CO 2	T1- 7.1-7.12

20-21	Illustrate the features, price-output determination under Perfect Competition, Monopoly and Monopolistic competition Markets.	CO 3	T1- 8.4-8.16 R2- 5.29-6.8
22-24	Demonstrate the Objectives, Policies and Methods of Pricing Strategies and Price Methods.	CO 3	T1- 8.21-8.25
25-26	Describe Features of business, Definitions of Various forms of Business Units.	CO 4	T1-9.3-9.15
27-30	State the Merits & Demerits of Different types of Public Enterprises and Changing Business Environment to Post Liberalization Scenario.	CO 4	T1-9.2-10.23 R1- 8.21-8.25
31-32	Explain the significance and classification of capital, Methods and Sources of Raising Finance.	CO 6	T1-9.2-10.23
33-34	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems.	CO 6	T1-11.3-11.5 R2-12.3-12.5
35-37	Illustrate the Significance of Financial Accounting, Double Entry, Accounts, Accounting Concepts and Conventions	CO 6	T1-12.1-12.26
38-40	Explain the meaning, advantages and Limitations of the Journal, Ledger and Trial Balance and Final Accounts and Solve simple Problems.	CO 6	T1-13.4-13.15 R2-11.3-11.5
41-42	Describe Meaning, Definitions and Limitations of Ratio Analysis	CO 6	T1-13.4-13.15 R2-11.7-11.8
43-45	Compute different types of Financial Ratios (Problems)	CO 6	T1-13.5-13.68
PROBLEM SOLVING/ CASE STUDIES			
46	Problems relating to Demand elasticty measurement and Forecasting	CO 1	T1: 1.1 - 2.8, R1:2.1
47	Problems relation to Break Even Point	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
48	Problems in determining the price in different types of markets	CO 3,4	T3: 6.0 to 6.4, R1:5.1
49	Problems relating to Capital Budgeting Decisions	CO 5	R2:7.5
50	Problems relating to Final Accounts and Calculation of Ratios	CO 6	R3: 4.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
51	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
52	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
53	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
54	Capital Budgeting	CO 5	R2:7.5
55	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

DISCUSSION OF QUESTION BANK			
56	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
57	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
58	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
59	Capital Budgeting	CO 5	R2:7.5
60	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

Signature of Course Coordinator **HOD,CSE**

Dr. S. Sivasankara Rao, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**ANALOG AND DIGITAL ELECTRONICS**				
Course Code	AECB05				
Program	B.Tech				
Semester	THREE				
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Course Coordinator	Ms. M Saritha, Assistant Professor				

I. COURSE OVERVIEW:

This course provides the basic knowledge over the construction and functionality of the basic electronic devices such as diodes and transistors. It also provides the information about the uncontrollable and controllable electronic switches and the flow of current through these switches in different biasing conditions and also will make them to learn the basic theory of switching circuits and their applications in specified relationship between signals at the input and output terminals. They will be able to design combinational and sequential circuits detail. Starting from a problem statement they will learn to design circuits of logic gates that have a.They will learn to design counters, adders, sequence detectors.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B TECH	AHSB13	II	Semiconductor Physics

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Analog And Digital Electronics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	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 expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

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

Percentage of Cognitive Level	Blooms Taxonomy Level
10 %	Remember
50 %	Understand
25 %	Apply
15 %	Analyze
0 %	Evaluate
0 %	Create

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 and 05 marks for Alternative Assessment Tool (Table 3).

Table 2: Assessment pattern for CIA

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 8th and 16th 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 3**.**

Table 3: Assessment pattern for AAT

5 Minutes Video	Assignment	Tech-talk	Seminar	Open Ended Experiment
20%	30%	30%	10%	10%

VI. COURSE OBJECTIVES:

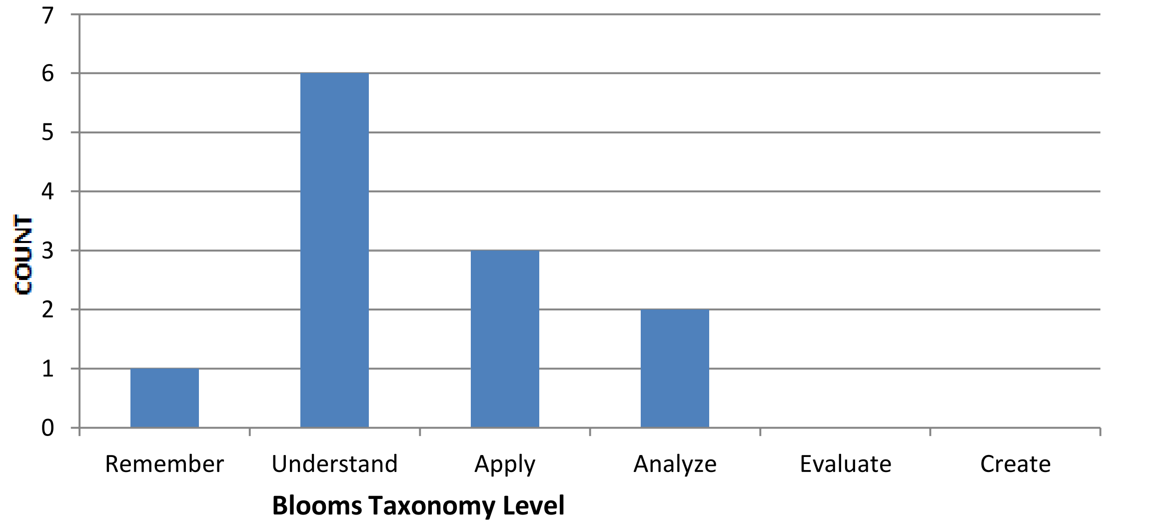
The students will try to learn:	
I	The Fundamental knowledge of the operational principles and characteristics of semiconductor devices and their applications.
II	The basic concept of number systems, Boolean algebra and optimized implementation of combinational and sequential circuits.
III	The perceive subsequent studies in the Area of microprocessors, microcontrollers, VLSI design and embedded systems effectively use of fundamentals of digital electronics.

VII. COURSE OUTCOMES:

After successful completion of the course, students will be able to:		
Course Outcomes		**Knowledge Level (Bloom's Taxonomy)**
CO 1	**Recall** the properties of semiconductor materials which form the basis for the formation of PN junction diode.	Remember
CO 2	**Illustrate** the volt-ampere characteristics of semiconductor devices for finding cut-in voltage, resistance and capacitance.	Understand
CO 3	**Apply** the pn junction characteristics for the diode applications such as switch and rectifiers.	Apply
CO 4	**Explain half** wave and full wave rectifier circuits with filter and without filters for conversion of alternating current in to direct current.	Understand

CO 5	**Interpret** DC and AC load line analysis of different amplifiers for optimal operating level regardless of input, load placed on the device.	Understand
CO 6	**Analye** the input and output characteristics of transistor configurations and small signal h-parameter models for determining the input - output resistances, current gain and voltage gain	Analyze

COURSE KNOWLEDGE COMPETENCY LEVELS



VIII. 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	3	SEE/CIE/AAT/ QUIZ
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes	3	SEE/CIE/AAT/ QUIZ

Program Outcomes		Strength	Proficiency Assessed by
	that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.		

3 = High; 2 = Medium; 1 = Low

IX. 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	Seminar

3 = High; 2 = Medium; 1 = Low

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

Course Outcomes	Program Outcomes												Program Specific 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	√	-	√	-	-	-	-	-	-	-	-	-	√	-	-
——	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 8	√	√	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 9	√	√	-	-	-	-	-	-	-	-	-	-	√	-	-
CO 10	√	√	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 11	√	-	√	-	-	-	-	-	-	-	-	-	-	-	-
CO 12	-	√	√	-	-	-	-	-	-	-	-	-	√	-	-

XI. JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING – DIRECT

Course Outcomes	POs/ PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO1	**PO 1**	Recall the semiconductor device properties (**knowledge)** for understanding conduction, Fermi-levels, barrier potentials through energy band diagrams, diffusion and drift currents in the device characteristics by applying the principles of **science**	**1**

Course Outcomes	POs/ PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO2	PO 1	Illustrate the volt-ampere characteristics (**knowledge**) of semiconductor devices to derive **mathematical model** for diode current, static and dynamic resistance by applying the principles of **mathematical** model and **science**	2
	PO 2	Understand the given **problem statement** and **formulate** the static and dynamic resistance from the volt-ampere characteristics of the semiconductor devices using **first principles of mathematics, natural sciences, and engineering sciences**	5
CO3	PO 2	Apply (**knowledge**) the given the diode application **problem statement** and finding the **solution implementation** of rectifier circuits	4
CO4	PO1	Understand the pn junction characteristics for the diode applications of diode as switch, and rectifiers for **complex engineering problems** by applying the principles of **mathematics, science**.	2
CO5	PO 1	Interpret (Understand) DC and AC load line analysis of different amplifiers for optimal operating level by applying **Mathematics, science engineering for complex engineering problems.**	2
	PO3	**Design** an amplifier from the AC and DC load line analysis by applying solutions for **complex engineering problems and design system components**.	5
CO6	PO 1	Analyse (Understand) the input and output characteristics of transistor configurations and determine the input output resistance, current and voltage gains by applying the principles of **mathematics, science**.	2
	PO3	**Design a transistor configuration and** find input and output characteristics by applying in **design system components.**	3
	PSO1	Develop the capability to **analyze** and **design** simple circuits containing nonlinear elements such as transistors using the concepts of load lines, operating points and incremental analysis.	2

XII. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING

Course Outcomes	Program Outcomes / No. of Key Competencies Matched												PSO/ No. of key competencies		
	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	2	2	2
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	3	-	-	-	-	-	-	-	-	-	1	-	-

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

Course Outcomes	Program Outcomes / No. of key competencies												PSO/ No. of key competencies		
	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	2	1	2
CO 1	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 2	66.7	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 3	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 4	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 5	66.7	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
CO 6	66.7	0.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

XIV. COURSE ARTICULATION MATRIX (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; **2** – 40 % $< C <$ 60% – Moderate.
1 – 5 $< C \leq$ 40% – Low / Slight; **3** – 60% $\leq C <$ 100%– Substantial / High

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	2	-	-	-	-	-	-	-	-	-	3	-	-
CO 6	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**26**	**10**	**7**	-	-	-	-	-	-	-	-	-	**9**	-	-
AVERAGE	**2.6**	**1.6**	**1.7**	-	-	-	-	-	-	-	-	-	**3**	-	-

XV. ASSESSMENT METHODOLOGY - DIRECT

CIE Exams	PO 1,PO 2	SEE Exams	PO 1,PO 2	Assignments	-	Seminars	PO 1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XVI. ASSESSMENT METHODOLOGY - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

XVII. SYLLABUS

MODULE-I	**DIODE AND APPLICATIONS**
Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Diode Applications: Switch-Switching times. Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifiers with Capacitive Filter	
MODULE-II	**BIPOLAR JUNCTION TRANSISTOR (BJT)**
Principle of Operation and characteristics - Common Emitter, Common Base, Common Collector Configurations, Operating point, DC & AC load lines, Transistor Hybrid parameter model, Determination of hparameters from transistor characteristics, Conversion of h-parameters.	
MODULE-III	**NUMBER SYSTEMS**
Number systems, Complements of Numbers, Codes- Weighted and Non-weighted codes and its Properties, Parity check code and Hamming code. Boolean Algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates, Multilevel NAND/NOR realizations.	

MODULE-IV	MINIMIZATION OF BOOLEAN FUNCTIONS
Karnaugh Map Method - Up to five Variables, Don't Care Map Entries, Tabular Method, Combinational Logic Circuits: Adders, Subtractors, comparators, Multiplexers, Demultiplexers, Encoders, Decoders and Code converters, Hazards and Hazard Free Relations	
MODULE-V	**SEQUENTIAL CIRCUITS FUNDAMENTALS**
Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another. Registers and Counters: Shift Registers – Left, Right and Bidirectional Shift Registers, Applications of Shift Registers - Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.	
Text Books:	
1. Electronic Devices and Circuits "Jacob Millman", McGraw Hill Education, 2017 2. Electronic Devices and Circuits theory "Robert L. Boylestead, Louis Nashelsky",11th Edition, Pearson, 2009. 3. Switching and Finite Automata Theory, "Zvi Kohavi & Niraj K. Jha, 3rd Edition", Cambridge, 2010. 4. Modern Digital Electronics, "R. P. Jain, 3rd Edition", Tata McGraw-Hill, 2007.	
Reference Books:	
1. Pulse, Digital and Switching Waveforms, "J. Millman, H. Taub and Mothiki S. Prakash Rao", 2 Ed., McGraw Hill, 2008. 2. Electronic Devices and Circuits, "S. Salivahanan, N.Suresh Kumar, A Vallvaraj, 2nd Edition", TMH. 3. Digital Design, "Morris Mano", PHI, 4th Edition,2006. 4. Introduction to Switching Theory and Logic Design, "Fredriac J. Hill, Gerald R. Peterson",3rd Ed, John Wiley & Sons Inc.	

XVIII. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Outcomes	Reference
1-5	Introduction to semiconductors, Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis.	CO 1	T2:1.1-1.8, 2.2
6-7	Diffusion and Transition Capacitances, Diode Applications, Switch-Switching times	CO 1	T2:1.10
8	Design Rectifier - Half Wave Rectifier & problems	CO 2	T2:2.7
9-10	Design Full Wave Rectifier & problems	CO 3	T2:2.8
11-12	Design Bridge Rectifier, Rectifiers with Capacitive Filter	CO 4	T2:2.8
15-16	Understand the concepts of Transistor operation	CO 6	T2:3.1-3.2
17-18	Characteristics of CB,CE,CC	CO 8	T2:3.3-3.7
19-21	Operating point, DC & AC load line Analysis & problems	CO 7	T2:4.2,7.1-7.4
22-25	Transistor Hybrid parameter model, Determination of h-parameters from transistor characteristics, Conversion of h-parameters.	CO 9	T2: 7.6 7.7, 8.9-8.10
26-27	Understand the need for digital systems, review of number systems, number base conversion	CO 10	T3:1.1 R3:1.1-1.4

28-30	Complements of numbers, Weighted codes & Non-weighted codes.	CO 11	T3:1.1-1.2 R3:1.5-1.7
31-32	error detecting and correcting codes, Digital Logic Gates	CO 12	T3:1.3 R3:1.7,7.4
33-35	Basic Theorems and Properties, Algebraic Simplification,	CO 13	T3:3.1-3.4 R3:2.1-2.4
36-37	Canonical and Standard Form	CO 14	T3:3.3-3.5 R3:2.6
38-39	Universal Gates, Multilevel NAND/NOR realizations.	CO 16	T3:5.1-5.3 R3:2.8,3.7-3.8
40-43	Identify basic building blocks of digital systems and Minimization using three variable; four variable; five variable K-Maps; Don‘t Care Conditions.	CO 15	T4:5.1.-5.10 R3:3.6
44-45	Understand Tabular Method	CO 15	T3:4.4-4.6 T4: 5.11 R3:3.10
46-47	Design Combinational Logic Circuits adders, subtractors.	CO 17	T4:6.1,6.4 R3:4.1-4.5
48-49	Design different combinational logic circuits comparators Multiplexers, Demultiplexer.	CO 14	T4:6.2-6.3,6.7 R3:4.8,4.11
50-51	Demonstrate the Encoders, Decoders.	CO 18	T4:6.3,6.10 R3:4.9-4.10
52-54	Code converters, Hazards & Hazard Free Relations	CO 18	T4:6.9,5.12
55	Combinational and sequential circuits, the binary cell, the Fundamentals of sequential machine operation, SR-Latch	CO 19	T4:7.1 R3:5.2-5.3
56-58	Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops. Timing & Triggering	CO 19	T4:7.2-7.6 R3:5.4-5.5
59-60	Excitation tables of Flip-flops, Conversion from one type of Flip-Flop to another	CO 19	T4:7.7-7.10 R3:5.5
61	Draw and explain about Shift Registers	CO 20	T4:8.1-8.3 R3:6.1-6.2
62	Implement Synchronous, Asynchronous Counters using flip flops	CO 21	T4:8.4-8.7 R3:6.3-6.5

Prepared by:
Ms M.Saritha, Assistant Professor **HOD, CSE**

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

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**DATA STRUCTURES LABORATORY**				
Course Code	ACSB05				
Program	B.Tech				
Semester	III	CSE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr. P Ravinder, Assistant Professor, CSE				

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 generallybased on the ability of a computer to fetch and store data at any place in its memory, specified by anaddress. This course is essential for image viewer software, in this images are linked with each otherso, 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 trackof turns in a multi player game, a circular linked list is used.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	ACSB01	I	Programming for problem solving

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
DATA STRUCTURES LABORATORY	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

C	Demo Video	C	Lab Worksheets	C	Viva Questions	C	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, continuouslab 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 con- ducted 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 em- phasis 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	The hands on experience in design, develop, implementation and evaluation byusing Asymptotic notation.
II	The demonstration knowledge of basic abstract data types (ADT) and associated algorithms for organizing programs into modules using criteria that are based on the data structures of the program
III	The practical implementation and usage of non linear data structures for solving problems of different domains.
IV	The knowledge of more sophisticated data structures to solve problems involving balanced binary search trees, AVL Trees, B-trees and B+ trees, hashing.
V	The graph traversals algorithms to solve real-world challenges such as findingshortest paths on huge maps and assembling genomes from millions of pieces.

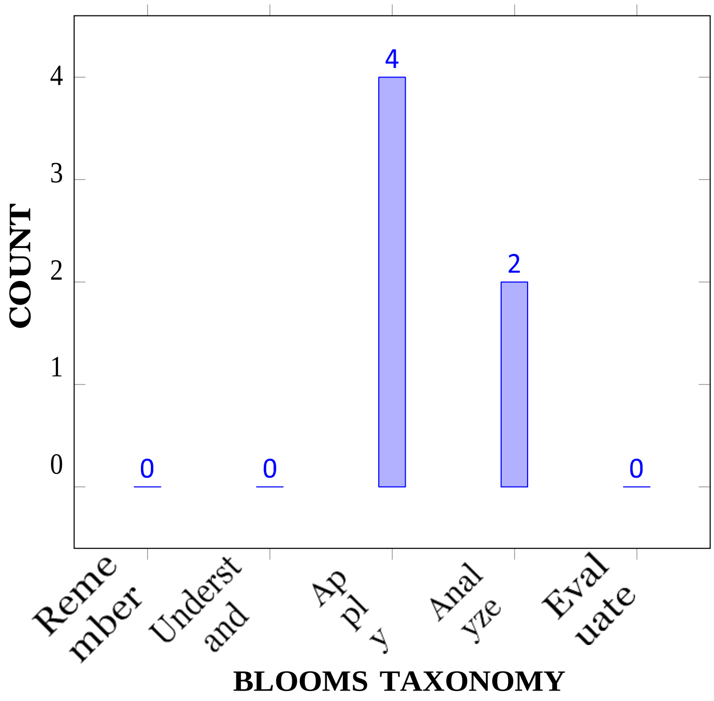
VII COURSE OUTCOMES:

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

CO 1	Carryout the analysis of a range of algorithms in terms of algorithm analysis and express algorithm complexity using the Onotation.	Apply
CO 2	Implement techniques like searching, to find the most efficient solutions for underlying problems in different domains.	Apply
CO 3	Gain the knowledge of basic abstract data types (ADT) and associated algorithms for organizing programs into modules usingcriteria that are based on the data structures of the program.	Understand
CO 4	Interpret the recursive and non-recursive techniques to solve problems in DFS of Graph, Towers of Hanoi, Different Types ofTree Traversals, and others (Graphs and Tree traversals)	Apply
CO 5	Implement the sorting algorithm to order the elements of the array according to zip code before printing a set of mailing labels.	Analyze
CO 6	Apply appropriate data structures for solving computing problemswith respect to performance.	Analyze
CO 7	Interpret Dynamic data structures like linked list considered efficient with respect to memory complexity of the code.	Analyze
CO 6	Apply appropriate data structures for solving computing problemswith respect to performance.	Analyze
CO 8	Extend their knowledge of data structures to more sophisticated data structures to solve problems involving balanced binary searchtrees, AVL Trees, B-trees and B+ trees, hashing, and basic graphs.	Analyze
CO 9	Interpret the use of basic data structures such as arrays, stacks,queues and linked lists in program design.	Analyze
CO 10	Interpret the benefits of dynamic and static data structures withrespect to memory complexity of the code.	Analyze
CO 11	Apply appropriate data structures for solving computing problemswith respect to performance.	Analyze

CO 12	Implement the hashing technique to triad's primary principles of assuring the integrity of data	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 PROGRAMS / / 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.	3	LAB PROGRAMS / / 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 considerationfor the public health and safety, and the cultural, societal, and Environmental considerations	1	LAB PROGRAMS / / CIA/SEE

PO 5	**Conduct investigations of complex problems:** 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 PROGRAMS / / CIA/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 PROGRAMS / / CIA/SEE
PO 12	**Life-long learning:** 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 PROGRAMS / / CIA/SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Profi-ciency Assessed by
PSO 1	Understand, design and analyze computer programsin the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, MachineLearning and Networking.	2	LAB PRO-GRAMS / CIA/SEE

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	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insightinto reasonable directions of search for efficient algorithms by applying the principles of mathematics and science.	3
	PO 5	Understand the (knowledge) appropriate techniques, resources, and modern Engineering and IT tools includingprediction and modeling to complex Engineering activitieswith an understanding of the limitations.	3
CO 2	PO 1	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insightinto reasonable directions of search for efficient algorithms by applying the principles of mathematics and science.	3
	PO 5	Understand the (knowledge) appropriate techniques, resources, and modern Engineering and IT tools includingprediction and modeling to complex Engineering activitieswith an understanding of the limitations.	3
CO 3	PO 1	(**Design**) a Test Plan which helps us to validate the quality of the application for finding the solution of **complex engineering**	1
	PO 5	Understand the (knowledge) appropriate techniques, resources, and modern Engineering and IT tools includingprediction and modeling to complex Engineering activitieswith an understanding of the limitations.	3
	PO 10	Recognize the importance of efficient sorting techniques for optimizing the efficiency of other algorithms that require input data to be in sorted by communicating effectively with engineering community.	3
CO 5	PO 1	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insightinto reasonable directions of search for efficient algorithms by applying the principles of mathematics and science.	3
	PO 10	Recognize the importance of efficient sorting techniques for optimizing the efficiency of other algorithms that require input data to be in sorted by communicating effectively with engineering community.	3

CO 6	PO 1	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insightinto reasonable directions of search for efficient algorithms by applying the principles of mathematics and science.	3
	PO 10	Recognize the importance of efficient sorting techniques for optimizing the efficiency of other algorithms that require input data to be in sorted by communicating effectively with engineering community.	3
CO 7	PO 1	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insightinto reasonable directions of search for efficient algorithms by applying the principles of mathematics and science.	3
	PO 2	Build strong foundation of data Structures which tells the program how to store data in memory and forming some relations among the data and use them in design and development of new products.	3
	PO 3	Recognize the need of linear data structures such as linkedlist, array, stack and queue by designing solutions for complex Engineering problems in real-time.	2
	PSO 1	Acquire sufficient knowledge to develop real-time applications by making use of linear data structures in career building and higher studies.	3
CO 8	PO 1	(**Design**) a Test Plan which helps us to validate the quality of the application for finding the solution of **complex engineering**	3
	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.	7
	PO 3	Understand the applications of basic data structures suchas stacks, queues, linked lists in designing and developing solutions of complex engineering applications.	6
	PSO 1	Make use of modern computer tools for applying the basicdata structure concepts in building real-time applications for a successful career.	2
CO 9	PO 1	(**Design**) a Test Plan which helps us to validate the quality of the application for finding the solution of **complex engineering**	3
	PO 2	Make use of non-linear data structures such as balanced trees in by identifying, formulating and analyzing complex engineering problems such as databases, syntax tree in compilers and domain name servers etc. with the help of basic mathematics and engineering sciences.	6

	PO 3	Extend the concept of tree data structures to design and develop solutions for complex engineering problems.	6
	PSO 1	Make use of modern computer tools in implementing non-linear data structures for various applications to become a successful professional in the domain.	2
CO 10	PO 1	Demonstrate different tree structures in Python to implement real-time problems by applying basic knowledgeof science and engineering fundamentals.	3
	PO 2	Illustrate the importance of tree data structures used for various applications by identifying, formulating and analyzing complex engineering problems such as operatingsystems and compiler design.	6
	PO 3	Make use of tree data structures to design and develop solutions for complex engineering problems and which is the key organizing factor in software design. Data structures can be used to organize the storage and retrievalof information stored in both main memory and secondary memory.	6
	PSO 1	Acquire sufficient knowledge in field of data structures andits applications by using modern computer tools so that new product development can take place, which leads to become successful entrepreneur and or to obtain higher education.	2
CO 11	PO 1	Understand (knowledge) the benefits of dynamic and staticdata structures implementations and choose appropriate data structure for specified problem domain using knowledge of mathematics, science and engineering fundamentals.	3
	PO 2	Recognize the need of dynamic and static data structuresin identifying, formulating and analyzing complex engineering problems.	4
	PO 3	Describe (knowledge) the usage of static and dynamic data structures in designing solutions for complex Engineering problems.	6
	PSO 1	Build sufficient knowledge of dynamic data structures by using modern tools so that new product can be developed,which leads to become successful entrepreneur in the present market.	2
CO 12	PO 1	Build strong foundation of quickly determining the efficiency of an algorithm or data structure for solving computing problems with respect to performance by usingknowledge of mathematics, science and engineering fundamentals.	3
	PO 2	Recognize the importance of suitable data structures in checking the efficiency of algorithms used for complex engineering problems.	4
	PO 3	Make use of broad usage of data structures in designingand developing of complex engineering applications.	6

	PSO 1	Extend the concept of data structures in solving complex engineering problems using modern engineering tools to become a successful professional in the domain.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENTOF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Outcomes	Program Outcomes					Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO12	PSO1	PSO2	PSO3
CO1	3							
CO2	3							
CO3	1							
CO4	1		3			3		
CO5						3		
CO6	3		2					

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO1, PO2,PO4	SEE Exams	PO1, PO2,PO4	Seminars	-
Laboratory Practices	PO1, PO2,PO4	Student Viva	PO1, PO2,PO4	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

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

XIV SYLLABUS:

WEEK I	**SEARCHING TECHNIQUES**
	Write python program for implementing the following searching techniques. a. Linear search. b. Binary search. c. Fibonacci search
WEEK II	**SORTING TECHNIQUES**
	a. Write Python programs for implementing the following sorting techniquesto arrange a list of integers in ascending order. a. Bubble sort. b. Insertion sort. c. Selection sort.
WEEK III	**SORTING TECHNIQUES**
	a. Write Python programs for implementing the following sorting techniquesto arrange a list of integers in ascending order. a. Quick sort. b. Merge sort.
WEEK IV	**IMPLEMENTATION OF STACK AND QUEUE**
	Write Python programs to a. Design and implement Stack and its operationsusing Lists. b. Design and implement Queue and its operations using Lists.
WEEK V	**APPLICATIONS OF STACKL**
	Write Python programs for the following: a. Uses Stack operations to convertinfix expression into postfix expression. b. Uses Stack operations for evaluating the postfix expression. .
WEEK VI	**IMPLEMENTATION OF SINGLE LINKED LIST**
	Write Python 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 usinglinked list.
WEEK VII	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
	Write Python 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 Python 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 Python programs to implement stack using linked list.
WEEK X	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
	Write Python programs to implement queue using linked list.
WEEK XI	**GRAPH TRAVERSAL TECHNIQUES**
	Write Python 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 Python 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. Count the number of nodesin 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 &Sons, INC., 2011.
5. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt PublishingLtd., 2017.

WEB REFERENCE:

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 3	T1, T2
4	Implementation of Stack and Queue	CO 3, CO 4	T1, T2
5	Applications of Stack	CO 5, CO4	T1, W1
6	Implementation of Single Linked List	CO1, CO3	T1, W2
7	Implementation of Circular Single Linked List	CO 5	T1, W3
8	Implementation of Double Linked List	CO 5	T2, W3
9	Implementation of Stack Using Linked List	CO 4	T2, W2

10	Implementation of Queue Using Linked List	CO5	T2, W5
11	Graph Traversal Techniques	CO4, CO5	T2, W2
12	Implementation of Binary Search Tree	CO1	T1, W5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	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	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 studentmarks 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 differentdata (your two marks). To accomplish this, we might use a data structure called a "BSTwith duplicates", or BSTD.
3	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 elementactually 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	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	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, theerror message Truck x not near garage door.
6	How many non-null links are there in a binary tree with N nodes?
7	How can we remove loops in a linked list? What are the functions of fast and slow pointers?
8	Which data structures are applied when dealing with a recursive function?

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

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**OPERATING SYSTEMS**				
Course Code	AITB04				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. Laxman Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

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

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:

✓	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). 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
10%	Remember
45 %	Understand
18 %	Apply
27 %	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:

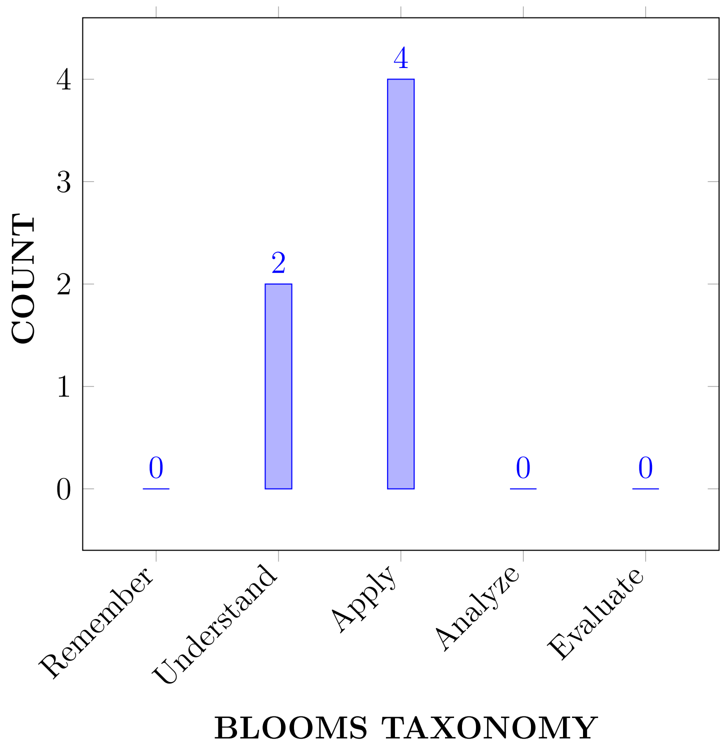
I	The principles of operating systems, services and functionalities with its evolution.
II	The structures, functions and components of modern operating systems
III	The conventional hardware at different OS abstraction levels.
IV	The essential skills to examine issues and methods employed in design of 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	SEE/AAT
PSO 2	Focus on improving software reliability, network security / information retrieval systems.	3	SEE/AAT
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	3	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	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	**INFORMATION TECHNOLOGY**				
Course Title	**THEORY OF COMPUTATION**				
Course Code	AITB03				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R-18				
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	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	x	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 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
10%	Remember
60%	Understand
20%	Apply
10 %	Analyze

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:

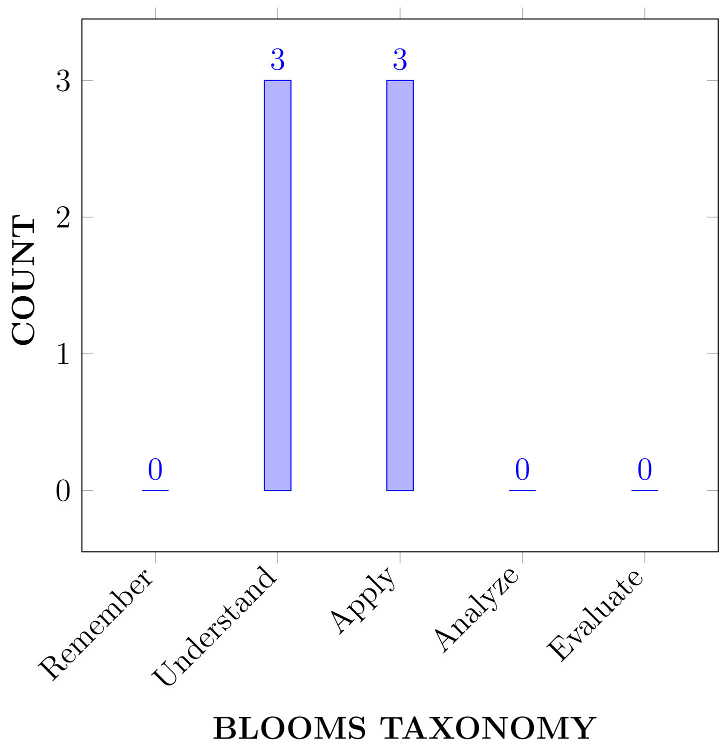
I	The fundamental knowledge of automata theory which is used to solve computational problems
II	The reorganization of context free language for processing infinite information using push down automata.
III	The computer based algorithms with the help of an abstract machine to solve recursively Enumerable 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 commMODULEy 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
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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
	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:

MODULE 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.
MODULE 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.

MODULE 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)
MODULE 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.
MODULE 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:

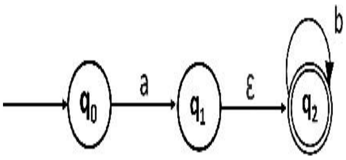
https://nptel.ac.in/courses/106103070

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≥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 = $\{w^n x^n y^n z^n$ | n≥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={$a^i b^j$ | i≤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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**					
Course Title	**DESIGN AND ANALYSIS OF ALGORITHMS**					
Course Code	AITB05					
Program	B.Tech					
Semester	IV					
Course Type	Core					
Regulation	R-18					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	1	4	3	1.5	
Course Coordinator	Dr. K.Suvarchala, Associate Professor , CSE					

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	x	Chalk & Talk	x	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 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 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 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.

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:

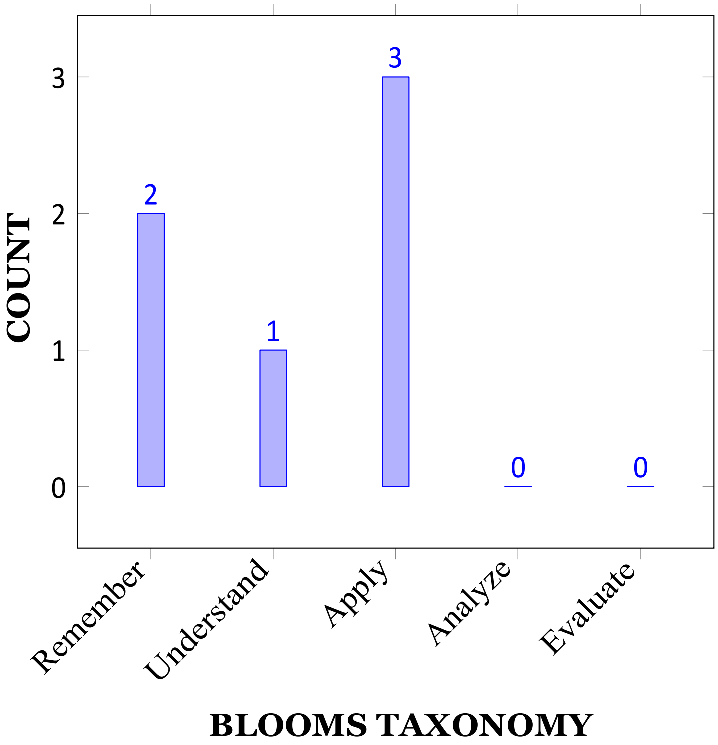
I	Calculate performance of algorithms with respect to time and space complexity.
II	Illustrate the graph traversals and tree traversals to solve the problems
III	Demonstrate the concepts greedy method and dynamic programming for several applications like knapsack problem, job sequencing with deadlines, 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.	Under-stand

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	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

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.	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	Profi-ciency 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	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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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
	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 ≤ C≤ 5% – No correlation

1 -5 <C≤ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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	-	-
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	-	-
AVER-AGE	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.

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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,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (AI & ML)**				
Course Title	**COMPUTER ORGANIZATION AND ARCHITECTURE**				
Course Code	ACS004				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr. P Cahandana, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSOO4	II	PROGRAMING FOR PROBLEM SOLVING

II COURSE OVERVIEW:

This course introduces the principles of basic computer organization, CPU organization, and the basic architecture concepts. The course emphasizes performance and cost analysis, instruction set design, register transfer languages, arithmetic, logic and shift micro-operations, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O organization of computer, parallel processing and inter process communication and synchronization.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Organization and Architecture	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). 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
10%	Remember
45 %	Understand
18 %	Apply
27 %	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:

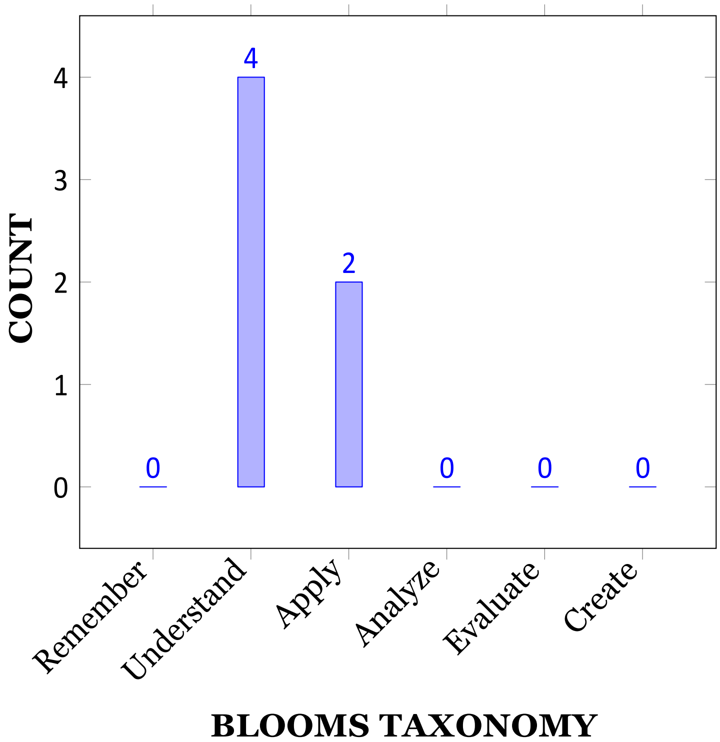
I	Understand the organization and architecture of computer systems and electronic computers.
II	Study the assembly language program execution, instruction format and instruction cycle.
III	Design a simple computer using hardwired and micro-programmed control methods.
IV	Study the basic components of computer systems besides the computer arithmetic .
V	Understand input-output organization, memory organization and management, and pipelining.

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 interprocess 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.
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	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.	1	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 modeling to complex engineeringactivities 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.	3	SEE / CIE / 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	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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).	3	CIE/Quiz/ AAT
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.	2	CIE/Quiz/ AAT
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.	3	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 various functional units of Computer with computer science principles.	1
	PO 2	Explore the types of programming languages for problem identification and to formulate computer science and Engineering Problems.	2
	PO 3	Evaluate the instruction set architecture based on the cost drivers, integration, manage design process and understand customer needs..	4
	PSO 1	Understand levels of programming languages related to Software.	1
	PSO 2	Develop micro programs using instruction set architecture with a major focus on improving software reliability and information retrieval systems.	1

CO 2	PO1	Explore taxonomy of microoperations and RTL for micro program development by using the mathematical and computer science principles.	2
	PSO 1	Understand the notations of RTL related to Software.	4
	PSO 2	Develop assembly language programs with a major focus on improving software reliability and information retrieval systems.	3
CO 3	PO 1	Select appropriate addressing mode for finding effective address of operand using mathematical and computer science principles	2
	PO 2	Choose appropriate addressing mode for information and data collected from various sources memory locations or registers and perform microoperations and validation the results for interpretation	1
	PO 3	Classify the addressing modes in terms of defining various problems and understanding appropriate codes of practice.	3
	PO 4	Utilize Instruction set architecture of processors for designing assembly language programs through laboratory skills and technical literature.	2
	PO 10	Make use of variety of addressing modes to fetch operands for the development of assembly language program with clarity and semantics or grammar of the assembly language.	2
	PSO 1	Develop applications for specific problems by including huge volume of data and related to Software.	1
CO 4	PO 1	Explain the concept of data representation by applying mathematical and computer science principles.	3
	PO 2	Understand the data representation and computer arithmetic for understanding of appropriate codes to formulate, solve problem, document and interpretation of results.	6
	PO 3	Identify the appropriate representation of data suitable for customer needs, investigation of a problem, identify and manage architecture design process.	4
	PO 4	Communicate effectively in orally and written by comprehend and write effective reports and design documentation with the engineering community by having major focus on clarity on content, Grammar/Punctuation, appropriate References, good Speaking style and depth in subject matter.	2
	PO 10	Recognize the need for advanced concepts in binary arithmetic and algorithms 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	3
	PSO 1	Explain the technologies used to represent data and computer arithmetic related to Algorithms and architecture.	1

CO 5	PO 1	Design control unit by considering various issues and types risk assessment and analysis activity to identify and analyze root causes using computer science principles.	1
	PO 2	Design and develop hardwired and micro programmed control units with knowledge and uncertainty of commercial engineering process and management.	2
	PO 3	Design a control memory of system by investigating and defining various problems, understanding user needs.	3
	PO 4	Utilize micro instructions for designing assembly language programs through laboratory skills, technical literature, technical uncertainty and quality issues.	3
	PO 5	Experiment the design of control unit with Computer software or simulation packages.	2
	PO 10	Recognize the need for advanced concepts of control memory design and micro instructions based on micro architecture 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.	4
	PSO 1	Explain the design issues of control memory and micro instruction format used to develop micro program related to Algorithms and architecture.	1
	PSO 3	Develop micro programs and support design of control memory by using modern computer software and simulation tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	1
CO 6	PO 1	Understand the concept of pipelining to improve performance of the system by applying mathematical principles and computer science methodologies.	2
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation advanced micro architectures with the engineering community by having major focus on clarity on content, Grammar/Punctuation, good Speaking style	2
	PO 12	Recognize the need for advanced concepts 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.	4
	PSO 1	Develop MIMD architecture for optimizing the performance related to Algorithms, Software and Networking.	1
	PSO 3	Recognize importance of pipelining, inter process communication of advanced micro processors for creating innovative career paths, to be an entrepreneur and desire for higher studies.	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	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		
	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	33.4	20	40	-	-	-	-	-	-	-	-	-	16.6	50	-
CO 2	66.6	-	-	-	-	-	-	-	-	-	-	-	16.6	100	-
CO 3	66.6	20	10	27.3	-	-	-	-	-	20	-	16.6	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	66.7	-	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
1 -5 <C≤ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
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	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	8	-	12
AVERAGE	2.3	1.5	2.6	1	-	-	-	-	-	1	-	1	1.33	-	3

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
Seminars	✓	Student Viva	-	Certification	-
Laboratory Practices	-	Student viva	-	Mini projects	-
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 COMPUTER ORGANIZATION**
	Basic computer organization, CPU organization, memory subsystem organization and interfacing, input or output subsystem organization and interfacing, a simple computer levels of programming languages, assembly language instructions, instruction set architecture design, a simple instruction set. .
MODULE II	**ORGANIZATION OF A COMPUTER**
	Register transfer: Register transfer language, register transfer, bus and memory transfers, arithmetic micro operations, logic micro-operations, shift micro-operations; Control unit: Control memory, address sequencing, micro program example, and design of control unit.
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.

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2. 2.John D. Carpinelli, “Computer Systems Organization and Architecture”, Pearson, 1 st Edition, 2001.
3. 3. Patterson, Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, Morgan Kaufmann, 5 th Edition, 2013.

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

WEB REFERENCES:

1. http://www.web.stanford.edu/class/cs103x

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details & course_id=528

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)			
1-2	Outline the basic computer organization	CO1	T1: 4.1-4.2,T1: 4.1
2-3	Understand the CPU organization, memory subsystem organization and interfacing	CO 1	T1: 4.3-4.4
4-5	Analyze the input or output subsystem organization and interfacing	CO 1,CO6	T1: 3.1-3.2
5-6	Understand a simple computer levels of programming languages	CO 1	T2: 2.5-2.6,
7-8	Explain assembly language instructions	CO 2, CO 3	T1:1.5, 1.4.2,1.4.3
9	Determine the simple instruction set architecture	CO 2	T2: 7.4
10-11	Understand the register transfer language, register transfer.	CO 2	T2: 5.6-5.7
12	Analyze bus and memory transfers	CO 2	T1: 6.7-6.8
13-15	Explain the arithmetic micro-operations, logic micro-operations, shift micro-operations	CO 2	T2: 8.5-8.7
16	Understand the control memory	CO 5	T2: 8.6
17-18	Explain the instruction cycle	CO 2	T2: 10.1-10.5
19-20	Outline the data representation, memory reference instructions	CO 3	T2: 12.1
20-21	Analyze input-output, and interrupt, addressing modes	CO 3	T2: 11.2

22	Discuss the data transfer and manipulation, program control	CO 3	T2: 11.3-11.4
23-25	Determine the Addition and subtraction, floating point arithmetic operations, decimal arithmetic unit	CO 4	T2: 11.5
26	Need of Input or output organization	CO5	R1: .3.1
27-29	Discuss the Input or output Interface	CO5	R1: 3.3-9.5
30-31	Understand the asynchronous data transfer, modes of transfer	CO5	T2: 9.4
32-33	Analyze the priority interrupt, direct memory access	CO5	T2:13.1
34	Understand the memory organization	CO5	T2:13.2
35-36	Discuss Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory	CO 5	T2: 13.3
37-38	Understand the Pipeline: Parallel processing, Instruction pipeline	CO6	T2: 13.
39	Characteristics of multiprocessors	CO6	T2: 13.1
40	Inter connection structures	CO6	T2: 13.2
41	Inter processor arbitration	CO 3,CO6	T2: 13.3
42	Inter processor communication and synchronization	CO 6	T2: 13.4
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on BCD conversions	CO1	T2:2.1
2	Problems on BCD conversions	CO1	T2:2.3
3	Problems on Addition and substraction	CO3	T2:2.3.1
4	Problems on Multiplication	CO3	T2:7.2,7.3
5	Problems on Booths multiplication	CO3	T2:10.3.1
6	Problems on Booths Algorithm	CO3	T2:13.3.2, 13.4.1
7	Problems on Division	CO3	T2:17.1.1, 17.1.3
8	Problems on Data presentation	CO3	T2:18.3.4, 18.3.4.1
9	Problems on Data presentation	CO3	T2:22.12, 19.1.2
10	Problems on Data presentation	CO3	T2:18.4, 18.4.3
11	Problems on floating point arithmetic operations	CO3	T2:19.2, 18.4.4
12	Problems on Decimal arithmatic unit	CO3	T2:23.1.1, 23.1.3
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Define register transfer language,fixed point number,instruction format,data Processing instruction,data Processing instruction	CO 1	T2:18.3.4, 18.3.4.1
2	Define miscellaneous Instructions, addressing mode,micro operation.	CO 2	T2:22.12, 19.1.2
3	Define arithmetic micro operations,arithmetic micro operations,logical shift operation	CO 3	T2:18.4, 18.4.3

4	Define data bus,metropolitan area network,network topology,star topology,bus tropology	CO4, CO 5	T2:19.2, 18.4.4
5	define vecto,pipeline cycle time, arithmetic pipeline,optimal number of pipeline stages	CO 6	T2:23.1.1, 23.1.3
DISCUSSION ON QUESTION BANK			
1	Illustrate the input and output operations with a neat diagram.	CO 1	T2:18.3.4, 18.3.4.1
2	List the various instruction formats and illustrate with an example.	CO 2	T2:22.12, 19.1.2
3	Identify micro programexample and build a computer hardware configuration	CO3,CO4	T2:18.4, 18.4.3
4	Illustrate the belowaddressing modes withexamples a. Implied Modeb. Immediate Mode c. Autoincrement and Auto,decrement Mode d. Direct and Indirect Address Mode.	CO5	T2:19.2, 18.4.4
5	Define parallel processing and explain the flynn's classification of computer with suitable diagram	CO 6	T2:23.1.1, 23.1.3

Course Coordinator **HOD,CSE (AI & ML)**
Dr. P Cahandana, Associate Professor

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

COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

Course Title	**DATABASE MANAGEMENT SYSTEMS LABORATORY**				
Course Code	ACSB09				
Program	B.Tech				
Semester	IV	CSE/IT			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms B Geetavani, 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	ACSB03	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:

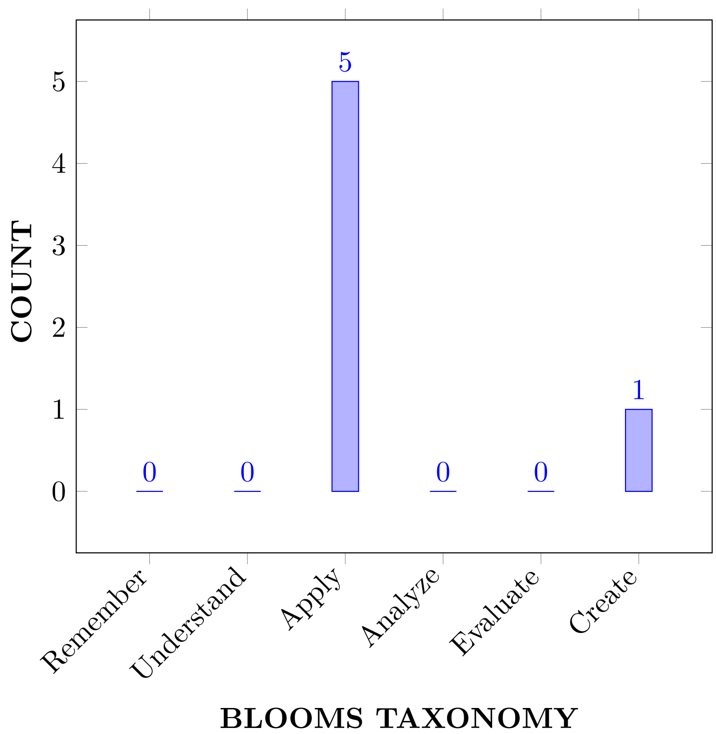
I	The SQL commands for data definition, manipulation, control and perform transactions in database systems.
II	The procedural language for implementation of functions, procedures, cursors and triggers using PL/SQL programs.
III	The logical design of a real time database system with the help of Entity 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.	Create

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	**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

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
	PO 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
	PSO 2	Demonstrate the use of SQL for database creation and maintenance **by using a set of instructions**	1
CO 2	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.**	2
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 needs**Manage 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

Table 10:

Course Outcomes	Program Outcomes					Program Specific Outcomes
	PO2	PO3	PO5	PO10	PO12	PSO2
CO1	2	3	3			3
CO2	2	3	3	2		3
CO3	2			3		
CO4	2	3	3			2
CO5	2					
CO6	2	3	3		2	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 2, PO 3, PO 5	SEE Exams	PO 2,PO 3, PO 5, PO 10,PO 12	Seminars	-
Laboratory Practices	PO 2,PO 3, PO 5	Student Viva	PO 2, PO 3,PO 10	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

- Insert values into the reserves table.
- Add column time to the reserves table.
- Alter the column day data type to date.
- Drop the column time in the table.
- Delete the row of the table with some condition.

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% rise in salary. 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. (When „hello passed to the program it should display „Hll removing e and o from the world Hello). 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);** a. Write a Insert Trigger to check the Passport id is exactly six digits or not. b. Write a trigger on passenger to display messages „1 Record is inserted , „1 record is deleted , „1 record is updated when insertion, deletion and updation are done on passenger respectively.

	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.**

	5. To write a Cursor to find employee with given job and deptno. **6. Write a PL/SQL block using implicit cursor that will display message, the salaries of all the employees in the „employee table are updated. If none of the employee s salary are updated we get a message 'None of the salaries were updated'. Else we get a message like for example, 'Salaries for 1000 employees are updated' if there are 1000 rows in "employee table.**
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 diagrams.
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 garages to 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,CO 4	T1:3, T2:8
4	Working with DCL and TCL commands	CO 1,CO 2	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,CSE**
Ms B Geetavani, Assistant Professor

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
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
	2	1	3	-	-
Course Coordinator	Ms. K.Sreeveda , 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 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
7.69%	Remember
53.84 %	Understand
38.46 %	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:

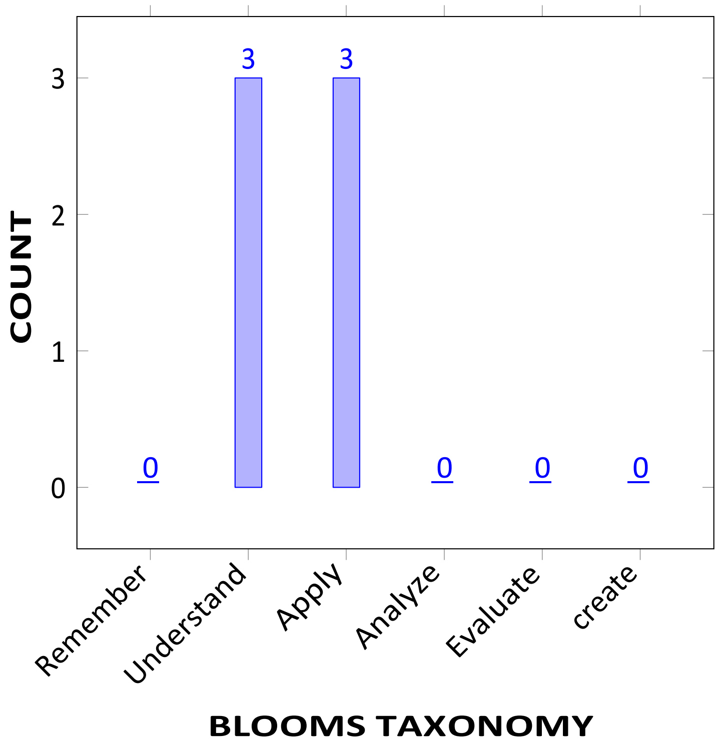
I	The process of translating a high-level language to machine code required for compiler construction.
II	The Software tools and techniques used in compiler construction such as lexical analyser and parser generators.
III	The data structures used in compiler construction such as abstract syntax trees, 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 improving software reliability, network security and information retrieval systems.	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	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	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
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

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	66.7	30.0	0.0	0.0	100.	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 aBDh , B cC , C bC / ϵ , D EF , E g / ϵ , F f / ϵ	CO 3	T1: 4.9
7	Construct SLR parsing table for the below grammar? E E+T |T T T*F | F F (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

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COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**MACHINE LEARNING**				
Course Code	ACSB21				
Program	B.Tech				
Semester	V	CSE			
Course Type	Elective				
Regulation	IARE-R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. Chukka Santhaiah, Associate Professor				

I COURSE OVERVIEW:

The main emphasis of this course is toprovide 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.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB12	II	Probability and statistics

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	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

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.

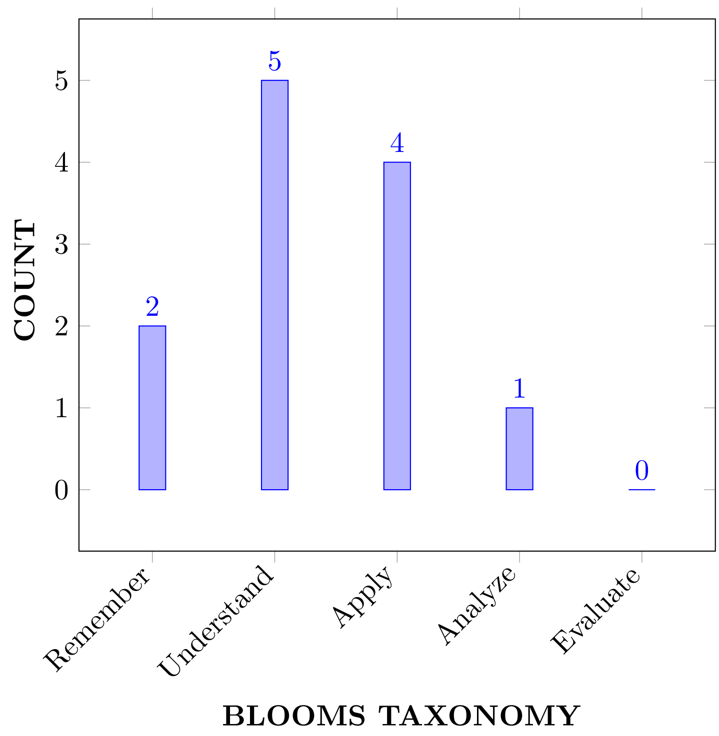
VII COURSE OUTCOMES:

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

CO 1	**Recall** the thermodynamic properties and discern the path and point functions through exact differentials.	Remember
CO 2	**Summarize** working principles of energy conversions in physical systems systems by fundamental laws of thermodynamics.	Understand
CO 3	**Explain** the various energy transfer mechanisms which leads to the ascertaining of properties involving thermodynamic cycles.	Understand
CO 4	**Identify** the laws of conservation of energy to yield the relationship between heat, work and change in internal energy.	Apply

CO 5	**Contrast** between various statements of purpose in heat to work conversion and notice that thermodynamic direction laws defining them are mutually complementary.	Understand
CO 6	**Relate** various relations involving pressure, temperature and volume to discern the change in entropy generation in universe.	Understand
CO 7	**Interpret** the properties of pure substances and steam to emit relevant inlet and exit conditions of thermodynamic work bearing systems..	Understand
CO 8	**Outline** fundamental relationship between intensive properties in form of partial derivatives implemented for perfect gases.	Understand
CO 9	**Show** the significance of partial pressure and temperature to table the performance parameters of gaseous mixtures.	Understand
CO 10	**List** the properties of air conditioning systems by practicing psychrometry chart and gas property tables.	Analyze
CO 11	**Illustrate** the working of various air standard cycles and work out to get the performance characteristics.	Understand
CO 12	**Infer** the performance of power and refrigerant cycles, and their significanceand in real world systems.	Understand

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, 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 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.	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	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

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	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

X 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	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 7	✓	✓	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 8	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-
CO 9	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 10	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-
CO 11	-	✓	-	-	-	-	-	-	-	-	-	-	✓	-	✓
CO 12	✓	-	-	-	✓	-	-	-	-	✓	-	✓	✓	-	✓

XI 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	PO2	Characteristics of machine learning that make it useful to **identify** real-world data and analyze **complex engineering problems** using principles of **mathematics and engineering sciences.**	4

CO 2	PO3	Design a learning system involving various steps to **meet the specified needs** of information to provide **valid conclusions for complex engineering problems.**	3
	PSO1	Discuss the steps involved in **designing** a learning system for **next generation computer systems, intelligent systems and knowledge discovery tools.**	4
CO 3	PO1	Apply the **knowledge of mathematics** to analyze the underlying **mathematical relationships** within and across machine learning algorithms to find solutions for **complex engineering problems.**	3
	PO4	**Interpretation**of data, and **synthesis** of the information to be doneto provide **valid conclusions across machine learning algorithms.**	4
	PO10	**Communicate effectively** the underlying mathematical relationships within and across machine learning algorithms and **write effective reports.**	2
CO 4	PO 1	Apply the **knowledge of mathematics, science, engineering fundamentals** to relate the hypothesis space search for an application using decision tree learning.	3
	PO 4	Relate the hypothesis space search for an application by **analyzing and interpretation of data** to provide **valid conclusions.**	3
	PO 5	**Select** appropriate techniques for hypothesis space search for an application using decision tree learning.	1
	PO12	In the **broadest context of technological change** relate the hypothesis space search for different applications using various machine learning algorithms for **life-long learning.**	2
CO 5	PO2	**Identify** best **models using algorithms** for reasoning with uncertainty as well as the use of unreliable information using **natural sciences and engineering sciences.**	5
	PO4	Use **research-based knowledge and methods for reasoning models** with uncertainty as well as the use of unreliable information.	3
	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
	PO12	**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
	PSO1	Identify appropriate **learning functions** as activation function for **designing next generation computer systems, intelligent systems and knowledge discovery tools.**	4
CO 7	PO1	Make use of **knowledge of mathematics, engineering fundamentals** in optimizing the error in prediction model.	2
	PO2	**Identify and formulate the optimizing function** for reducing the error in **prediction model using first principles of mathematics.**	5
	PO5	Select appropriate techniques of optimizing function for reducing the error in **prediction modelling to complex engineering activities.**	1
	PSO1	In designing **next-generation computer systems, intelligent systems and knowledge discovery tools** select suitable **optimizing function**for reducing the error.	4
CO 8	PO1	Apply the **knowledge of mathematics and engineering fundamentals** in back propagation algorithm for designing artificial neural network for **complex engineering problems.**	3
	PO3	Design solutions for **complex engineering problems** using back propagation algorithm that **meet the specified needs** of given data.	2
	PO4	Use **research-based knowledge** to analyze the back propagation algorithm for **designing artificial neural network applications to provide valid conclusions.**	3
CO 9	PO1	Apply the **knowledge of mathematics and engineering fundamentals** to demonstrate Naïve Bayes algorithm based on Bayes theorem for **classification problem.**	3
	PSO1	Design **next-generation computer systems, intelligent systems and knowledge discovery tools** for classification problem using Naïve Bayes algorithm based on Bayes theorem.	4
CO 10	PO1	Apply the **knowledge of mathematics and engineering fundamentals** for solving both classification and regression problems.	3
	PO3	Design solutions for **complex classification and regression problems** using k-nearest neighbor algorithm.	2

	PSO1	Design **next-generation computer systems, intelligent systems and knowledge discovery tools** for solving both **classification and regression problems** using algorithms.	5
CO 11	PO2	**Formulate** reinforcement learning by observing the current environment state for **complex engineering problems** using principles of **mathematics and engineering sciences.**	4
	PSO1	Understand reinforcement learning used in **next-generation computer systems and knowledge discovery tools** based on observing the current environment state.	2
	PSO3	Analyze how reinforcement learning is done when practical experience in **shipping real world software** by observing the current environment state.	1
CO 12	PO1	Identify appropriate **machine learning techniques** and computing environment considering **engineering specialization** to the solution of **complex engineering problems.**	3
	PO5	Apply machine learning techniques modelling to **complex engineering activities** with an understanding of the limitations.	1
	PO10	**Communicate effectively** on machine learning techniques performing **complex engineering activities by effective presentations.**	3
	PO12	**Recognize** the need for **life-long** machine learning techniques suitable for the applications in the **broadest context of technological change.**	3
	PSO1	Identify appropriatemachine learning techniques and computing environment suitable for **designing next-generation computer systems, intelligent systems and knowledge discovery tools.**	3
	PSO3	Gain **practical experience** in identifying appropriate machine learning techniques and computing environment suitable for the applications in **shipping real world software.**	2

XII 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	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	3	-	-	-	-	-	-	-	-	-	4	-	-
CO 3	3	-	-	4	-	-	-	-	-	2	-	-	-	-	-
CO 4	3	-	-	3	1	-	-	-	-	-	-	2	-	-	-
CO 5	-	5	-	3	-	-	-	-	-	3	-	3	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 7	2	5	-	-	1	-	-	-	-	-	-	-	4	-	-
CO 8	3	-	2	3	-	-	-	-	-	-	-	-	-	-	-
CO 9	3	-	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 10	3	-	2	-	-	-	-	-	-	-	-	-	5	-	-
CO 11	-	4	-	-	-	-	-	-	-	-	-	-	2	-	1
CO 12	3	-	-	-	1	-	-	-	-	3	-	3	3	-	2

XIII 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	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	30	-	-	-	-	-	-	-	-	-	66.6	-	-
CO 3	100	-	-	36.3	-	-	-	-	-	40	-	-	-	-	-
CO 4	100	-	-	27.2	100	-	-	-	-	-	-	16.0	-	-	-
CO 5	-	50	-	27.2	-	-	-	-	-	60	-	25.0	-	-	-
CO 6	100	30	-	-	-	-	-	-	-	-	-	-	66.6	-	-
CO 7	66.7	50	-	-	100	-	-	-	-	-	-	-	66.6	-	-
CO 8	100	-	20	27.2	-	-	-	-	-	-	-	-	-	-	-
CO 9	100	-	-	-	-	-	-	-	-	-	-	-	66.6	-	-
CO 10	100	-	20	-	-	-	-	-	-	-	-	-	83.3	-	-
CO 11	-	40	-	-	-	-	-	-	-	-	-	-	33.3	-	50
CO 12	100	-	-	-	100	-	-	-	-	60	-	25.0	50	-	100

XIV 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	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	3	-	-	1	-	-	-	-	-	1	-	-	-	-	-
CO 4	3	-	-	1	3	-	-	-	-	-	-	1	-	-	-
CO 5	-	2	-	1	-	-	-	-	-	2	-	1	-	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 7	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
CO 8	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-
CO 9	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 10	3	-	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 11	-	1	-	-	-	-	-	-	-	-	-	-	1	-	2
CO 12	3	-	-	-	3	-	-	-	-	2	-	1	2	-	3
TOTAL	24	8	3	4	6	-	-	-	-	5	-	3	18	-	5
AVERAGE	3.0	1.6	1.0	1.0	3.0	-	-	-	-	1.6	-	1.0	2.5	-	2.5

XV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO1, PO2, PO4	SEE Exams	PO1, PO2, PO	Seminars	PO3, PO5
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	PO5	5 Minutes Video	PO1, PO2	Open Ended Experiments	-
Assignments	PO3, PO5				

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII 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..

XVIII 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	Introduction to machine Learning	CO1	T1:1
2	Understanding Well posed learning problems	CO1, CO2	T1:1.1
3-4	Discuss the steps involved in Designing a Learning system	CO2	T1:1.2

5	Interpreting Issues in MachineLearning.	CO1	T1:1.3
6	Explain Concept learning task and Concept learning as search	CO3	T1:2.1,2.2,2.3
7	Explain Find-S algorithm	CO3	T1:2.4
8-9	Construct Version space using Candidate Elimination algorithm	CO3	T1:2.5,2.6
10	How to use Inductive Bias for different algorithms	CO1, CO3	T1:2.7
11	Decision tree representationusing attributes and values	CO4	T1:3.1,3.2
12	Appropriate problems for decision tree learning	CO4	T1:3.3
13	Basic decision tree learning algorithm advantages and disadvantages	CO4	T1:3.4
14-15	Construct decision tree by finding best attribute using ID3 Algorithm	CO4	T1:3.4
16	Explain how Hypothesis space search is used for prediction in decision tree learning	CO4	T1:3.5
17	How Inductive bias helps in reducing hypotheses space searching indecision tree learning	CO5	T1:3.6
18	Discussing Issues like overfitting in decision tree learning	CO5	T1:3.1
19	Introduction to Artificial Neural Networks	CO6	T1:4.1
20	Neural Network representation using inputs, output, weights and perceptron.	CO6	T1:4.2
21	Appropriate problems for neural network learning with different characteristics	CO6	T1:4.3
22-23	Representing single layer neural network and multilayer neural network using perceptrons	CO6	T1:4.4,4.5
24-25	Demonstration of Back propagation algorithm to update the weights.	CO7, CO8	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.	CO4, CO6	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, CO7	T1:5.4
30	Observing the difference in error of two hypothesis so that prediction is accurate based on hypotheses.	CO4, CO7	T1:5.5
31	Comparing learning algorithms based on target functions considering the same training examples.	CO12	T1:5.6
32	Introduction to Bayesian Learning	CO9	T1:6.1
33	Design a concept learning algorithm based on Bayes theorem.	CO9	T1:6.2,6.3
34	Learning methods to minimize Least Squared error and maximize likelihood hypothesis.	CO9	T1:6.4

35	Using maximum likelihood hypotheses for predicting probabilities.	CO9	T1:6.5
36-37	Discussing Minimum Description Length principle and Bayesian learning method Naive Bayes classifier.	CO9	T1:6.6,6.7,6.9
38	Understand EM algorithm to train Bayesian belief networks used to describe the probability distribution.	CO9	T1:6.11,6.12
39	Introduction to Instance Based Learning	CO1	T1:8.1
40	k-nearest neighbor learning	CO5	T1:8.2
41	Locally weighted regression	CO12	T1:8.3
42	Radial basis function	CO12	T1:8.4
43	Cased-based reasoning	CO12	T1:8.5
44	Introduction to Reinforcement Learning	CO11	T1:13.1
45	Learning Task and Q Learning	CO11	T1:13.2,13.3

Signature of Course Coordinator **HOD, CSE**
Dr. Chukka Santhaiah, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**DIGITAL IMAGE PROCESSING**				
Course Code	AECB35				
Program	B.Tech				
Semester	V				
Course Type	PROFESSIONAL ELECTIVE - II				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
Course Coordinator	Dr. B. Surekha Reddy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AEC003	III	Probability Theory and Stochastic Process
UG	AEC009	V	Digital Communications

II COURSE OVERVIEW:

The course is intended to provide image processing fundamentals, representation, sampling, quantization, image acquisition and imaging geometry. Transform techniques including two dimensional Fourier transforms, Walsh, Hotelling, Haar and Slant transforms. Analyze image processing filters and techniques for the applications of enhancement, segmentation and compression.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Image Processing	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
10%	Remember
70%	Understand
20%	Apply
0 %	Analyze

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:

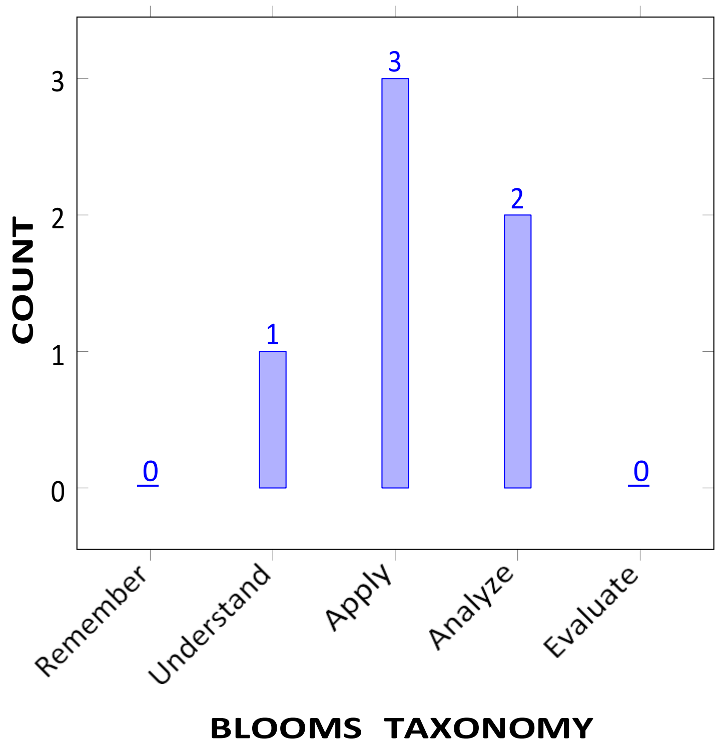
I	The fundamental concepts of digital image processing methods and techniques.
II	The image enhancement, image segmentation and compression techniques in spatial and frequency domains.
III	The algorithms to solve image processing problems to meet design specifications of various applications of image processing in industry, medicine and defense.
IV	Fundamentals of image representation and processing in MATLAB.

VII COURSE OUTCOMES:

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

CO 1	**Interpret** the principles and terminology of digital image processing for describing the features of image.	Understand
CO 2	**Make use of** image transform techniques for analyzing images in transformation domain for image pre-processing.	Apply
CO 3	**Construct** image intensity transformation and filtering techniques for image enhancement in the spatial and frequency domain.	Apply
CO 4	**Analyze** the image restoration in the spatial and frequency domains to deal with noise models for removing degradation from given image.	Analyze
CO 5	**Apply** region-based morphological operations and edge-based image segmentation techniques for detection of objects in images to remove the imperfections in the structure of the image.	Apply
CO 6	**Compare** the lossy and lossless compression models for achieving image compression.	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	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.	3	SEE/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	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.	2	SEE /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	TECH TALK/ CONCEPT VIDEOS
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 = 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	SEE, PROJECTS

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	Illustrate the principles of the Digital Image Processing terminology **(knowledge)** for understanding image and its representation, pixel, intensity, gray level, relationship between the pixels by applying the principles of **engineering science to complex engineering problems**	2
	PO 10	**Effective presentation and Speaking Style** on sampling and quantization and **write Subject Matter Effectively** the difference between analog and digital images.	4
CO 2	PO 1	**Develop a image with various** image transform properties types and its types using **Scientific principles and methodology fundamental mathematics.**	3
	PO 2	**Formulate and analyze (Problem analysis) complex Engineering problems** for image transforms using **first principles of mathematics and Engineering sciences.**	5
	PO 10	**Effective presentation and Speaking Style** on properties of transforms and **write Subject Matter Effectively** on types of transforms.	4
	PSO 1	**Design of experiments** on image transforms **with project development and execution process** of **modern** tools such as MATLAB with image processing tool box, python, CV2.	2
CO 3	PO 1	**Illustrate the principles of an image find by using engineering** techniques for image enhancement by using **mathematical methods.**	2
	PO 2	**Illustrate** the filter processing **model translation** for spatial domain and **formulate** the time domain filter.	2
	PO 3	**Develop** a histogram techniques **complex engineering problem with appropriate considerations** and environmental considerations for image enhancement.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	**Demonstrate** the **Use** image enhancement **analyze and interpretation and Ability to apply quantitative methods** in frequency domain processing technique to **provide valid** digital image.	7
	PO 10	**Effective presentation and Speaking Style** on histogram processing **Write Subject Matter Effectively** on manipulation technique of an digital image.	4
	PO 12	**Recognize the need for** the image segmentation in different image applications and **ability to improve** the enhancement algorithms in the broadest context of **technological advancements.**	6
	PSO 1	**Design of experiments with project development and execution** modern tools such as MATLAB with image processing tool box, python, CV2.	6
CO 4	PO 1	Distinguish the image restoration in the spatial and frequency domains **(knowledge)** to remove the noise present the image by applying the principles of **(mathematics, engineering science for complex engineering problems.**	2
	PO 2	Formulate and analyze **(Problem analysis) complex Engineering problems** for image restoration using first principles of **mathematics and Engineering sciences**	5
	PO 3	**(Develop** spatial and frequency domain techniques **complex engineering problem with appropriate considerations** and **environmental considerations** for image restoration.	4
	PO 4	Understand the image restoration in the spatial and frequency domains **(knowledge)** methods **including design of experiments, analysis of complex problems.**	4
	PO 10	**Effective presentation and Speaking Style and write** on degradation models and noise sources for image restoration of digital images	3
	PSO 1	**Design of experiments with project development and execution** image restoration with modern tools such as MATLAB with image processing tool box, python, CV2.	2
CO 5	PO 1	**Interpret** Image Segmentation and formulate representation techniques to apply **Mathematical principles fundamental mathematics.**	3
	PO 2	**Apply Problem statement** the segmentation techniques for edge linking and boundaries by using **principles of mathematics and formulate** segmentation techniques.	3
	PO 10	**Effective presentation and Speaking Style and write on** image segmentation techniques.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	**Recognize** the **need** for image Segmentation technique, and **broadest context of technological change in digital image and advanced engineering concepts.**	6
	PSO1	**Design of experiments with project development and execution** image segmentation with modern tools such as MATLAB with image processing tool box, python, CV2.	2
CO6	PO 1	**Understand the** various source coding techniques and Interpret Image Compression standards using **engineering science and mathematical models.**	3
	PO 2	**Identify and analyze** fidelity criteria, image compression models **implement** using **engineering science, design system components** for source Encoder and decoder, error free compression and **model translation** using **principal of mathematics.**	5
	PO 10	**Present effectively** and **Clarity** source encoder and **write effectively subject matter** on decoder techniques.	4
	PO 12	**Recognize the ability** of image restoration algorithms for **life-long learning in the broadest context of** image processing.	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	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	3	5	-	-	-	-	-	-	-	2	-	-	2	-	-
CO 3	2	2	5	7	-	-	-	-	-	2	-	6	2	-	-
CO 4	2	5	5	4	-	-	-	-	-	2	-	-	2	-	-
CO 5	3	3	-	-	-	-	-	-	-	2	-	6	2	-	-
CO 6	3	5	-	-	-	-	-	-	-	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	66.6	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 2	100	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	100	0.0	0.0
CO 3	66.6	20.0	50.0	63.6	0.0	0.0	0.0	0.0	0.0	40.0	0.0	50.0	100	0.0	0.0
CO 4	66.6	50.0	50.0	36.3	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	100	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	100	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	50.0	100	0.0	0.0
CO 6	100	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	33.3	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 ≤ C≤ 5% – No correlation

1 -5 <C≤ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	1	-	-	3	-	-
CO 3	3	1	2	3	-	-	-	-	-	1	-	2	3	-	-
CO 4	3	2	2	1	-	-	-	-	-	1	-	-	3	-	-
CO 5	3	1	-	-	-	-	-	-	-	1	-	2	3	-	-
CO 6	3	2	-	-	-	-	-	-	-	1	-	1	-	-	-
TOTAL	18	8	4	4	-	-	-	-	-	6	-	5	12	-	-
AVERAGE	3	1.6	2	2	-	-	-	-	-	1	-	1.6	3	-	-

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:

MODULE I	**INTRODUCTION**
	Digital image fundamentals and image transforms digital image fundamentals, sampling and quantization, relationship between pixels; Image transforms: 2-D FFT, properties, Walsh transform, Hadamard transform, discrete cosine transform, Haar transform, Slant transform, Hoteling transform.

MODULE II	**IMAGE ENHANCEMENT**
	Introduction, image enhancement in spatial domain, enhancement through point processing, types of point processing, histogram manipulation, linear and non-linear gray level transformation, local or neighborhood operation, median filter processing; Spatial domain high pass filtering, filtering in frequency domain, obtaining frequency domain filters from spatial filters, generating filters directly in the frequency domain, low pass (smoothing) and high pass (sharpening) filters in frequency domain.
MODULE III	**IMAGE RESTORATION**
	Image restoration degradation model, algebraic approach to restoration. Inverse filtering, least mean square filters, constrained least square restoration, interactive restoration.
MODULE IV	**IMAGE SEGMENTATION**
	Image segmentation detection of discontinuities, edge linking and boundary detection, threshold, region oriented segmentation morphological image processing dilation and erosion, structuring element decomposition, the Strel function, erosion; Combining dilation and erosion: Opening and closing the hit and miss transformation.
MODULE V	**IMAGE COMPRESSION**
	Image compression: Redundancies and their removal methods, fidelity criteria, image compression models, source encoder and decoder, error free compression, lossy compression, JPEG 2000 standard.

TEXT BOOKS

1. R.C. Gonzalez & R.E. Woods, —Digital Image Processing , Addison Wesley/ Pearson education, 2nd Education, 2002.
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, “Digital Image Processing”, TMH, 3rd Edition, 2010.

REFERENCE BOOKS:

1. A.K.Jain, —Fundamentals of Digital Image Processing, PHI. 3RD Edition, 2003.
2. Rafael C. Gonzalez, Richard E Woods and Steven, —Digital Image Processing using MATLAB L. Edition, PEA, 2004.
3. William K. Pratt, John, —Digital Image Processing , Wilely, 3rd Edition, 2004.
4. Somka, Hlavac, Boyle, “Digital Image Processing and Computer Vision”, Cengage Learning, 1st Edition, 2008.
5. Adrain Low, “Introductory Computer vision Imaging Techniques and Solutions”, Tata McGraw-Hill, 2nd Edition, 2008.
6. John C. Russ, J. Christian Russ, “Introduction to Image Processing & Analysis”, CRC Press, 1st Edition, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117105135

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in/index?route=course/details&course_id=129

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	Introduction to Image Processing	CO 1	T1:1.4-1.5
2	Digital Image Fundamentals	CO 1	T1:1.4-1.5
3	Analyze sampling and quantization	CO 1	T1:2.4-2.5
4	Relationship between pixels	CO 1	T1:2.4-2.5
5	Introduction to Image transforms	CO 1	T1:2.4-2.5
6	2D-FFT and properties	CO 2	T1:2.6-2.6.8; R2: 5.8-5.10
7	Properties of 2D FFT	CO 2	T1:2.6-2.6.8; R2: 5.8-5.10
8	Haar transform, Slant transform	CO 2	T1:3.1-3.6
9	Hoteling transform, Walsh transform	CO 2	T1:3.1-3.6
10	Hoteling transform, Walsh transform	CO 2	T1:3.1-3.6
11	Discrete cosine transform, Hadamard transform	CO 2	T1:3.1-3.6
12	Introduction to image enhancement	CO 3	T1:3.1-3.6
13	Image enhancement in spatial domain	CO 3	T1:3.1-3.6
14	Understand enhancement through point processing	CO 3	T1:3.1-3.8
15	Types of point processing	CO 3	T1:3.1-3.8
16	Histogram manipulation	CO 3	T1:3.1-3.8

17	Understand median filter processing	CO 3	T1:3.1-3.8; R2: 7.4-7.5
18	Spatial domain high pass filtering	CO 3	T1:3.1-3.8; R2: 7.4-7.5
19	Histogram equalization	CO 3	T1:3.1-3.8; R2: 7.4-7.5
20	Apply the Histogram processing technique for image enhancement	CO 3	T1:3.1-3.8; R2: 7.4-7.5
21	Understand filtering in frequency domain	CO 4	T1:4.1-4.6
22	Obtaining frequency domain filters from spatial filters	CO 4	T1:4.1-4.6
23	Generating filters directly in the frequency domain	CO 4	T1:4.1-4.6
24	Low pass (smoothing) filter in frequency domain.	CO 4	T1:4.1-4.6
25	High pass (sharpening) filter in frequency domain	CO 4	T1:4.1-4.6
26	Introduction to Image segmentation	CO 5	T1:10.1-10.6
27	Detection of discontinuities	CO 5	T1:10.1-10.6
28	Edge linking and boundary detection	CO 5	T1:10.1-10.6
29	Threshold techniques for image segmentation	CO 5	T1:10.1-10.6
30	Understand region oriented segmentation	CO 5	T1:10.1-10.6 ; T1:9.1-9.6
31	Morphological image processing, dilation and erosion	CO 5	T1:10.1-10.6; T1:9.1-9.6
32	Understand structuring element decomposition, the Strel function, erosion;	CO 5	T1:9.1-9.6
33	Combining dilation and erosion: Opening and closing	CO 5	T1:9.1-9.6
34	The hit and miss transformation	CO 5	T1:9.1-9.6
35	Introduction to Image compression	CO61	T1:8.1-8.3 ; R2: 7.4-7.5

36	Redundancies and their removal methods	CO 6	T1:8.1-8.3; R2: 7.4-7.5
37	Fidelity criteria, image compression models	CO 6	T1:8.1-8.3; R2: 7.4-7.5
38	Understand source encoder and decoder	CO 6	T1-8.1-8.1.7
39	Error free compression	CO 6	T1-8.1-8.1.7
40	Lossy compression & JPEG 2000 standard	CO 6	T1-8.1-8.1.7
	PROBLEM SOLVING/ CASE STUDIES		
1	Problem solving on 2-D FFT and it's properties	CO 2	T1:2.6-2.6.8; R2: 5.8-5.10
2	Problem solving on Walsh transform, Hadamard transform	CO 3	T1:3.1-3.6
3	Problem solving on Haar Transform	CO 2	T1:3.1-3.6
4	Problem solving on Slant, Hoteling and discrete cosine transform	CO 2	T1:3.1-3.6
5	Problem solving on image enhancement in spatial domain and point processing	CO 3	T1:3.1-3.6
6	Problem solving on histogram manipulation and equalization	CO 3	T1:3.1-3.8
7	Problem solving on gray-level transformation and median filter processing	CO 3	T1:3.1-3.8
8	Problem solving on image enhancement using filtering methods	CO 3	T1:4.1-4.6
9	Problem solving on image enhancement using filtering methods	CO 3	T1:4.1-4.6
10	Problem solving on image restoration using filtering techniques	CO 4	T1:4.1-4.6
11	Problem solving on image segmentation using edge linking and boundary detection	CO 5	T1:10.1-10.6
12	Problem solving on image segmentation using region orientation morphological processing	CO 5	T1:10.1-10.6
13	Problem solving on image segmentation using dilation and erosion	CO5	T1:10.1-10.6
14	Problem solving on image compression using removal of redundancies	CO 6	T1:8.1-8.3; R2: 7.4-7.5
15	Problem solving on image compression using JPEG 2000 standard	CO 6	T1:8.1-8.3; R2: 7.4-7.5

DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and terminologies on Introduction to Digital image processing	CO 1	T1:1.4-1.5
2	Definitions and terminologies on image enhancement	CO 3	T1:3.1-3.8
3	Definitions and terminologies on image restoration	CO 4	T1:4.1-4.6
4	Definitions and terminologies on image segmentation	CO 5	T1:10.1-10.6
5	Definitions and terminologies on image compression	CO 6	T1:8.1-8.3; R2: 7.4-7.5
DISCUSSION OF QUESTION BANK			
1	Discussion on question bank of introduction to digital image processing	CO 2	T1:1.4-1.5
2	Discussion on question bank of image enhancement	CO 3	T1:3.1-3.8
3	Discussion on question bank of image restoration	CO 4	T1:3.1-3.8; R2: 7.4-7.5
4	Discussion on question bank of image segmentation	CO 5	T1:10.1-10.6
5	Discussion on question bank of image compression	CO 6	T1:8.1-8.3; R2: 7.4-7.5

Signature of Course Coordinator **HOD,CSE**
Dr. B. Surekha Reddy, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**WEB TECHNOLOGIES**				
Course Code	AITB09				
Program	B.Tech				
Semester	FIVE				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	1	3	-	-
Course Coordinator	CH.Srividya, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming For Problem Solving
B.Tech	AITB06	IV	Object Oriented Programming Through Java Laboratory

II 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.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Web Technologies	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
25%	Apply
15%	Analyze

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:

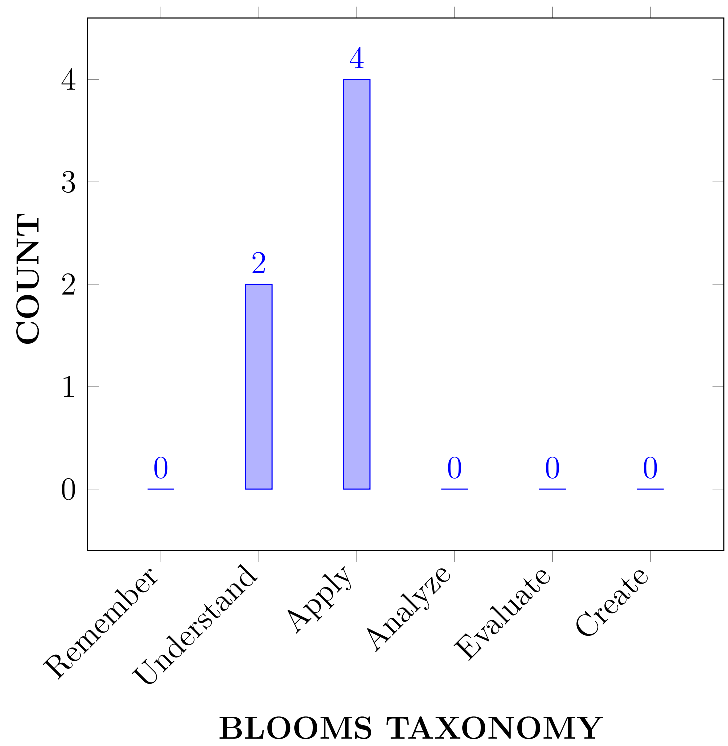
I	The fundamentals of designing static and dynamic web pages using HTML and DHTML for creation of websites..
II	The concepts of client - server programming with JavaScript, XML, Servlets, JSP and PHP..
III	The project-based experience needed for designing real time web based client-server applications..

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
AVERAGE	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 validate the form using XML file?	CO 5	T3:10,11,12
70	My SQL database, retrieving MVC architecture	CO 5	T3:10

Signature of Course Coordinator **HOD,CSE**
Ms.CH.Srividya, Assistant Professor

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**OBJECT ORIENTED ANALYSIS AND DESIGN**				
Course Code	ACSB10				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. C. Raghavendra, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITB01	III	Object Oriented Programming through Python
B.Tech	ACSB08	IV	Database Management Systems

II COURSE OVERVIEW:

This course emphasizes on the design and construction of software systems using Unified Modeling Language as a tool that view a system as a set of objects to realize the systems functionality. This course includes object oriented analysis and design techniques that impact the implementation of software systems. Learned skills will be applied to the development of project and the analysis of real-world object oriented systems.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Discrete Mathematical Structures	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
10%	Remember
60 %	Understand
20%	Apply
10 %	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:

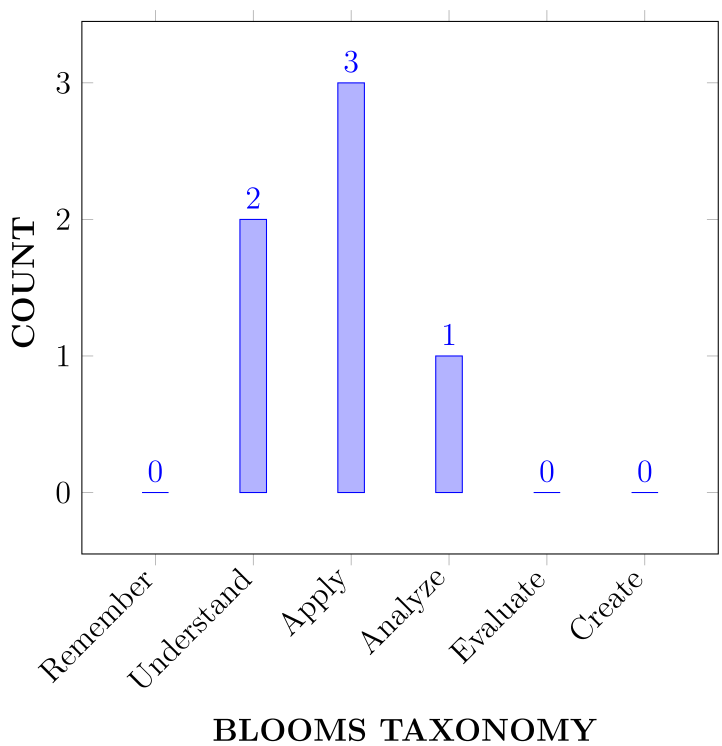
I	Applying UML meta models in analysis and design of software.
II	Transformation of use cases into object oriented software realization through object oriented analysis and design using UML.
III	Constructing forward and reverse engineering using case tools.
IV	Developing application of OOAD practices from a software project management perspective.

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** basic principles, building blocks and different views for designing conceptual model and architectural views of the system.	Understand
CO 2	**Outline** structural and behavioral design for visualizing the advanced relationships among components of a system.	Understand
CO 3	**Make use of** architectural modeling diagrams for studying static aspects of the system	Apply
CO 4	**Construct** behavioral modeling diagrams for studying dynamic aspects of the system	Apply
CO 5	**Model** software application like Unified Library with the help of UML diagrams for documenting static and dynamic aspects of a system.	Apply
CO 6	**Categorize** structural and behavioral modeling in analysis and design of real-time applications	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	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 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction analysis and interpretation of data, and synthesis of the information to provide valid conclusions and modeling to complex engineering activities with an understanding of the limitations.	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	SEE / CIE / 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.	2	SEE/AAT
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	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	Usage of CASE tool for modelling simple to complex engineering activities with understanding requirements and limitations of user.	1
	PO 3	Use of methods in CASE tools complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for development ofmodels in efficiant manner.	7
	PO 5	Apply Different views techniques, resources, and modern engineering and IT tools including prediction analysis and interpretation of data, and synthesis of the information to provide valid conclusions and modeling to complex engineering activities with an understanding of the limitations.	1
	PO 10	Use of designing conceptual model and 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	Apply architectural views of the system 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
	PSO 2	Formulate and Evaluate engineering concepts to Design next-generation computer systems for modelling simple to complex engineering activities with understanding requirements and limitations of user.	1
CO 2	PO 1	Apply Modeling diagrams in Engineering knowledge and modelling principles, building blocks and architectural views of the system with support of UML.	2
	PO 2	Identify, studying static aspects of the system formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	6
	PO 3	Design solutions for simple and complex problems by Defining and understanding customer requirements, identifying various static and dynamic functions, managing design process and evaluate the outcomes as UML diagrams.	7
	PO 5	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.	1
	PO 10	Make use of building blocks for creating architectural view of system using UML by communicating effectively to engineering community	2
	PO 12	Usage of CASE tool for modelling simple to complex engineering activities with understanding requirements and limitations of user for architectural view of system.	1
	PSO 2	Focus on studying static aspects of the system improving software reliability, network security or information retrieval systems.	1
CO 3	PO 1	Apply Engineering knowledge and modelling principles, building blocks and architectural views of the system with support of UML.	2
	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.	6
	PO 3	Make use of architectural modeling diagrams Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	7
	PO 5	Usage of CASE tool for modelling simple to complex engineering activities with understanding requirements and limitations of user.	1

	PO 10	Communicate static and dynamic aspects of the system using UML diagrams for specifying structure and interaction of objects during runtime.	2
	PO 12	Recognize the need and develop suitable building blocks using UML diagrams for future advancement and lifelong learning.	1
	PSO 2	Focus on studying static aspects of the system improving software reliability, network security or information retrieval systems.	1
CO 4	PO 1	Apply Engineering knowledge and modelling principles, in identifying basic building blocks for visualizing artefacts of system.	2
	PO 3	Design solutions for simple and complex problems by Defining problem, understand customer requirements, identifying basic building blocks to draw UML diagrams.	6
	PO 10	Communicate with structural and behavioral design patterns effectively on complex engineering activities with the engineering community and give and receive clear instructions.	2
	PO 12	Recognize solve design problems in real time applications and develop suitable building blocks using UML diagrams for future advancement and lifelong learning.	1
	PSO 2	Focus on studying static aspects of the system improving software reliability, network security or information retrieval systems.	1
	PSO 3	Make use of computational and advanced CASE tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	1
CO 5	PO 1	Apply Architectural and domain model Engineering knowledge and modelling principles, in identifying basic building blocks for visualizing artefacts of system.	2
	PO 3	Design representation of Next gen POS system for simple and complex problems by Defining problem, understand customer requirements, identifying basic building blocks to draw UML diagrams.	6
	PO 10	Communicate static and dynamic aspects of the system using using system sequence and use case diagrams. For specifying structure and interaction of objects during runtime	2
	PO 12	Recognize the need and develop suitable building blocks using UML diagrams for future advancement and lifelong learning	1
	PSO 2	Formulate and Evaluate engineering concepts to Design next-generation computer systems by using advanced building blocks of UML.	1
CO 6	PO 1	Apply structural modeling Engineering knowledge and modelling principles, in identifying basic building blocks for visualizing artefacts of system.	2

	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.	10
	PO 3	Design representation of Next gen POS system for simple and complex problems by Defining problem, understand customer requirements, identifying basic building blocks to draw UML diagrams.	7
	PO 5	Apply Design Patterns to Conduct investigation of complex problems for visualizing diagrams of static and dynamic aspects by using basic and advanced building blocks knowledge of process, laboratory skills, understanding knowledge and ability to apply a systems approach to engineering problems.	1
	PO 10	Communicate structural, behavioral modeling using system sequence and use case diagrams. For specifying structure and interaction of objects during runtime.	2
	PO 12	Recognize Design patterns the need and develop suitable building blocks using UML diagrams for future advancement and lifelong Learning.	1
	PSO 2	Focus on studying static aspects of the system improving software reliability, network security or information retrieval systems.	1
	PSO 3	Make use of computational and advanced CASE tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	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	-	7	-	1	-	-	-	-	2	-	1	-	1	-
CO 2	2	6	7	-	1	-	-	-	-	2	-	1	-	1	-
CO 3	2	6	7	-	1	-	-	-	-	2	-	1	-	1	-
CO 4	2	-	6	-	-		-	-	-	2	-	1	-	1	1
CO 5	2	-	6	-	-	-	-	-	-	2	-	1	-	1	-
CO 6	2	10	7	-	1	-	-	-	-	2	-	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	33.0	0.0	70.0	0.0	100	0.0	0.0	0.0	0.0	40.0	0.0	12.5	0.0	50.0	0.0
CO 2	66.0	60.0	70.0	0.0	100	0.0	0.0	0.0	0.0	40.0	0.0	12.5	0.0	50.0	0.0
CO 3	66.0	60.0	70.0	0.0	100	0.0	0.0	0.0	0.0	40.0	0.0	12.5	0.0	50.0	0.0
CO 4	66.0	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	12.5	0.0	50.0	50.0
CO 5	66.0	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	12.5	0.0	50.0	0.0
CO 6	66.0	100	70.0	0.0	100	0.0	0.0	0.0	0.0	40.0	0.0	12.5	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

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	-	3	-	3	-	-	-	-	3	-	1	-	2	-
CO 2	3	3	3	-	3	-	-	-	-	3	-	1	-	2	-
CO 3	3	3	3	-	3	-	-	-	-	3	-	1	-	2	-
CO 4	3	-	3	-	-	-	-	-	-	3	-	1	-	2	2
CO 5	3	-	3	-	-	-	-	-	-	3	-	1	-	2	-
CO 6	3	3	3	-	3	-	-	-	-	3	-	1	-	2	2
TOTAL	16	9	18	-	12	-	-	-	-	18	-	6	-	12	4
AVERAGE	2.6	3.0	3.0	-	3.0	-	-	-	-	3.0	-	1.0	-	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:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO UML**
	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.
MODULE II	**ADVANCED BEHAVIORAL MODELING**
	Advanced classes, advanced relationships, interfaces, types and roles, packages, terms, concepts; Class and Object Diagrams: Terms, concepts, common modeling techniques for class and object diagrams.
MODULE III	**ARCHITECTURAL MODELING**
	Basic Behavioral Modeling - I: Interactions, Interaction diagrams. Basic Behavioral Modeling-II: Use cases, Use case Diagrams, Activity Diagrams.
MODULE IV	**ADVANCED BEHAVIORAL MODELING**
	Events and signals, state machines, processes and threads, time and space, state chart and state chart diagrams. Case study: The next gen POS system.
MODULE V	**ARCHITECTURAL MODELING**
	Component, Component diagrams, Deployment, Deployment diagrams; Case Study: The Unified Library Application.

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. http://www.web.stanford.edu/class/cs103x

2. http://www.saylor.org/course/cs202/.

3. http://www.cse.iitd.ernet.in/ bagchi/courses/discrete-book

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details & course_id=413

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=137
CONTENT DELIVERY (THEORY)			
1	Introduction to UML: Importance of Modeling, Things, Principles of Modeling.	CO 1	T1:1.1
2	Object Oriented Modeling, Structural things, Structural diagrams.	CO 1	T1:1.2
3	Conceptual model of the UML, Structural diagrams	CO 1	T1:1.3-1.4
4	Behavioral diagrams.	CO 4	T1:2.3
5	UML architecture, Software Development Life Cycle.	CO 1	T1:2.4
6	Basic class diagram symbols and notations.	CO 2	T1:2.5
7-8	Class diagram: Purpose, Benefits with example.	CO 3	T1:4.1
9-10	Relationships: Dependencies, Generalizations, Associations with example	CO 2	T1:5.1
11	Aggregation vs. Composition, Common mechanisms.	CO 2	T1:6.1
12-13	Advanced classes: scope, multiplicity, operations, examples.	CO 3	T1:7.1.1
14-16	Common modeling techniques for class diagram, Advanced relationships: dependency, generalization,association, realization, common modeling techniques	CO 4	T1:8.1.1
17	ThPackages: Key elements of package diagram, visibility of packages, import and access.	CO 4	T1:11.4
18	Terms and Concepts: common uses, common modeling techniques, forward and reverse engineering.	CO 4	T1:12.5
19	Class Diagrams- Terms, concepts and common modeling techniques.	CO 6	T1:13.1
20	Object Diagrams: Terms, concepts and common modeling techniques.	CO 6	T1:13.1
21	OInteractions: Interactions, concepts and common modeling techniques.	CO 5	T1:14.1
22-23	Interaction Diagrams: Terms, concepts, uses and common modeling techniques.	CO 6	T2: 5.2

24-25	Use cases: Use case diagrams Terms, concepts, uses and common modeling techniques.	CO 4	T1:16.1
26-27	Activity Diagrams: Terms, concepts, uses and common modeling techniques.	CO 4	T1:16.4
28	Events and signals, State machines.	CO 4	T1:20.5
29	Processes and threads, Time and space.	CO 4	T1:21.4
30-31	State Chart: Terms, concepts, uses and common modeling techniques.	CO 4	T1:22.1
32-33	State chart diagrams: Terms, concepts, uses and common modeling techniques.	CO 4	T1:22.4
34	Case study: The next gen POS system.	CO 5	T1:22.7
35	Component: Terms and concepts.	CO 4	T1:29.1
36-37	Component diagrams: Terms, concepts, uses and common modeling techniques.	CO 4	T1:29.3
38	Deployment: Terms and concepts.	CO 4	T1:30.1
39-40	Deployment diagrams: Terms, concepts, uses and common modeling techniques.	CO 4	T1:30.7
41-43	Case Study: The Unified Library Application.	CO 4	T1:30.9
44-45	Case Study: Real-Time applications.	CO 6	T1:30.9
PROBLEM SOLVING/ CASE STUDIES			
1	Build a class hierarchy to organize the following drink classes: Mineral water, alcoholic, nonalcoholic, grape juice and soda.	CO 1	T2:2.1
2	Classify and describe four fundamental process activities which are common to all software processes.	CO 2	T2:2.3
3	List four facts which indicate that the requirement capture and analysis process to be very difficult.	CO 2	T2:2.3.1
4	Construct an object diagram that contains a three-level hierarchy of objects.	CO 6	T2:7.2,7.3
5	Assume that you wise to buy a car. Identify all the attributes and methods of the car object. Write a short description of services that each will provide. Create a class hierarchy of the “car” class.	CO 6	T2:10.3.1
6	Build basic class diagrams (of your choice) to identify and describe key concepts like classes, types in the system and their relationships.	CO 4	T2:13.3
7	Draw and model the activity diagrams to display either business flows or like flow charts. (Example: ATM system)	CO 4	T2:17.1.1, 17.1.3

8	Construct an activity diagram the shows flow of control from activity to another by modeling a credit card validation system with swim lanes.	CO 4	T2:18.1, 18.2.1
9	Develop the activity diagram for the process sale and specify actor, use case and scenario with swim lanes.	CO 4	T2:18.3.4, 18.3.4.1
10	Model a state machine for the controller of a home security system, which is responsible for monitoring various sensors around the perimeter of the house.	CO 6	T2:22.12, 19.1.2
11	Develop a state chart diagram of an ATM system.	CO 4	T2:18.4, 18.4.3
12	Develop a state chart diagram for the case study on the Next Gen POS system with suitable examples.	CO 6	T2:19.2, 18.4.4
13	Construct UML deployment and component diagrams for ATM system.	CO 1	T2:23.1.1, 23.1.3
14	Consider the Hospital Management System application with the following requirements i. System should handle the in- patient, out-patient information through receptionist. ii. Doctors are allowed to view the patient history and give their prescription iii. There should be a information system to provide the required information Construct the component and deployment diagram	CO 5	T2:18.3.4, 18.3, 4.1
15	Explain in detail about the notations of a sequence diagram with neat sketch.	CO 4	T2:24.2,28.4
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Model, encapsulation, behavioral things, UML,package	CO 1, CO 2	T2:18.3.4, 18.3.4.1
2	Class, object, use case.	CO 3, CO 4	T2:22.12, 19.1.2
3	Interaction Diagrams.	CO 4	T2:18.4, 18.4.3
4	Activity Diagram, State chat diagrams	CO 4	T2:19.2, 18.4.4
5	Component Diagram, Deployment Diagram	CO 5	T2:23.1.1, 23.1.3
DISCUSSION ON QUESTION BANK			
1	Introduction to Uml	CO 1,	T2:18.3.4, 18.3.4.1
2	Advanced Behavioral Modeling	CO 2,	T2:22.12, 19.1.2
3	architectural modeling	CO 3	T2:18.4, 18.4.3
4	Advanced Behavioral Modeling	CO 4	T2:19.2, 18.4.4
5	Architectural Modeling	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

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**WEB TECHNOLOGIES LABORATORY**				
Course Code	AITB11				
Program	B.Tech				
Semester	V	CSE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	2
Course Coordinator	Ms B Geetavani, Assistant Professor				

I COURSE OVERVIEW:

This Laboratory course provides a foundation for the development of a broad range of increasingly influential and strategic technologies, supporting a large variety of applications and services, both in the private and public sectors. 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. This module will give you an insight into architectures, protocols, standards, languages, tools and techniques; an understanding of approaches to more dynamic and mobile content; and demonstrate 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	ACSB01	II	Programming for Problem Solving
B.Tech	AITB06	IV	Object Oriented Programming Through Java

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Web Technologies 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 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.

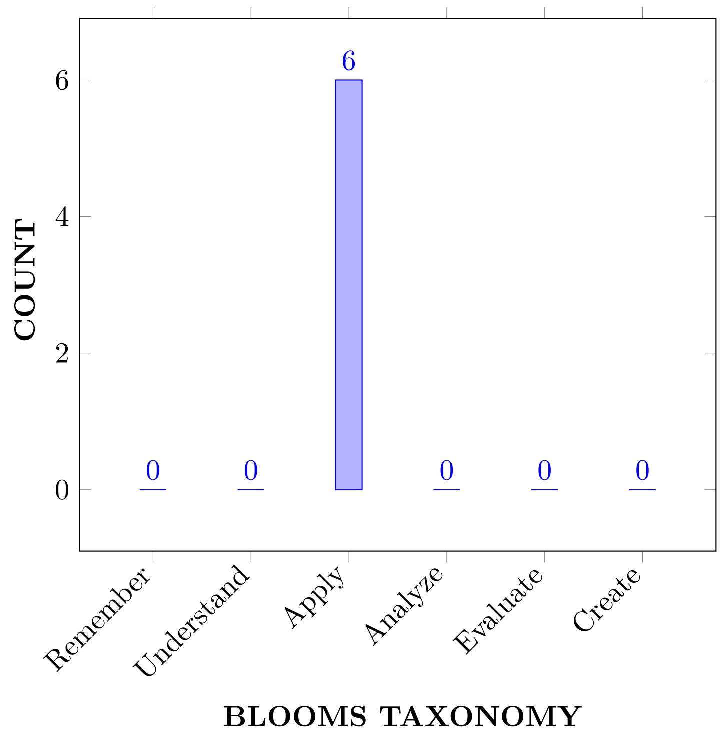
III	The project-based experience needed for designing real time web based client-server applications.

VII COURSE OUTCOMES:

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

CO 1	**Develop** static web pages using HTML and CSS. .	Apply
CO 2	**Develop** effective and interactive web pages using elements and selectors in style sheets and dynamic HTML.	Apply
CO 3	**Make use of** functions in JavaScript and PHP for implementing data validations in web applications.	Apply
CO 4	**Develop** dynamic web site using server side PHP programming and database connectivity.	Apply
CO 5	**Build** dynamic web pages using XML and PHP with database connectivity to perform CRUD operations.	Apply
CO 6	**Construct** website by using front end and back end programming.	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 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 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 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.	2.5	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.	2	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	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(knowledge) the structure of web page using HTML elements with their importance in web page designing by applying basic principles of **mathematics and engineering fundamentals of programming.**	2
	PO 2	Understand the problem statement and formulate (complex) specific engineering problems related to the concepts of HTML and CSSL by considering the information and data provided by the customer to provide sustained conclusions by using model translation and validate the implementation of webpage by interpretation of results .	8

	PO 3	Understand the customer needs of static and dynamic web pages and use creativity to provide innovative solutions in designing attractive web pages 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.	7
	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 6	Apply the contextual knowledge of HTML and CSS to assess societal, health and the consequent responsibilities relevant to the professional engineering practice.	2
	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.	2
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	Design the webpages effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	7
	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.	3
	PO 12	Recognize the need for advanced concepts related to HTML and CSS for understanding and developing web applications through continuing education efforts **with ongoing learning – stays up with industry trends/ new technology .**	4
	PSO 1	**Identify the Customer needs and problem specific constraints** in designing web pages related to the basic concepts of HTML and CSS.	4
	PSO 2	Focus on improving software reliability and information retrieval systems using data validation.	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 .**	2
CO 2	PO 1	Illustrate all variations of styling web pages such as internal, external and inline by applying principles of programming **engineering fundamentals and mathematics.**	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 by interpretation of results .	5
	PO 3	**Understand the customer needs** of developing interactive web pages identify the **cost limitations** of the web application and use creativity in applying style sheets and changing element's style object for **innovative solutions** by properly **managing design process.**	6
	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 6	Apply the contextual knowledge of Javascript and XML to assess societal, health and the consequent responsibilities relevant to the professional engineering practice.	2
	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.	2
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	Design the webpages effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
	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.	3
	PO12	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 HTML,Javascript,XML.	6
	PSO 1	Understand the need and constraints related to programming concepts of dynamic HTML, Java Script and XML languages in designing web pages.	4
	PSO 2	Focus on improving software reliability and information retrieval systems using data validation functions.	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	Apply the knowledge of client side and server side scripting, mark-up languages to validate the information and data provided by the user by applying principles of **mathematics and engineering fundamentals.**	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.	5
	PO 3	**Understand the customer needs** of validating data; **identify the cost limitations** based on requirements and network traffic, **use creativity** in implementing validation functions for **innovative solutions** of the web application.	6
	PO 5	Effective web pages are developed by using computer software related to web development with concepts related to PHP for client/server based web applications.	1
	PO 6	Apply the contextual knowledge of client side and server side scripting to assess societal, health and the consequent responsibilities relevant to the professional engineering practice.	1
	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.	2
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	Design the webpages effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
	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 PHP .	4
	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.	4
	PSO 1	Understand the need and constraints related to programming concepts of PHP in designing web pages.	4
	PSO 2	Focus on improving **software reliability and information retrieval systems** by implementing appropriate data validation functions.	1
	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 4	PO 1	Make use of (apply) programming constructs such as arrays, functions and database connectivity (knowledge) in solving (complex) engineering problems related to web applications by applying the principles of **engineering fundamentals and mathematical principles.**	3

	PO 2	Understand the given **problem statement** and **formulate** the (complex) engineering problems of creating fast and flexible web application to **collect data and information, develop solutions** based on the programming constructs of PHP, **validate** the web application in reaching substantiated conclusions by the **Interpretation of results.**	5
	PO 3	**Understand the user needs** of creating web applications, **use creativity** of widgets, containers and frames in applying the methods **for innovative solutions, and evaluate the outcomes** of the model analysis for developing the web applications **to achieve engineering objectives.**	5
	PO 5	Create the PHP code for interaction with the database to perform CRUD operations by properly using cookies and encryption in developing web application (complex) Engineering activities in **Computer software.**	1
	PO 6	Apply the contextual knowledge of PHP, client side and server side scripting to assess societal, health and the consequent responsibilities relevant to the professional engineering practice.	2
	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.	2
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	Design the webpages effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
	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 PHP .	4
	PO 12	Create **web applications** according to **technological changes** done in **software environment.**	4
	PSO 1	Understand the need and constraints related to programming concepts of PHP in designing web pages.	3
	PSO 2	Focus on improving **software reliability and information retrieval systems** by implementing appropriate data validation functions.	1
	PSO 3	Make use of **modern computer tools** in designing Web applications at coding competitions and solving complex engineering problems	1
CO 5	PO 1	Apply the knowledge of client side and server side scripting, mark-up languages to validate the information and data provided by the user by applying principles of **mathematics and engineering fundamentals.**	2

	PO 2	Understand the given **problem statement and formulate** the(complex) engineering problems of creating user interface of Web application for the **collection of data and information develop solutions** based on open, send methods of request object, **validate** the web application in reaching substantiated Conclusions by the **Interpretation of results.**	5
	PO 3	**Understand the customer needs** of validating data; **identify the cost limitations** based on requirements and network traffic, **use creativity** in implementing validation functions for **innovative solutions** of the web application.	7
	PO 5	Create the PHP code for interaction with the database to perform CRUD operations by properly using cookies and encryption in developing web application(complex) Engineering activities in **Computer software.**	1
	PO 6	Apply the contextual knowledge of client side and server side scripting to assess societal, health and the consequent responsibilities relevant to the professional engineering practice.	2
	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.	2
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	Design the webpages effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	5
	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 PHP with data base connectivity.	2
	PO 12	Create **web applications** according to **technological changes** done in **software environment.**	4
	PSO 1	Focus on improving **software reliability and information retrieval systems** by implementing appropriate data validation functions.	3
	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 by **applying the technical skills and Knowledge on advanced frameworks and platforms .**	1
CO 6	PO 1	Relate the principles of HTML and XML for separation of data and presentation during the development (complex) of web pages by the **principles of mathematics and engineering fundamentals.**	2

	PO 2	Understand the given problem statement and formulate the(complex)engineering problems of creating user interface of Web application for the **collection of data and information develop solutions** based on open, send methods of request object, **validate** the web application in reaching substantiated Conclusions by the **Interpretation of results.**	8
	PO 3	**Manage the design process by understanding the customer needs for**simplification of sharing and transport of data and use creativity to wrap the data in order to **provide innovative solutions** for the requirements.	6
	PO 5	Create web site by using front end and backend technologies in developing web application by using **Computer software.**	1
	PO 6	Apply the contextual knowledge of client side and server side scripting to assess societal, health and the consequent responsibilities relevant to the professional engineering practice.	2
	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.	2
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	Design the webpages effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
	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 PHP with data base connectivity.	3
	PO 12	Create **web applications** according to textbf technological changes Done in **software environment.**	4
	PSO 1	Make use of concepts in XML for improving **software reliability and information retrieval systems.**	3
	PSO 2	Understand and develop web applications for **Improving software reliability.**	1
	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

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

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	8	6	2	2
CO 1	2	8	7	-	1	2	2	2	7	3	-	4	4	2	2
CO 2	2	5	6	-	1	2	2	2	6	3	-	6	4	2	2
CO 3	2	5	6	-	1	1	2	2	6	4	-	4	4	1	1
CO 4	3	5	5	-	1	2	2	2	6	4	-	4	3	1	1
CO 5	2	5	7	-	1	2	2	2	5	2	-	4	3	1	1
CO 6	2	8	6	-	1	2	2	2	6	3	-	4	3	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	**INSTALLATIONS**
	Installation of XAMPP and WAMP servers.
WEEK II	**HTML**
	1. Create a table to show your class time table. 2. Use tables to provide layout to your HTML page describing your college infrastructure. 3. Use <span> and <div> tags to provide a layout to the above page instead of a table layout.
WEEK III	**HTML**
	1. Use frames such that page is divided into 3 frames 20% on left to show contents of pages, 60% in center to show body of page, remaining on right to show remarks. 2. Embed Audio and Video into your HTML web page.

WEEK IV	**HTML**
	1. Create a webpage with HTML describing your department use paragraph and list tags. 2. Apply various colors to suitably distinguish key words, also apply font styling like italics, underline and two other fonts to words you find appropriate, also use header tags. 3. Create links on the words e.g. Wi-Fi‖ and LAN‖ to link them to Wikipedia pages. 4. Insert an image and create a link such that clicking on image takes user to other page. 5. Change the background color of the page; At the bottom create a link to take user to the top of the page.
WEEK V	**HTML**
	Develop static pages (using only HTML) of an online book store, the pages should resemble: www.amazon.com, the website should consist the following pages, home page, registration and user login, user profile page, books catalog, shopping cart, payment by credit card, order confirmation.
WEEK VI	**CASCADING STYLE SHEET**
	Write an HTML page that contains a selection box with a list of 5 countries, when the user selects a country, its capital should be printed next to the list; Add CSS to customize the properties of the font of the capital (color, bold and font size).
WEEK VII	**CASCADING STYLE SHEET**
	Let your visitors change the style sheet on your web site, this script will let your visitors choose between five style sheets, which can create yourself or use the one‘s included.
WEEK VIII	**JAVASCRIPT**
	1. Write a Java Script program to test the first character of a string is uppercase or not. 2. Write a pattern that matches e-mail addresses. 3. Write a Java Script function to print an integer with commas as thousands separators.
WEEK IX	**JAVASCRIPT**
	1. Write a Java Script program to sort a list of elements using quick sort. 2. Write a Java Script for loop that will iterate from 0 to 15 for each iteration, it will check if the current number is odd or even, and display a message to the screen. 3. Write a Java Script function which will take an array of numbers stored and find the second lowest and second greatest numbers, respectively.
WEEK X	**JAVASCRIPT**
	1. Write a Java Script program which compute, the average marks of the following students then this average is used to determine the corresponding grade. 2. Write a Java Script program to sum the multiples of 3 and 5 under 1000. 3. To design the scientific calculator and make event for each button using java script.

WEEK XI	**PHP**
	1. A simple calculator web application that takes two numbers and an operator (+, -,/,*and %) from an HTML page and returns the result page with the operation performed on the operands. 2. Write php program how to send mail using PHP.
WEEK XII	**PHP**
	1. Write php program to convert a string, lower to upper case and upper case to lower case or capital case. 2. Write php program to change image automatically using switch case.
WEEK XIII	**PHP**
	1. Write php program to calculate current age without using any pre-define function. 2. Write php program to upload image to the server using html and PHP.
WEEK XIV	**PHP**
	1. Write php program to upload registration form into database. 2. Write php program to display the registration form from the database.
WEEK XV	**PHP**
	1. Write php program to update the registration form present in database. 2. Write php program to delete the registration form from database

REFERENCE BOOKS

1. Uttam K Roy, Web Technologies‖, Oxford University Press, 1st Edition, 2010.
2. Steven Holzner, The Complete Reference PHP‖, Tata McGraw-Hill, 1st 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	Installations	CO1	T2:1
2	HTML tables	CO1	T1:2.6-2.9
3	HTML frames	CO1	T1:4.1-4.2
4	HTML basic tags.	CO1	T1:2.1-2.4 T1:2.6-2.9
5	HTML form elements	CO2	T1:4.2-4.3
6	HTML using CSS	CO2	T1:4.4-4.7
7	Javascript functions.	CO3	T1:5.6-5.10
8	Javascript Control statements	CO3	T1:5.6-5.10
9	Javascript Control statements	CO3	T1:5.6-5.10
10	PHP	CO4	T2:1, 2
11	PHP functions	CO4	T2:2

12	PHP database access	CO4	T2:10
13	PHP database access	CO4	T2:10

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Updating latest version and new features of the PHP Language.
2	Familiarizing the role of Java script Objects in developing system level programs.
3	Updating to latest Technology React JS in developing all devices interoperability

Signature of Course Coordinator **HOD,CSE**
Ms B Geetavani, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**CASE TOOLS LABORATORY**				
Course Code	ACSB12				
Program	B.Tech				
Semester	V	CSE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1
Course Coordinator	Mr.Rajesh Kumar Bhavani, Assistant Professor				

I COURSE OVERVIEW:

This Laboratory course introduces the Unified Modeling language for visualizing, specifying, constructing and documenting in preparing blueprint of a software intensive system. This lab covers Static and Dynamic aspects of the System with illustrations of Class,Object,Component, Deployment Use case, State chart, sequence, activity, collaboration Diagrams. These diagrams are used to create low level and high level design documents of the software system.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITB06	IV	Object Oriented Programming through Java.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Case Tools 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:

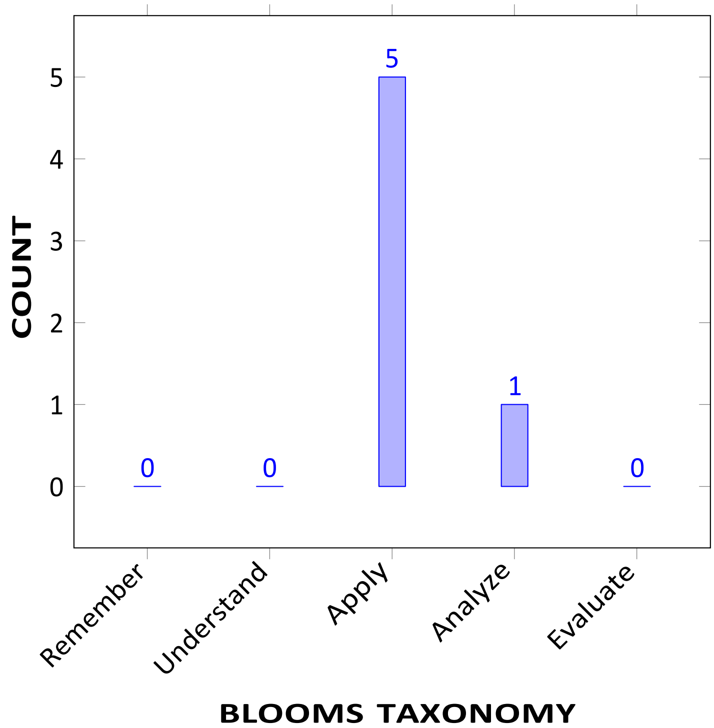
I	The Usage of CASE tools in modeling and designing of real time applications
II	The implementation of Architectural views for different case studies.
III	Applying common modeling techniques of forward and reverse engineering.

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** Interlocking views of software intensive system for projection into the structure of system. .	Apply
CO 2	**Analyze** use case view for designing overall behavior of different systems.	Analyze
CO 3	**Apply** Design view for implementing vocabulary and functionality of various systems.	Apply
CO 4	**Apply** process view for improving performance and scalability in designing systems.	Apply
CO 5	**Apply** implementation view in system assembly and configuration management.	Apply
CO 6	**Apply** tdeployment view for designing system topology of various systems.	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 Exercise, 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 Exercise, 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 Exercise, 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 Exercise, 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	SEE

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.	3	Lab Exercises
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	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 5	Usage of **CASE tool** for modeling simple to complex engineering activities with understanding requirements and limitations of user.	1
	PSO 1	**Formulate** and **Evaluate engineering concepts** to Design next-generation computer systems for modeling simple to complex engineering activities with understanding requirements and limitations of user	2
CO 2	PO 3	**Design solutions** for simple and complex problems by **Defining** and **understanding** customer requirements, **identifying** various static and dynamic functions, **managing design process** and **evaluate the outcomes** as UML diagrams.	4
	PO 10	Make use of building blocks for creating architectural view of system using UML by **communicating effectively to engineering community.**	3
	PO 5	Usage of **CASE tool** for modeling simple to complex engineering activities with understanding requirements and limitations of user for architectural view of system.	1
	PSO 3	Make use of **computational and advanced CASE tools** for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2
CO 3	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.	4
	PO 5	Usage of **CASE tool** for modeling simple to complex engineering activities with understanding requirements and limitations of user.	1
	PO 10	**Communicate** static and dynamic aspects of the **system using UML diagrams** for specifying structure and interaction of objects during runtime.	5
	PO 12	Recognize the need and develop suitable building blocks using UML diagrams for **future advancement and lifelong learning.**	5
CO 4	PO 3	R**Design solutions** for simple and complex problems by **Defining problem, understand customer requirements, identifying** basic building blocks to draw UML diagrams.	3
	PO 5	Usage of **CASE tool** for modelling simple to complex engineering activities with understanding requirements and limitations of user.	1
	PO 10	Recognize building blocks for **visualizing design requirements** of an **object-oriented System.**	4

	PO 12	Visualize objects based on the need, through identifying required design requirements and build architectural model using the object-oriented system for **future advancement and lifelong learning.**	5
	PSO 1	**Formulate** and **Evaluate engineering concepts** to Design next-generation computer systems in identifying basic building blocks for visualizing artifacts of system.	2
	PSO 3	Make use of **computational and advanced CASE tools** for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2
CO 5	PO 2	**Understand** the given problem and system **definition, problem formulation, collecting data, modelling, solution development** and **documentation** for design solution by using advanced building blocks of UML.	5
	PO 5	Usage of **CASE tool** for modelling simple to complex engineering activities with understanding requirements and limitations of user.	1
	PSO 1	**Formulate** and **Evaluate engineering concepts** to Design next-generation computer systems by using advanced building blocks of UML.	2
	PSO 3	Make use of **computational and advanced CASE tools** for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2
CO 6	PO 10	**Make effective presentation** and better understanding of the scenario, use structural modeling framework with **knowledge and system approach.**	5
	PSO 1	**Formulate** and **Evaluate engineering concepts** to Design next-generation computer systems for structural modeling.	2
	PSO 3	Make use of **computational and advanced CASE tools** for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2

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

Table 10:

Course Outcomes	Program Outcomes					Program Specific Outcomes	
	PO2	PO3	PO5	PO10	PO12	PSO1	PSO3
CO1			1			2	
CO2		4	1	3			2
CO3	4		1	5	5		
CO4		1	1	4	5	2	2
CO5	5		1			2	2
CO6				5		2	2

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 2, PO 3, PO 5	SEE Exams	PO 2,PO 3, PO 5,PO 10, PO 12	Seminars	-
Laboratory Practices	PO 2,PO 3, PO 5	Student Viva	PO 2, PO 3, PO 10	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 UML**
	Study Of UML.
WEEK II	**ON LINE PURCHASE SYSTEM**
	Create a UML model for On line Purchase System
WEEK III	**LIBRARY MANAGEMENT SYSTEM**
	Create a UML model for Library Management System
WEEK IV	**E-TICKETING**
	Create a UML model for E-Ticketing
WEEK V	**QUIZ SYSTEM**
	Create a UML model for Quiz System.
WEEK VI	**STUDENT MARK ANALYZING SYSTEM**
	Create a UML model for Student Mark Analyzing System.
WEEK VII	**E-MAIL CLIENT SYSTEM**
	Create a UML model for E-Mail Client System.
WEEK VIII	**TELEPHONE PHONE DIALING**
	Create a UML model for Telephone Phone Dialing.
WEEK IX	**POINT OF SALE**
	Create a UML model for Point of sale.
WEEK X	**WORKING COMPANY**
	Create a UML model for a Working Company
WEEK XI	**ATM TRANSACTIONS**
	Create a system to design Bank ATM Transactions and generate code by using MS-Access as back end and VB as the front end.

WEEK XII	**STUDENT MARK ANALYSIS**
	Create a system to design Student mark analysis system and generate code by using MS-Access as back end and VB as the front end

TEXTBOOKS

1. Grady Booch, James Rumbaugh, Ivar Jacobson, —The Unified Modeling Language User Guide , Pearson Education, 2ndEdition, 2004.

REFERENCE BOOKS:

1. Craig Larman, —Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development , Pearson Education, 3rd Edition, 2005.

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 UML.	CO 1	R1: 1.1
2	On Line Purchase System.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1: 2.3
3	Library Management System	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1: 4.1
4	E-Ticketing	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1: 5.1
5	Quiz System.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R2: 6.1
6	Student Mark Analyzing System.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1: 7.1
7	E-Mail Client System.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R2: 11.4
8	Telephone Phone Dialing.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1: 12.5
9	Telephone Phone Dialing.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R2: 14.3
10	Working Company.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1: 15.1
11	ATM Transactions.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R2:16.4
12	Student Mark Analysis.	CO 1, CO 2 ,CO 3, CO 4 ,CO 5 ,CO 6	R1:20.5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Real time Online Transform** for embedded Systems considering non-functional aspects with rate-monotonic analysis.
2	Implementation of **Advanced relationships** and common mechanisms in real time applications.
3	**Reverse engineering:** Encourage students to implement model from a given input of source code.

Course Coordinator **HOD,CSE**
Mr. Rajesh Kumar Bhavani

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	COMPUTER SCIENCE AND ENGINEERING				
Course Title	INFORMATION SECURITY				
Course Code	AITB22				
Program	B.Tech				
Semester	VI				
Course Type	Elective				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms B.Geetavani , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITB10	V	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	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
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:

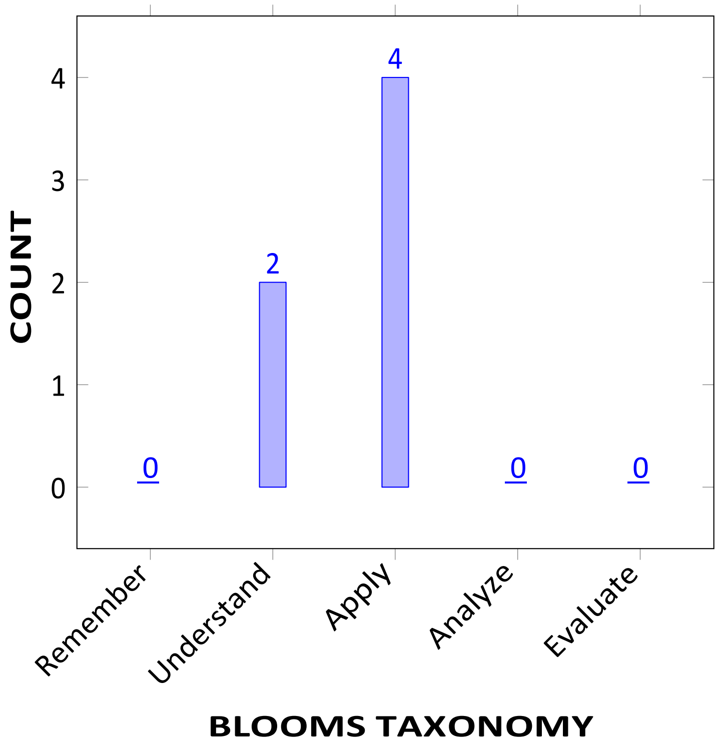
I	Understand security standards and practices. The scope and essentiality of threats, attacks to computers and networks associated to them
II	The symmetric and asymmetric key generation techniques used for providing message authentication, confidentiality and Integrity
III	The use cases on cryptography 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.	2.3	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.	2.6	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.	1	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 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	SEE/CIE/AAT
PSO 2	Focus on improving software reliability, network security / information retrieval systems.	2	SEE/CIE/AAT
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	2	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, Scientific and Engineering principals to prevent attacks on computer using network security and cryptographic algorithms	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	7
	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 and the ability to apply them to develop the cryptographic and network security algorithms to prevent attacks on computer.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Security problems on computers will be solved with clear applications of engineering network, security and cryptographic algorithms	2
	PO 12	Use appropriate techniques and algorithms in computer science related, industry oriented applications for preventing attacks on computers.	3
	PSO 1	Understand the problem specific constraints to prevent attacks on computers by applying appropriate network security and cryptographic algorithms.	4
	PSO 2	Focus on improving network security by selecting appropriate network security and cryptographic algorithms to prevent attacks on computer.	1
	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 using symmetric and asymmetric key ciphers for messaging end to end encryption	6
	PO 3	Outline the customer requirements, maintenance and engineering activities to prevent attacks on computer using symmetric and asymmetric key ciphers for messaging end to end encryption.	3
	PO 10	Security problems on computers will be solved with clear applications of engineering network, security and cryptographic algorithms	2
	PO 12	BUse appropriate techniques and algorithms in computer science related, industry oriented applications for preventing attacks on computers.	3
	PSO 1	IUnderstand 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 2	Focus on improving network security by selecting appropriate symmetric and asymmetric key ciphers to provide end to end security.	1
	PSO 3	BExtend 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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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.	2
	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 10	Security problems on computers will be solved with clear applications of engineering network, security and cryptographic algorithms	2
	PO 12	Use appropriate techniques and algorithms in computer science related, industry oriented applications for preventing attacks on computers.	3
	PSO 1	Understand the problem specific constraints to prevent attacks on computers by applying appropriate network security and cryptographic algorithms.	4
	PSO 2	Focus on improving network security by selecting appropriate tools and protocols used in message authentication and hashing functions for every day computing to remain secure.	1
‘	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
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.	2
	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.	7
	PO 3	Outline the customer requirements, maintenance and engineering activities to provide security to email against attackers and intruders.	4
	PO 10	Security problems on computers will be solved with clear applications of engineering network, security and cryptographic algorithms	2
	PO 12	Use appropriate techniques and algorithms in computer science related, industry oriented applications 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.	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 2	Focus on improving network security by selecting appropriate network security and cryptographic algorithms to prevent attacks on computer.	1
	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	2
	PO 2	Classify different firewalls required for problem identification, formulation, abstraction, data collection, design and to provide web security.	7
	PO 3	Outline the customer requirements, maintenance and engineering activities to provide web security using appropriate firewalls.	4
	PO 10	Security problems on computers will be solved with clear applications of engineering network, security and cryptographic algorithms .	2
	PO 12	Use appropriate techniques and algorithms in computer science related, industry oriented applications for preventing attacks on computers.	3
	PSO 1	Understand the problem specific constraints to provide web security by using appropriate firewall.	4
	PSO 2	Focus on improving network security by selecting appropriate firewalls and methods to provide web security.	1
	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.	3
	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.	7
	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	5
	PO 4	Interpret the appropriate quantitative method, engineering principles and the ability to enhance defence against cyber-attacks and to improve organization working culture	5
	PO 10	Security problems on computers will be solved with clear applications of engineering network, security and cryptographic algorithms	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	Use appropriate techniques and algorithms in computer science related, industry oriented applications for preventing attacks on computers.	3
	PSO 1	Understand the problem specific constraints to prevent attacks on computers by applying appropriate network security and cryptographic algorithms.	4
	PSO 2	Focus on improving network security by selecting appropriate network security and cryptographic algorithms to prevent attacks on computer.	1
	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	3	7	3	4	-	-	-	-	-	2	-	1	4	1	1
CO 2	3	6	3	-	-	-	-	-	-	2	-	1	4	1	1
CO 3	2	7	3	-	-	-	-	-	-	2	-	1	4	1	1
CO 4	2	7	4	-	-	-	-	-	-	2	-	1	4	1	1
CO 5	2	7	4	-	-	-	-	-	-	2	-	1	4	1	1
CO 6	3	7	5	5	-	-	-	-	-	2	-	1	4	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	100	70	30	36.3	-	-	-	-	-	40	-	12.5	66.66	50	50
CO 2	100	60	30	-	-	-	-	-	-	40	-	12.5	66.66	50	50
CO 3	60	70	30	-	-	-	-	-	-	40	-	12.5	66.66	50	50
CO 4	60	70	40	-	-	-	-	-	-	40	-	12.5	66.66	50	50
CO 5	60	70	40	-	-	-	-	-	-	40	-	12.5	66.66	50	50
CO 6	60	60	40	45.4	-	-	-	-	-	40	-	12.5	66.66	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	3	1	1	-	-	-	-	-	1	-	1	3	2	2
CO 2	3	2	1		-	-	-	-	-	1	-	1	3	2	2
CO 3	2	3	1	-	-	-	-	-	-	1	-	1	3	2	2
CO 4	2	3	2	-	-	-	-	-	-	1	-	1	3	2	2
CO 5	2	3	2	-	-	-	-	-	-	1	-	1	3	2	2
CO 6	2	2	1	1	-	-	-	-	-	1	-	1	3	2	2
TOTAL	14	16	8	2	-	-	-	-	-	6	-	6	18	12	12
AVERAGE	2.3	2.6	1.3	1	-	-	-	-	-	1	-	1	3	2	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	**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.

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1. http://bookboon.com/en/search?q=INFORMATION+SECURITY

2. https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0C

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, CSE**

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

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**LINUX PROGRAMMING LABORATORY**				
Course Code	AITB13				
Program	B.Tech				
Semester	VI	CSE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Ms K.Aishwarya, Assistant Professor				

I COURSE OVERVIEW:

The main emphasis of this lab course is to provide the idea behind the open source operating system approach to programming and to write bash scripts to solve real-world problems. Linux is the blend of innovative concepts required by its unique environment involving kernel concepts, basic commands, shell scripting, file processing, socket programming, processes and inter process communication (IPC). Linux is one of the most prominent open-source software used for commercial and non-commercial distributions.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	I	PPS
B.Tech	AITB04	IV	Operating Systems

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
LINUX PROGRAMMING LABORATORY	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

X	Demo Video	C	Lab Worksheets	C	Viva Questions	C	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:

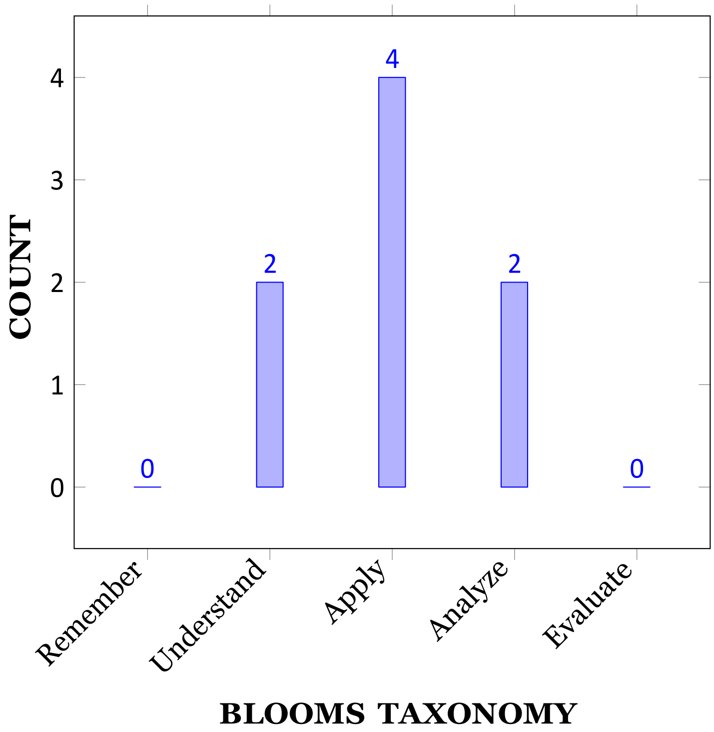
I	The fundamental concepts of operating system including bourne again shell (bash) with the linux command line environment.
II	The shell programming by writing shell scripts using arithmetic operations, control structures and functions in vi editor.
III	The process management and inter-process communication used for exchanging data between multiple threads in one or more processes.

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** text processing utilities, file handling utilities, security by file permissions, process utilities, disk utilities and networking commands with different options available for solving problems.	Understand
CO 2	**Make use of** bourne shell constructs, decision structures and loops in designing programs for complex problems.	Apply
CO 3	**Analyze** the process of parent and child relationships using fork(), vfork(), wait() and exec() system calls.	Analyze
CO 4	**Interpret** to write, compile, debug and run C language program in linux shell environment for implementing kernel level concepts.	Understand
CO 5	**Identify** basic methods and techniques used in solving simple programming tasks in the area of execution environment, processes signals and threads.	Apply
CO 6	**Experiment with** IPC mechanisms such as pipes, named pipes, shared memory, message queues, semaphores and sockets for interprocess communication.	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	CIE / SEE/ 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.	3	CIE / SEE/ 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	CIE / SEE/ 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.	3	CIE / SEE/ 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	CIE / SEE/ 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.	2	Lab Exercises
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	Lab Exercises
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies	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	Demonstrate shell commands for creating and searching files in **engineering fundamentals**, and an **engineering specialization** to the solution of **complex engineering problems.**	3
CO 2	PO 1	Make use of the following bourne shell constructs: test, if then, if then else, if then elif, for, while, until, and case to find the solution of **complex engineering problems.**	1
CO 3	PO 1	Analyze the process of parent and child relationships using system calls to apply the **knowledge of engineering fundamentals** , and an **engineering specialization** to the solution of **complex engineering problems** .	3
	PO 3	Analyze the process of parent and child relationships used for **designing solutions** for **complex engineering problems** .	2
CO 4	PO 1	Interpret to write, compile, debug and run C language program in linux shell environment to apply the knowledge of **engineering fundamentals**, and an **engineering specialization** to the solution of **complex engineering problems**.	3
	PO 3	Interpret to write, compile, debug and run C language program in linux shell environment for designing solutions for **complex engineering problems**.	1
CO 5	PO 1	Identify basic methods and techniques used in solving simple programming tasks in the area of execution environment, processes and signals, threads and asynchronous I/O using **engineering fundamentals** for the solutions of **complex engineering problems**.	2
CO 6	PO 1	Apply the knowledge of IPC mechanisms for inter process communication in **engineering fundamentals**, and an **engineering specialization** to the solution of **complex engineering problems**.	3
	PO 2	Experiment with IPC mechanisms for inter process communication to analyze **complex engineering problems** reaching **substantiated conclusions** using **principles of engineering sciences**.	3
	PSO 1	Design **next-generation computer systems, networking devices** using IPC mechanisms for inter process communication..	2
CO 7	PO 1	Find the effective solution of **complex engineering problems** by choosing the appropriate protocol for effective communication in client-server applications.	1
	PSO 2	Focus on **web applications development** and learn the **emerging technologies** for effective communication in client-server applications.	2

CO 8	PO 1	Test for different bash shell scripts and programs to solve real-world problems, or automate repetitive and complex tasks by applying the **knowledge of engineering fundamentals**, and an **engineering specialization** to the solution of **complex engineering problems**.	3
	PO 3	Test for different bash shell scripts and programs to solve real-world problems for **designing solutions** for **complex engineering problems**.	2
	PO 12	Use shell scripts and programs to solve real-world problems in linux which is needed for **life-long learning** in the **broadest context** of **technological change** in commercial and non-commercial distributions.	3

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

COURSE OUTCOME	PROGRAM OUTCOMES				PROGRAM OUTCOMES		
	PO 1	PO 2	PO 3	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3						
CO 2	1						
CO 3	3		2				
CO 4	3		1				
CO 5	2						
CO 6	3	3			2		
CO 7	1					2	
CO 8	3		2	3			3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 2, PO 3	SEE Exams	PO 1,PO 2, PO 3	Seminars	-
Laboratory Practices	PO 1,PO 2, PO 3	Student Viva	PO 1, PO 2, PO 3	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

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

XIV SYLLABUS:

WEEK 1	**BASIC COMMANDS I**
	Study and Practice on various commands like man, passwd, tty, script, clear, date, cal, cp, mv, ln, rm, unlink, mkdir, rmdir, du, df, mount, umount, find, unmask, ulimit, ps, who, w.
WEEK 2	**BASIC COMMANDS II**
	Study and Practice on various commands like cat, tail, head , sort, nl, uniq, grep, egrep,fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, tar, cpio.
WEEK 3	**SHELL PROGRAMMING I**
	a) Write a Shell Program to print all .txt files and .c files. b) Write a Shell program to move a set of files to a specified directory. c) Write a Shell program to display all the users who are currently logged in after a specified time. d) Write a Shell Program to wish the user based on the login time.
WEEK 4	**SHELL PROGRAMMING II**
	a) Write a Shell program to pass a message to a group of members, individual member and all. b) Write a Shell program to count the number of words in a file. c) Write a Shell program to calculate the factorial of a given number. d) Write a Shell program to generate Fibonacci series.
WEEK 5	**SIMULATING COMMANDS I**
	a) Simulate cat command b) Simulate cp command
WEEK 6	**SIMULATING COMMANDS II**
	a) Simulate tail command b) Simulate head command
WEEK 7	**SIMULATING COMMANDS III**
	a) Simulate mv command b) Simulate nl command
WEEK 8	**SIGNAL HANDLING**
	Write a program to handle the signals like SIGINT, SIGDFL, SIGIGN
WEEK 9	**INTERPROCESS COMMUNICATIONS**
	Implement the following IPC forms a) FIFO b) PIPE
WEEK 10	**MESSAGE QUEUES**
	a) Write a C program(sender.c) to create a message queue with read and write permissions to write 3 messages to it with different priority numbers. b) Write a C program(receiver.c) that receives the messages (from the above message queue as specified and displays them.
WEEK 11	**SHARED MEMORY**
	Implement shared memory form of IPC.
WEEK 12	**SOCKET PROGRAMMING**

	a) Write client and server programs (using c) for interaction between server and client processes using TCP elementary functions. b) Write client and server programs (using c) for interaction between server and client processes using UDP elementary functions.

TEXTBOOKS

1. Sumitabha Das, “Your Unix The Ultimate Guide”, Tata McGraw-Hill, New Delhi, India, 2007.
2. B. A. Forouzan and R. F. Gilberg, “Unix and Shell Programming”, Cengage Learning.

REFERENCE BOOKS:

1. Robert Love, “Linux System Programming”, O’Reilly, SPD.
2. Stephen G. Kochan, Patrick Wood, “Unix Shell Programming”, Sams publications, 3rd Edition, 2007.
3. T. Chan, “Unix System Programming using C++”, Prentice Hall India, 1999

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1. http://spoken-tutorial.org/tutorialsearch/?search_foss=Linux&search_language=English
2. https://www.redhat.com/en/files/resources/en-rhel-whats-new-in-rhel-712030417.pdf
3. http:// www.tutorialspoint.com/unix/ 4. http://cse09-iiith.virtual-labs.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	Basic Commands I	CO 1	T2: 4.7-4.8, 5.3-5.4
2	Basic Commands II.	CO 1	T2: 4.7-4.8, 5.3-5.4
3	Shell Programming I	CO 2	T2: 8.5, 14.14
4	Shell Programming II	CO 2	T2: 8.5, 14.14
5	Simulating Commands I	CO3, CO4	T2: 12.3-12.9, 15.9-15.10
6	Simulating Commands II	CO3, CO4	T2: 3.10,15.6, 17.5-17.6
7	Simulating Commands III	CO3, CO4	T2: 3.10,15.6, 17.5-17.6
8	Signal Handling	CO4, CO5	R4: 10.4-10.19
9	Inter process Communications.	CO 6	R4: 14.1-14.5
10	Message Queues	CO4, CO6	R4: 14.1-14.5
11	Shared Memory	CO4, CO6	R4: 14.7
12	Socket Programming	CO7, CO8	R2: 15.5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Write a C program to create a child process and allow the parent to display parent and the child to display child on the screen.
2	Write a C program to create a Zombie process.
3	Write a Shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. Whenever the argument is a file, the number of lines on it is also reported.
4	Write a C Program that makes a copy of a file using standard I/O and system calls.
5	Write a C program in which a parent writes a message to a pipe and the child reads the message.
6	Write a C program that illustrates how an orphan is created.
7	Write a C program that illustrates how an orphan is created.

Signature of Course Coordinator **HOD,CSE**

Ms K.Aishwarya Assistant Professor

COURSE DESCRIPTION

Department	COMPUTER SCIENCE AND ENGINEERING				
Course Title	LINUX PROGRAMMING				
Course Code	AITB12				
Program	B.Tech				
Semester	VI				
Course Type	CORE				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	1	3	-	-
Course Coordinator	Dr B.J.D Kalyani, ASSOCIATE PROFESSOR				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS001	I	Computer Programming
B.Tech	AIT003	IV	Computer Networks

II COURSE OVERVIEW:

This course provides a deep understanding of the operating system architecture and low-level interfaces (principally, system calls and library functions) that are required to build system-level, multithreaded, and network applications on Linux and UNIX systems. The course consists of a mixture of detailed presentations coupled with a large number of carefully designed practical exercises that allow participants to apply the knowledge learned in the presentations.By the completion of the course, participants will have the mastery needed to write complex system, network, and multithreaded applications on a Linux or UNIX system.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Linux Programming	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	✓	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 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
10 %	Remember
70 %	Understand
20 %	Apply
0 %	Analyze

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 averageof 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:

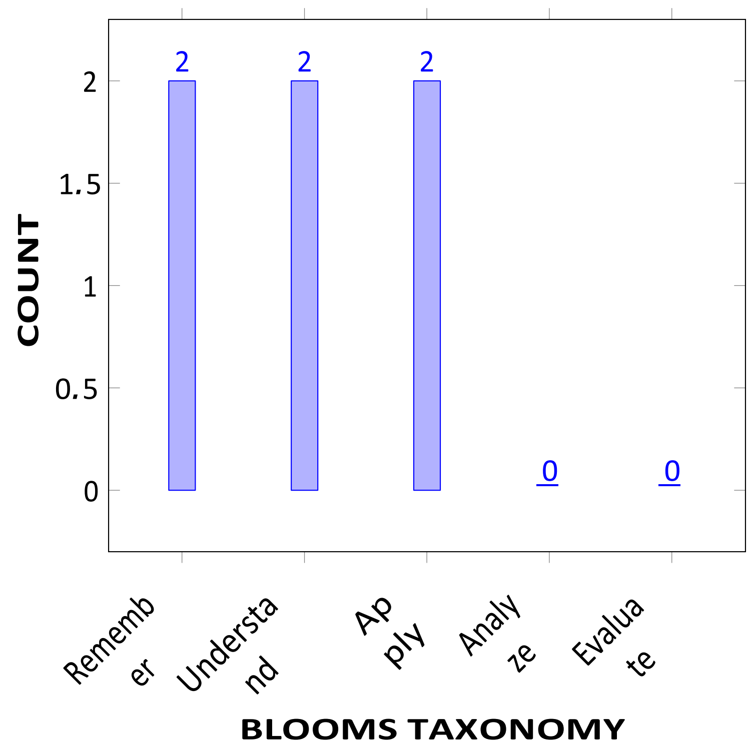
I	The features and architecture of Linux operating system along with linux utilities and shell scripting language to solve problems.
II	The concepts of Low-Level system call for file handling and process management.
III	To develop skills the necessary for systems programming including file system programming, process and signal management.
IV	Mechanisms for establishing communication in client- server applications.

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** operations using file handling, text processing and linux utilities.	Understand
CO 2	**Outline** the different shell scripts to execute systems programs and application programs.	Remember
CO 3	**Make use of** different system calls for file I/O operations and managing the file systems.	Apply
CO 4	**Demonstrate** the concepts of process and signal system calls for process creation, scheduling, controlling and termination.	Understand
CO 5	**Outline** IPC mechanisms such as pipes, shared memory, message queues, semaphores for performing inter process communication	Remember
CO 6	**Utilize** socket concepts for connection-oriented and connectionless communication between client and server systems.	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, 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 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 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	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	Assignments
PSO 2	Focus on mobile and web applications development and learn the emerging technologies and frameworks in demand with employers and contemporary challenges.	2	Assignments
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 = 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 knowledge of mathematics, science, engineering fundamentals** for overcoming the problems of operating systems like Windows, Mac etc and managing file systems.	3
	PO 5	**Create, select, and apply appropriate techniques** to solve the problems in inter process communication.	3
	PSO 1	**Understand, analyze and develop computer programs** to implement own operating systems using system calls and utilities.	3
CO 2	PO 1	**Apply the knowledge of mathematics, science, engineering fundamentals** for overcoming the problems of operating systems like Windows, Mac etc and managing file systems.	3
	PO 5	**Create, select, and apply appropriate techniques** to solve the problems in inter process communication.	3
CO 3	PO 1	**Apply the knowledge of mathematics, science, engineering fundamentals** for overcoming the problems of operating systems like Windows, Mac etc and managing file systems.	3
	PO 5	**Create, select, and apply appropriate techniques** to solve the problems in inter process communication.	3
CO 4	PO 1	**Apply the knowledge of mathematics, science, engineering fundamentals** for overcoming the problems of operating systems like Windows, Mac etc and managing file systems.	3
	PO 2	**Identify and analyze complex engineering problems** for accessing operating services.	2
	PO 5	**Create, select, and apply appropriate techniques** to solve the problems in inter process communication.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 2	**Ability to apply standard practices and strategies in software project devleopment using open ended programming** to design client server applications.	2
CO 5	PO 1	**Apply the knowledge of mathematics, science, engineering fundamentals** for overcoming the problems of operating systems like Windows, Mac etc and managing file systems.	3
	PO 3	**Design solutions for complex engineering problems** using inter process communication mechanisms.	3
	PO 5	**Create, select, and apply appropriate techniques** to solve the problems in inter process communication.	3
	PSO 1	**Understand, analyze and develop computer programs** to implement own operating systems using system calls and utilities.	3
CO 6	PO 1	**Apply the knowledge of mathematics, science, engineering fundamentals** for overcoming the problems of operating systems like Windows, Mac etc and managing file systems.	3
	PO 3	**Design solutions for complex engineering problems** using inter process communication mechanisms.	3
	PO 5	**Create, select, and apply appropriate techniques** to solve the problems in inter process communication.	3
	PSO 1	**Understand, analyze and develop computer programs** to implement own operating systems using system calls and utilities.	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	-	-	-	-	-	-	-	3	-	-
CO 2	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	3	-	-	-	-	-	-	-	-	2	-
CO 5	3	-	2	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	-	2	-	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	-	-	-	100	-	-	-	-	-	-	-	100	-	-
CO 2	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	-	100	-	-	-	-	-	-	-	-	40	-
CO 5	100	-	40	-	100	-	-	-	-	-	-	-	100	-	-
CO 6	100	-	40	-	100	-	-	-	-	-	-	-	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	-	-	-	-	-	-	-	3	-	-
CO 2	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	3	-	-	-	-	-	-	-	-	2	-
CO 5	3	-	2	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	-	2	-	3	-	-	-	-	-	-	-	3	-	-
TOTAL	18	4	4	-	18	-	-	-	-	-	-	-	9	2	-
AVERAGE	3	2	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:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION AND LINUX UTILITIES**
	Introduction to Linux operating system: History of Linux, features of Linux, architecture of Unix/Linux, Linux Utilities-File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities;Applications: Shell programming with Bourne again shell(bash)- Introduction, shell responsibilities, pipes and Redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.
MODULE II	**FILES AND DIRECTORIES SYSTEM CALLS**
	Files and Directories: File Concept, File types, File System Structure, File metadata- Inodes, kernel support for files, System calls for file I/O operations- open, create, read, write, close, lseek,dup2, file status informationstat family, file and record locking- fcntl function, permission- chmod, fchmod, file ownership- chown, lchown, links- soft links and hard links- symlink, link, unlink; Directories: creating, removing and changing directories- mkdir, rmdir, chdir, obtaining current working directory- getcwd, directory contents, scanning directories- opendir, readdir, closedir, rewinddir functions.
MODULE III	**PROCESS AND SIGNALS**
	Process – Process concept, Layout of a C program, image in main memory, process environment- environment list, environment variables, getenv, setenv, Kernel support for process, process identification, process control - process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process, system call interface for process management- fork, vfork, exit, wait, waitpid, exec family, process groups, sessions and controlling terminal, differences between threads and processes. Signals– Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, abort, sleep functions.
MODULE IV	**INTERPROCESS COMMUNICATION**
	Inter process Communication: Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, Pipes-creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs(named pipes), differences between unnamed and named pipes. Message Queues- Kernel support for messages, APIs for message queues, client/server example; Semaphores-Kernel support for semaphores, APIs for semaphores, file locking with Semaphores.
MODULE V	**SHARED MEMORY AND SOCKETS**
	Shared Memory- Kernel support for shared memory, APIs for shared memory, shared memory example. Sockets: Introduction to Berkeley Sockets, IPC over a network, client/server model, Socket Address structures (UNIX domain and internet domain), Socket system calls for connection oriented protocol and connectionless protocol, example-client / server programs- single client/server connection, Multiple simultaneous clients.

TEXTBOOKS

1. Sumitabha Das, "Your Unix The Ultimate Guide", Tata McGraw-Hill, New Delhi, India, 2012.
2. W. Richard. Stevens, "Advanced Programming in the UNIX Environment" Pearson Education, New Delhi, India, 2013.

REFERENCE BOOKS:

1. T. Chan, "Unix System Programming using C++" PHI. 4 th Edition, 2007.
2. N. Mathew, R. Stones, Wrox, "Beginning Linux Programming", Wiley India Edition, 4 th Edition, 2014.
3. Graham Glass, King Ables, "Unix for Programmers and Users",Pearson Education, 3 rd Edition, 2008.
4. A. Hoover, "System Programming with C and Unix", 3 rd Edition, 2008.
5. K. A. Robbins, "System Programming, Communication, Concurrency and Threads", Pearson Education, 4 thEdition, 2014.

WEB REFERENCES:

1. https://www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-0
2. http://www.tutorialspoint.com/listtutorials/linux/1
3. http://www.compsci.hunter.cuny.edu/ sweiss/course_materials/unix_lecture_notes.php.

COURSE WEB PAGE:

https://www.youtube.com/playlist?list=PLzkMouYverAL-n5gSzmx00aAusHgyzfGD

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	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	Understand history of Linux and its features	CO 1	T2: 1.1-1.5, T1: 4.1
3	Architecture of Unix/Linux	CO 1	T2: 4.7-4.8, 5.3-5.4
4-5	Linux Utilities-File handling utilities,	CO 1	T2: 3.10,15.6, 17.5-17.6

6	Security by file permissions, Process utilities,	CO 1	T2: 3.10,15.6, 17.5-17.6
7-8	Disk utilities, Networking commands, Filters.	CO 1	T2: 12.3-12.9 15.9-15.10
9	Text processing utilities and Backup utilities.	CO 1	T2: 13.4
10-11	Demonstrate pattern scanning and processing in problem solving.	CO 1	T2: 18.1, T2:18.12
12-13	Understand basic shell scripting.	CO 2	T2: 8.5
14	Understand shell script execution.	CO 2	T2: 14.14
15	Classify use of special characters.	CO 2	T2: 8.9
16-17	Illustrate forwarding the command output into another context	CO 2	T2: 8.4, 8.10
18-19	Develop solutions to complex tasks.	CO 2	T2: 14.5-14.17
20	Demonstrate the use of the formatting Specifies of IO.	CO 3	R4: 4.1-4.14
21-22	Demonstrate standard stream and buffer based input and output system calls.	CO 3	R4: 5.1-5.9
23	Demonstrate layout of what's being printed.	CO 3	R4: 5.10-5.11
24-25	Demonstrate modification and editing.	CO 2	R4: 3.1-3.12, 4.2
26-27	Demonstrate security concepts in files.	CO 3	T2: 5.2
28	Discuss scanning and linking methods.	CO 3	R4: 4.20-4.22, 4.15-4.17
29-31	Understand internal procedures and states of IPC	CO 4	R4: 8.6
32-33	Illustrate daemons and varieties.	CO 4	R4: 8.6
34	Classify processes to respond to asynchronous events.	CO 4	R4: 10.1-10.3
35-36	Understand and to handle exceptional situations.	CO 4	R4: 10.4-10.19
37-38	Demonstrate inter related process communication	CO 5	R4: 14.1-14.4
39	Demonstrate named pipes.	CO 5	R4: 14.5
40	Discuss types of restricting and accessing different resources.	CO 5	R4: 14.6
41-43	Demonstrate dividing up work among to balance work over multiple processes.	CO 5	R4: 14.7
44	Demonstrate user variables and semaphore operations, provided at the kernel level.	CO 5	R4: 14.8
45-46	Solve security hurdles using programming interface of Linux	CO 5	R4: 14.8
47	Demonstrate common memory portion which other processes	CO 6	R4: 14.9
48-49	Illustrate common memory sharing interfacing example.	CO 6	R4: 14.9

50-51	Demonstrate parallelism in Linux based system calls.	CO 6	T1: 13.1-13.2
52	Demonstrate concurrency in Linux APIs.	CO 6	T1: 13.4
53-54	Demonstrate multiple processes to a common resource in Linux based parallel	CO 6	T1: 13.5
55-57	Demonstrate multiple threads access the same resource for read and write.	CO 6	T1: 13.5
58	Understand end to end network communication	CO 6	R2: 15.1
59-60	Understand TCP based system calls	CO 6	R2: 15.5
61-62	Understand UDP protocol system calls	CO 6	R2: 15.5
63-64	Demonstrate connection oriented, connectionless communications in two and three	CO 6	R2: 15.5
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on shell scripting in linux operating system to do various operations.	CO 3	R2:7.5
2	Problems on file system calls to implement utilities in linux operating system.	CO 2	R2:7.5
3	Problems on directory system calls to create and access directory files in linux operating system.	CO 3	R2:7.5
4	Problems on process for creating and terminating of linux operating system.	CO 2	R2:7.5
5	Problems on signals to control the process in linux.	CO 2	R2:7.5
6	Problems on Interprocess communication using pipes, fifo mechanisms.	CO 3	R2:7.5
7	Problems on Interprocess communication using message queues system calls.	CO 3	R2:7.5
8	Problems on Interprocess communication using shared memory and semaphores.	CO 3	R2:7.5
9	Problems on connection oriented and connection less to exchange data between process using system calls.	CO 3	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions on linux operating system and utilities	CO 1	T1:1.2
2	Definitions on shell responsibilities	CO 2	T1:1.6
3	Definitions on process system calls	CO 3	T1:8,9
4	Definitions on signal system calls	CO 4	T1:9.1
5	Definitions on inter process communication mechanisms	CO 5	T1:10,11

DISCUSSION OF QUESTION BANK			
1	Linux architecture and utilities, shell programming	CO 1	T1:1.2
2	Files and Directory system calls	CO 2	T1:1.5
3	Process and Signals	CO 3	T1:8,9
4	Inter Process Communication mechanisms of pipes, fifo, message queues	CO 4	T1:9.1
5	Inter Process Communication using TCP and UDP protocols	CO 5,6	T1:10,11

Signature of Course Coordinator **HOD,CSE**

Ms B.Geetavani, Assistant Professor

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**PRINCIPLES OF ARTIFICAL INTELLIGENCE**				
Course Code	ACSB13				
Program	B.Tech				
Semester	VI				
Course Type	Core				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr.Ch.Santhaiah, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHSC08	II	Probability and Statistics
UG	ACSB03	II	Data Structures
UG	ACSB04	III	Discrete Mathematical Structures
UG	AITB05	IV	Design and Analysis of Algorithms

II COURSE OVERVIEW:

Driven by the combination of increased access to data, computational power, and improved sensors and algorithms, Artificial Intelligence (AI) technologies are entering the mainstream of technological innovation. These technologies include search, machine learning, natural language processing, robotics and image processing.
Artificial intelligence (AI) is a study field that examines how to achieve intelligent human behaviours on a computer. An ultimate objective of AI is to make a PC that can learn, plan, and take care of issues independently.
In spite of the fact that AI has been thought for many years, we can't make a PC that is as clever as a human in all perspectives. Still, we do have several successful applications. In some cases, the computer implemented with AI technology can be even more clever than us. The Deep Blue system which won against the world chess champion is a great example.
Presentation of artificial intelligence is though, ideas and methods to familiarize the student with the basic programs in the field and their underlying theory. Students will explore this through problem-solving paradigms, logic and theorem proving, language and image understanding, search and control methods and learning.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Principles of Artificial Intelligence	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
%	Remember
%	Understand
%	Apply
0 %	Analyze

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:

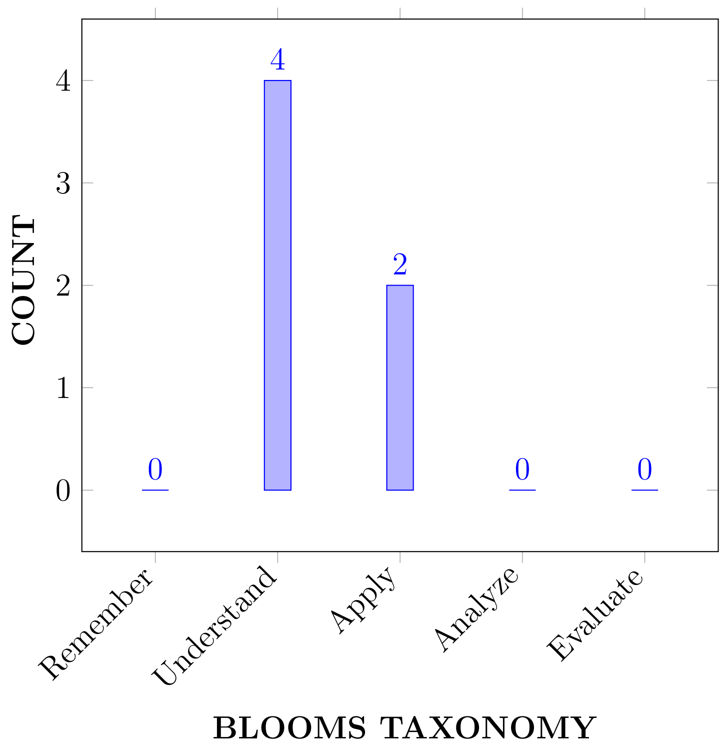
I	Gain a historical perspective of AI and its foundations.
II	Become familiar with basic principles of AI toward problem solving, inference, knowledge representation, and learning.
III	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
IV	Experience AI development tools such as Prolog (AI language), expert system shell, and/or data mining tool.
V	Explore the current scope, potential, limitations, and implications of intelligent systems.

VII COURSE OUTCOMES:

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

CO 1	**Summarize** knowledge representation and issues in AI and Related fields.	Understand
CO 2	**Demonstrate** knowledge reasoning with predicate logic and inference rules in the presence of incomplete and/or uncertain information.	Understand
CO 3	**Choose** Heuristic, Adversarial search and game playing algorithms for addressing a particular AI problem and implement the selected strategy.	Apply
CO 4	**Experiment with** uncertainty issues by using statistical and symbolic reasoning approaches.	Apply
CO 5	**Outline** subfields and applications of AI such as planning, learning, and expert systems in specific domain problems.	Understand
CO 6	**Demonstrate** knowledge representation with the help of AI languages and tools.	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
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 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	CIE/Quiz/AAT
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	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 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, 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

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	3	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	Learn definition of AI and its underlying assumptions. The approaches also evolved from the foundation of AI algorithms to the paradigm slot in symbolic algorithms and expert system development, Machine learning and Deep learning **to support study of their own engineering discipline applying mathematical and scientific principles.**	3
	PSO 1	Understand Early works in AI to design **System Software** and make use of these in the areas related to **Web design, Machine learning and Networking.**	4
CO 2	PO 3	Relate Knowledge and understand approaches to knowledge representation **in commercial and economic context of engineering process to Various problems, customer and user needs, cost effective and creative solutions, design process and Management techniques.**	7
	PSO 2	Understand Issues in Knowledge Representation in improving **Software reliability, security and information retrieval systems.**	2
CO 3	PO 1	Compare procedural and declarative knowledge in **solving complex engineering problems.**	3
	PSO 1	Demonstrate algorithms for **solving logic programming.**	4
CO 4	PO 1	Recall steps of algorithm to convert casual forms with **scientific principles and mathematical principles.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 1	Make use of **algorithms** to convert casual forms relating formula in proof.	4
CO 5	PO 1	Explain axioms and rules of inference in nonmonotonic reasoning to extend some kind of numeric measure of certainty using **scientific principles and mathematical principles.**	2
	PO 2	Explore techniques for solving problems with incomplete and uncertain models **by identifying the problem statement, information collection and develop a solution and documentation**	4
	PO 3	Design solutions for uncertainty problems in any AI system that seeks to model and reasoning by **investigating, identifying constraints to establish innovative solutions evaluate outcomes and promote sustainability.**	5
	PO 10	Understand the techniques for solving problems and **communicate effectively with the engineering community and with society at large.**	3
	PSO 2	Understand the techniques of uncertainty for improving **software reliability and information retrieval.**	2
CO 6	PO 1	Apply inference and resolution for conversion of facts into first order logic, statements into CNF(Conjunctive Normal form) using **scientific, mathematical principles and support study of their own engineering discipline**	3
	PO 2	Build refutation proofs that are proofs by contradiction by **identifying, formulating and analysing complex engineering problems with the help of basic mathematics and engineering sciences.**	7
	PSO 1	Make use of inference and resolution to **design and analyze computer programs** for converting the facts and statements	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	-	-	-	-	-	-	-	-	-	-		4	-	-
CO 2	-	-	7	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 5	2	4	5	-	-	-	-	-	-	3	-	-	-	2	-
CO 6	3	7	-	-	-	-	-	-	-	-	-		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.6	0.0	0.0
CO 2	0.0	0.0	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0
CO 3	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.6	0.0	0.0
CO 4	66.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.6	0.0	0.0
CO 5	66.6	40	50	0.0	0.0	0.0	0.0	0.0	0.0	60	0.0	0.0	0.0	100	0.0
CO 6	100	70	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

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	0	0	0	0	0	0	0	0	0	0	0	3	0	0
CO 2	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0
CO 3	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0
CO 4	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0
CO 5	3	2	2	0	0	0	0	0	0	3	0	0	0	3	0
CO 6	3	3	0	0	0	0	0	0	0	0	0	0	2	0	0
TOTAL	15	5	5	0	0	0	0	0	0	3	0	0	11	6	0
AVERAGE	2.5	0.83	1.6	0	0	0	0	0	0	0.5	0	0	1.8	1.0	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:

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

XVIII SYLLABUS:

MODULE I	**INTRODUCTION OF AI AND KNOWLEDGE REPRESENTATION**
	Definition of AI, The AI Problems, The Underlying Assumption, AI Techniques, The Level of the Model, Criteria for Success, The importance of AI, Early works in AI, AI and Related fields, The Foundations of Artificial Intelligence, The History of Artificial Intelligence. Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs. Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation. AI Languages and Tools: Lisp, Prolog, CLIPS.
MODULE II	**FIRST ORDER LOGIC AND INFERENCE**
	Using Predicate Logic: Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Properties of Wff, Clausal Forms, Conversion to clausal forms, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge.
MODULE III	**SEARCH TECHNIQUES**
	Heuristic Search Techniques: Generate-and-Test, Hill Climbing, Best-first Search, A* algorithm, AO* algorithm, Problem Reduction, And-Or search, Constraint Satisfaction, Means-ends Analysis. Adversarial Search and Game Playing: Optimal Decision in Games, The minimax algorithm, Alpha-Beta pruning, Iterative Deepening, Expectimax search.
MODULE IV	**HANDLING UNCERTANITY**
	Symbolic Reasoning Under Uncertainty: Introduction to Non monotonic Reasoning, Logics for Non monotonic Reasoning, Implementation Issues, Augmenting a Problem-solver. Statistical Reasoning: Probability and Bayes' Theorem, Certainty Factors and Rule-based Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic.
MODULE V	**PLANNING, LEARNING AND EXPERT SYSTEMS**
	Planning: Overview, An Example Domain: The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems. Learning: What is learning, Rote learning, Learning by taking Advice, Learning from example: Induction, Explanation based learning (EBL), Discovery, Clustering, Analogy, Neural net and genetic learning, Reinforcement learning. Expert System: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition, Expert System Architectures, Rule based systems, Non production system, knowledge acquisition.

TEXTBOOKS

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill, 3rd Edition, 2009.

2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall, 2007

REFERENCE BOOKS:

1. Nils J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1990.
2. Stuart Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Pearson Education, 2nd Edition, 2010.
3. VS Janakiraman K, Sarukesi Gopalakrishnan, Foundations of Artificial Intelligence & Expert Systems, Macmillan.

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	Definition of AI, The AI Problems, The Underlying Assumption	CO 1	T1:1.1-1.8, 2.2
2	AI Techniques, The Level of the Model, Criteria for Success	CO 1	T1:1.10
3	The importance of AI, Early works in AI	CO 2	T2:2.7
4	AI and Related fields, The Foundations of Artificial Intelligence	CO 3	T2:2.8
5	The History of Artificial Intelligence.	CO 4	T3:2.8
6	Defining the Problem as a State Space Search.	CO 1	
7	Production Systems, Problem Characteristics,	CO 4	T1:3.1-3.2
8	Production System Characteristics,	CO 4	T1:4.2,7.1-7.4
9	Issues in the Design of Search Programs.	CO 5	T1:3.3-3.7
10	Representations and Mappings.	CO 5	T1:4.2,7.1-7.4
11	Approaches to Knowledge Representation	CO 1	T2:2.8
12	Issues in Knowledge Representation.	CO 4	T1:1.3 T1:1.7,7.4
13	Representing Simple Facts in Logic,	CO 6	T1: 7.6 7.7, 8.9-8.10
14	Representing Instance and ISA Relationships,	CO 4	T1:1.3 T1:1.7,7.4
15	Computable Functions and Predicates,.	CO 3	T1:1.1 T1:1.1-1.4
16	Properties of Wff, Clausal Forms, Conversion to clausal forms, Resolution	CO 5	T1: 7.6 7.7, 8.9-8.10
17	Procedural Versus Declarative Knowledge, Logic Programming,	CO 4	T1:1.1-1.2 T1:1.5-1.7
18	Forward Versus Backward Reasoning,	CO 1	T1:1.3 T1:1.7,7.4
19	Matching, Control Knowledge.	CO 4	T1:1.1-1.2 T1:1.5-1.7
20	Generate-and-Test, Hill Climbing,	CO 1	T1:3.1-3.4 T1:2.1-2.4

21	Best-first Search,Problem Reduction,	CO 5	T1:5.1-5.3 T1:2.8,3.7-3.8
22	And-Or search, Constraint Satisfaction, Means-ends Analysis.	CO1	T1:1.1-1.2 T1:1.5-1.7
23	A* algorithm, AO* algorithm	CO 2	T1:3.3-3.5 T1:2.6
24	Optimal Decision in Games,	CO 3	T1:5.1-5.3 T1:2.8,3.7-3.8
24	The minimax algorithm, Alpha-Beta pruning,	CO 5	T1:3.3-3.5 T1:2.6
25	Iterative Deepening, Expectimax search.	CO 4	T1:5.1.-5.10 T1:3.6
26	Introduction to Non monotonic Reasoning,	CO 4	T1:4.4-4.6 T1: 5.11 T1:3.10
27	Logics for Non monotonic Reasoning,	CO 1	T1:5.1-5.3 T1:2.8,3.7-3.8
28	Probability and Bayes' Theorem,	CO 5	T1:3.3-3.5 T1:2.6
29	Certainty Factors and Rule-based Systems,.	CO1	T1: 5.11 T1:3.10
30	Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic	CO2	T1:3.3-3.5 T1:2.6
31	Overview, An Example Domain: The Blocks World,	CO 5	T1:6.1,6.4 T1:4.1-4.5
32	Components of a Planning System,	CO 5	T1:6.3,6.10 T1:4.9-4.10
33	Goal Stack Planning, Nonlinear Planning Using Constraint Posting,	CO1	T1:5.1-5.3 T1:2.8,3.7-3.8
34	Hierarchical Planning, Reactive Systems. What is learning, Rote learning,	CO 1	T1:3.3-3.5 T1:2.6
35	learning by taking Advice, learning from example:	CO 5	T1:6.2-6.3,6.7 T1:4.8,4.11
36	Induction, Explanation based learning (EBL),	CO1	T1: 7.6 7.7, 8.9-8.10
37	Discovery, Clustering, Analogy, Neural net and genetic learning, Reinforcement learning.	CO2	T1:6.1,6.4 T1:4.1-4.5
38	Representing and Using Domain Knowledge,	CO3	T1:5.1.-5.10 T1:3.6
39	Expert System Shells, Explanation, Knowledge Acquisition, Expert System Architectures,	CO 6	T1:6.3,6.10 T1:4.9-4.10
40	Rule based systems, Non production system, knowledge acquisition	CO 1	T1:1.3 T1:1.7,7.4
PROBLEM SOLVING			
41	Enumerate Classical "Water jug Problem". Describe the state space for this problem and also give the solution	CO 1	T1:6.1,6.4 T1:4.1-4.5
42	Illustrate Knowledge Organization and Manipulation IN AI	CO1	T1:6.1,6.4 T1:4.1-4.5

43	Imagine that you had been to an aquarium and seen a shark and an octopus .Describe these to a child who has never seen one. What resources and mechanisms does the child use to comprehend the nature of these marine animals?	CO2	T1: 7.6 7.7, 8.9-8.10
44	Analyze each of them with respect to the seven problem characteristics, Chess, 8-puzzle, Missionaries and cannibals, Monkey and bananas, Tower of Hanoi, Crypt arithmetic	CO1	T1:6.3,6.10 T1:4.9-4.10
45	Find a good state space representation for the following. Water jug, Traveling salesman, Tower of Hanoi , Crypt arithmetic, Chess , 8-puzzle.	CO2	T1:5.1.-5.10 T1:3.6
46	Trace the operation of the unification algorithm on each of the following pairs of literals: f(Marcus) and f(Caesar) ii. f(x) and f(g(y)) f(Marcus,g(x,y)) and f(x,g(Caesar,Marcus))	CO3	T1:6.1,6.4 T1:4.1-4.5
47	Convert the following well formed formula into clause from with sequence of steps: x: [Roman(x) Know (x, Marcus)] [hate(x, Caesar) v (y: z: hate(y,z) thinkcrazy(x,y))]	CO4	T1: 7.6 7.7, 8.9-8.10
48	Assume the following facts: Steve only likes easy courses. Science courses are hard. All the courses in the basketweaving department are easy BK301 is a basketweaving course. Use resolution to answer the question, "What course would Steve like?"	CO3	T1:6.2-6.3,6.7 T1:4.8,4.11
49	Imagine a Robot trying to move from one place in a city to other.It has complete knowledge of the connecting roads in the city.As it moves the road condition keep changing.If the robot is to reach its destination with in a prescribed time,Suggest an algorithm for the same [HINT:Split the roadmap into a set of connected nodes and imagine that the costs of moving from one node to another change based on sometime dependent conditions].	CO2	T1: 7.6 7.7, 8.9-8.10
50	What are the Implementation Issues and explain about Augmenting a Problem-solver.	CO2	T1:5.1-5.3 T1:2.8,3.7-3.8
51	Use Fuzzy logic.For example,you might want to define such fuzzy sets as honest people or greedy people and describe Abott,Babbit,and Cabot's memberships in those sets.	CO1	T1:6.3,6.10 T1:4.9-4.10
52	Show how a JTMS could be used in medical diagnosis. Consider rules such as, "If you have a runny nose, assume you have a cold unless it is allergy season."	CO4	T1:6.1,6.4 T1:4.1-4.5
53	Explain in detail about STRIPS and write the components of STRIPS for the given scenario: "Consider a flight journey in a luxurious flight fom India to US"	CO3	

54	Consider the problem of building a program to learn a grammar for a language such as English. Assume that such a program would be provided, as input, with a set of pairs, each consisting of a sentence and a representation of the meaning of the sentence. This is analogous to the experience of a child who hears a sentence and sees something at the same time. How could such a program be built using the techniques	CO4	T1: 7.6 7.7, 8.9-8.10
55	Consider the problem of devising a plan for cleaning the kitchen. (a)Write a set of STRIPS-style operators that might be used. When you describe the operators, take into account such considerations as: Cleaning the stove or the refrigerator will get the floor dirty. To clean the oven, it is necessary to apply oven cleaner and then to remove the cleaner. Before the floor can be washed, it must be swept. Before the floor can be swept, the garbage must be taken out. Cleaning the refrigerator generates garbage and messes up the counters. Washing the counters or the floor gets the sink dirty. (b) Write a description of a likely initial state of a kitchen in need of cleaning. Also write a description of a desirable (but perhaps rarely obtained) goal state. (c) Show how the technique of planning using a goal stack could be used to solve this problem.	CO3	T1:5.1-5.3 T1:2.8,3.7-3.8
DEFINITION AND TERMINOLOGY			
56	Define Artificial Intelligence	CO1	T1:6.2-6.3,6.7 T1:4.8,4.11
57	What is a Support Vector Machine?	CO2	T1:6.1,6.4 T1:4.1-4.5
58	What is Disjunctive normal form?	CO4	T1: 7.6 7.7, 8.9-8.10
59	Why is Depth-first search used?	CO2	T1:6.3,6.10 T1:4.9-4.10
60	Define the term STRIPS	CO5	T1:6.3,6.10 T1:4.9-4.10
DISCUSSION OF TUTORIAL QUESTION BANK			
61	Solve the Water Jug problem: you are given 2 jugs, a 4-gallon one and 3-gallon one. Neither has any measuring maker on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into 4-gallon jug? Explicit assumptions: A jug can be filled from the pump, water can be poured out of a jug onto the ground, water can be poured from one jug to another and that there are no other measuring devices available.	CO1	T1:5.1-5.3 T1:2.8,3.7-3.8

62	What problems would be encountered in attempting to represent the following statements in predicate logic?It should be possible to deduce the final statement from the others John only likes to see French movies. It's safe to assume a movie is American unless explicitly told otherwise The playhouse really shows the Foreign films People don't do things that will cause them to be in situations that they don't like	CO3	T1:6.2-6.3,6.7 T1:4.8,4.11
63	The constraint satisfaction procedure we have described performs depth-first search whenever some kind of search is necessary.But depth-first search is not the only way to conduct such a search (a) Rewrite the constraint satisfaction procedure to use breadth first search (b) Rewrite the constraint satisfaction procedure to use best first search	CO2	T1: 7.6 7.7, 8.9-8.10
64	Construct a Bayesian Network and define the necessary CPTs for the given scenario. We have a bag of three biased coins a,b and c with probabilities of coming up heads of 20%, 60% and 80% respectively. One coin is drawn randomly from the bag (with equal likelihood of drawing each of the three coins) and then the coins flipped three times to generate the outcomes X1, X2 and X3.	CO4	T1:6.3,6.10 T1:4.9-4.10
65	Explain in detail about STRIPS and write the components of STRIPS for the given scenario: "Consider a flight journey in a luxurious flight fom India to US"	CO5	T1:6.1,6.4 T1:4.1-4.5

Signature of Course Coordinator **HOD,CSE**

Dr. Ch Santhaiah, Associate Professor

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

Course Title	**INTERNET OF THINGS**				
Course Code	AITB20				
Program	B.Tech				
Semester	VI	CSE			
Course Type	Elective				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. B Anupama, Assistant Professor				

I COURSE OVERVIEW:

Internet of things (IoT) is a network of things that are embedded with software and sensors to process data. This course include physical and logical design of IoT systems, M2M systems, SDN, IoT Architecture components such as physical devices and endpoints, physical servers and cloud offerings. This is used in various applications such as Smart Refrigerator, Smart Homes and Smart environments.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITB10	V	Computer Networks

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Internet of Things	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 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

VI COURSE OBJECTIVES:

The students will try to learn:

I	The significance of the Internet of Things
II	The sensors, actuators and communication protocols used for establishing communication in M2M.
III	The real time IoT applications related to smart environments.

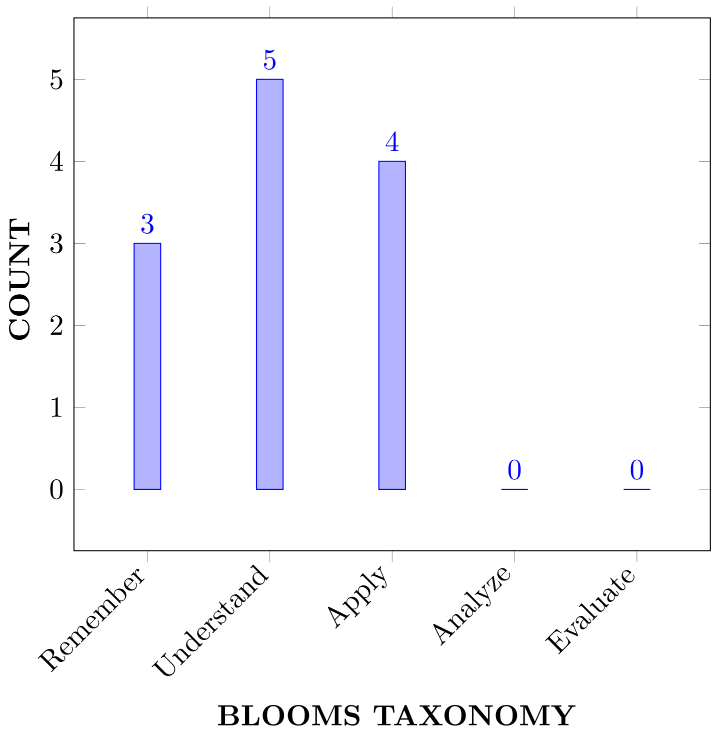
VII COURSE OUTCOMES:

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

CO 1	**Recall** design and characteristics of IoT for reuse of deployed IoT resources across application domains.	Remember
CO 2	**Illustrate** levels of IoT for storage of data either in local server or cloud.	Understand
CO 3	**Relate** most common ways of communication models for accessing data from sensors and actuators.	Understand
CO 4	**Identify** the differences between Machine to Machine and IoT for data exchange between devices.	Apply
CO 5	**Recall** network control functions (SDN &NFV) for communication with hardware infrastructure and direct traffic on a network.	Remember

CO 6	**Demonstrate** device management with NETCONFG-YANG for configuration data and manipulating configuration data on network.	Understand
CO 7	**Relate** architectural reference model for managing access control of IoT devices and the data they publish.	Understand
CO 8	**Identify** the necessity of communication protocols for overcoming issues like failure of any connected devices.	Apply
CO 9	**Demonstrate** importance of raspberry Pi interfaces (SPI, I2C) for connecting other devices/sensors to communicate with pi.	Understand
CO 10	**How** to set up the Raspberry Pi environment, get a Linux operating system running, for executing some basic Python code on the Raspberry Pi.	Remember
CO 11	**Choose** cloud storage models that are scalable & available on Demand	Apply
CO 12	**Identify** application program interface (REST, Communication)for better interchange of data between devices.	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	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	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.	3	CIE/Quiz/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	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

IX 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.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X 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	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	-	-
CO 7	✓	✓	-	✓	-	-	-	-	-	-	-	-	-		-
CO 8	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 9	✓	✓	-	-	✓	-	-	-	-	✓	-	✓	-	-	-
CO 10	✓	✓	-	-	✓	-	-	-	-	✓	-	✓	-	-	-
CO 11	✓	✓	-	-	-	-	-	-	-	✓	-	✓	-	✓	✓
CO 12	✓	✓	-	-	-	-	-	-	-	✓	-	✓	-	✓	✓

XI 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 characteristics and architecture of IoT in solving Engineering problems by applying Understand characteristics and architecture of IoT in solving Engineering problems by applying **scientific principals and methodology**	1
	PSO 1	Explain design and analyze of architecture of IoT in areas of **Artificial Intelligent and Machine Learning** for developing **Modern computer tools.**	2
	PSO 2	Develop communication protocols applications for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	1
CO 2	PO 1	Identify the Level of IoT for storage of data **in interpretation of results and apply them to analyze key engineering processes**	2

CO 3	PO 2	Explain types of communication models required for **effective data collection and information**	1
	PO 3	Understand model for communication in **design process and evaluate outcomes** and **Knowledge of management techniques** which may be used to achieve **engineering objectives**	3
	PO 10	Explain communication models with reference of real time examples	1
CO 4	PO 2	Identify the **definition and differences** between machine to machine and Internet of things	1
	PO 4	Understand the difference of technologies and ability to **apply them** to analyze key **engineering processes**	2
	PO 10	Make use of different parameters to differentiate M2M and IoT with reference of Make use of different parameters to differentiate M2M and IoT with reference of **real time examples**	1
CO 5	PO 1	Explain the differences between Machine to Machine and IoT by applying **Engineering specialization** and **computer science methodologies**	2
	PO 2	Understand the data exchange and apply the appropriate preprocessing techniques to solve real time data specific problems by including variant sizes of **information and data collection**, **validation, experimental design, solution development and interpretation of results.**	4
	PO 4	Explain network control functions, **using mathematical principles** and **computer science methodologies**	2
	PO 10	Understand the communication with hardware infrastructure and direct traffic on a network on transaction of **data collection, validation, experimental design, solution development and interpretation of results.**	3
CO 6	PO 1	Make use of network and **data communication concepts** on huge volume data used to develop **analytical solutions** related to **cloud computing** and **Networking.**	4
	PO 2	Explain the device management using the **mathematical principles** and **computer science methodologies**	2
	PO 3	Make use of NETCONFG-YANG for configuration data to model construction with consideration of related **information and data collection, validation, experimental design, solution development and interpretation of results.**	5
	PO 4	Develop advice management with **development of solution** of data on network	1
	PO 12	Explain Architectural reference model extending classification model with the help of **mathematical and scientific principles by integrating computer science knowledge.**	3

CO 7	PO 1	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 and interpretation of results.**	6
	PO 2	Develop a managing access control 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.**	5
	PO 4	Develop data model applications for specific problems by including huge volume of data and related to **Algorithms, Artificial Intelligence, Machine Learning.**	3
CO 8	PO 1	Develop managing **access control applications** for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	2
	PO 10	**Develop applications** by using **modern computer tools** related to **create innovative career paths**, to be an entrepreneur and desire for higher studies.	3
CO 9	PO 1	Understand the necessity of communication protocols by **applying mathematical** and **scientific principles** by **integrating computer science knowledge.**	3
	PO 2	Identify the appropriate measures for finding model accuracy to specific problems by including variant sizes of **information and data collection, validation, experimental design, Solution development and interpretation of results.**	6
	PO 4	Design solutions for overcoming issues like failure of any connected devices.by **investigating and defining various problems,** understanding **customer and user needs,** with **costeffective and creative solutions by managing the design process, knowledge on economic context, management techniques.**	4
	PO 10	Develop communication models applications for specific problems by including huge volume of data and related to **Algorithms, Artificial Intelligence, Machine Learning.**	4
	PSO 2	Develop communication protocols applications for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	1
CO 10	PO 1	**Develop applications** by using **modern computer tools** related to **create innovative career paths**, to be an entrepreneur and desire for higher studies.	3
	PO 2	Understand the **importance of raspberry Pi interfaces** by using **computer science methodologies** and **scientific principles.**	3

	PO 4	Demonstrate the connection between sensors and other devices for **specific problems** by including huge volume of **information and data collection**, **file structure translation**, **validation and solution development** with **proper documentation.**	6
CO 11	PO 10	Explain the communication process with Raspberry Pi including **various problems**, **customer and user needs**, with **cost effective** and **creative solutions by managing the design process**, knowledge on economic context, management techniques.	4
	PO 12	Explain the **data communicating features** and **services for analyzing programs** in the areas related to **algorithms**, **cloud computing** and **networking.**	5
	PO 1	Make use of tools for **developing unsupervised models** through **laboratory skills, technical literature, technical uncertainty and quality issues. Identify, classify and describe the performance of systems in computer software by applying quantitative methods through analytical methods and techniques**	6
	PO 2	Develop and analyze real time applications through **laboratory skills** and considering **technical literature**, **technical uncertainty** and **quality issues.**	4
	PO 10	Understand the importance of **application program interface** by using **computer science methodologies** and **scientific principles.**	3
	PO 12	Demonstrate the connection between sensors and other devices for specific **problems** by including huge volume of **information and data collection**, **file structure translation**, **validation and solution development** with **proper documentation.**	6
	PSO 2	Develop interchange of data between devices applications for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	1
CO 12	PSO 3	Develop communication protocols applications for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	1
	PO 1	Identify the **definition and differences** between machine to machine and Internet of things	1
	PO 2	Explain types of communication models required for **effective data collection and information**	1
	PO 10	Explain communication models with **reference of real time examples**	1
	PO 12	Explain Architectural reference model extending classification model with the help of **mathematical and scientific principles** by i**ntegrating computer science knowledge.**	3

	PSO 2	Develop interchange of data between devices applications for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	1
	PSO 3	Develop communication protocols applications for specific problems with a major focus on improving software reliability, network security and **information retrieval systems.**	1

XII 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO 2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0
CO 3	2	6	7	0	0	0	0	0	0	0	0	0	0	0	0
CO 4	2	4	7	0	0	0	0	0	0	5	0	5	4	0	0
CO 5	2	3	0	3	1	0	0	0	0	5	0	0	4	0	0
CO 6	2	6	0	0	1	0	0	0	0	3	0	5	0	0	0
CO 7	3	6	7	5	1	0	0	0	0	3	0	5	4	1	2
CO 8	3	6	7	8	1	0	0	0	0	3	0	5	4	1	3
CO 9	3	6	7	0	0	0	0	0	0	3	0	0	5	0	0
CO 10	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
CO 11	0	0	0	9	1	0	0	0	0	2	0	5	4	1	3
CO 12	1	1	0	0	0	0	0	0	0	1	0	3	0	1	1

XIII 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	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 2	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0
CO 3	66.7	60.0	70.0	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 4	66.7	40.0	0.0	70.0	0.0	0.0	0.0	0.0	0.0	100	0.0	41.6	66.7	0.0	0.0
CO 5	66.7	30.0	0.0	27.2	100	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0
CO 6	66.7	60.0	0.0	0.0	100	0.0	0.0	0.0	0.0	60.0	0.0	41.6	0.0	0.0	0.0
CO 7	100	60.0	70.0	45.4	100	0.0	0.0	0.0	0.0	60.0	0.0	41.6	66.7	33.3	66.7

CO 8	100	60.0	70.0	72.7	100	0.0	0.0	0.0	0.0	60.0	0.0	41.6	66.7	33.3	66.7
CO 9	100	60.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	66.7	0.0	0.0
CO 10	0.0	0.0	0.0	72.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 11	0.0	0.0	0.0	81.9	100	0.0	0.0	0.0	0.0	40.0	0.0	41.6	66.7	100	66.7
CO 12	0.0	0.0	0.0	81.9	100	0.0	0.0	0.0	0.0	40.0	0.0	41.6	66.7	100	66.7

XIV 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	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO 2	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0
CO 3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
CO 4	3	2	3	0	0	0	0	0	0	3	0	2	3	0	0
CO 5	3	1	0	1	3	0	0	0	0	3	0	0	0	0	0
CO 6	3	3	0	0	3	0	0	0	0	3	0	2	0	0	0
CO 7	3	3	3	2	3	0	0	0	0	3	0	2	3	1	3
CO 8	3	3	3	3	3	0	0	0	0	3	0	2	3	1	3
CO 9	3	3	3	0	0	0	0	0	0	3	0	0	3	0	0
CO 10	0	0	0	3	0	0	0	0	0	0	0	0	0	0	-
CO 11	0	0	0	3	3	0	0	0	0	2	0	2	3	3	3
CO 12	0	0	0	3	3	0	0	0	0	2	0	2	3	3	3
TOTAL	27	18	15	12	15	0	0	0	0	20	0	10	1.5	1.5	1.5
AVERAGE	3	2.5	3	2.4	3	0	0	0	0	2.8	0	2	3	2.5	3

XV ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1,PO 2, PO 3, PO 4, PO 5	SEE Exams	PO 1,PO 2, PO 3, PO 4, PO 5	Seminars	PO10, PO12
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO10, PO12	Open Ended Experiments	-
Assignments	PO 1, PO12				

XVI ASSESSMENT METHODOLOGY INDIRECT:

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

XVII SYLLABUS:

MODULE I	**INTRODUCTIONTO INTERNET OF THINGS (IoT)**
	Definition and characteristics of IoT, physical design of IoT, logical design of IoT, IoT Enabling technologies, IoT levels and deployment, domain specific IoTs.
MODULE II	**IoT AND M2M**
	Introduction, M2M, difference between IoT and M2M, software defined networking (SDN) and network function virtualization (NFV) for IoT, basics of IoT system management with NETCONF-YANG
MODULE III	**IoT ARCHITECTURE AND PYTHON**
	IoT Architecture: State of the art introduction, state of the art; Architecture reference model:Introduction, reference model and architecture, IoT reference model. Logical design using Python: Installing Python, Python data types and data structures, control flow, functions, modules, packages, file handling.
MODULE IV	**IoT PHYSICAL DEVICES AND ENDPOINTS**
	Introduction to Raspberry Pi interfaces (Serial, SPI, I2C), programming Raspberry PI with Python, other IoT devices.
MODULE V	**IoT PHYSICAL SERVERS AND CLOUD OFFERINGS**
	Introduction to cloud storage models and communication APIs; WAMP: AutoBahn for IoT, Xively cloud for IoT; Case studies illustrating IoT design: Home automation, smart cities, smart environment.

TEXTBOOKS

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A Hands-on-Approach", VPT, 1st Edition, 2014.
2. MattRichardson,ShawnWallac,"GettingStartedwithRaspberryPi,O Reilly,(SPD)",3rdEdition, 2014.
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things",Springer.

REFERENCE BOOKS:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of things", John Wiley and sons, 1stedition, 2014.
2. Francis DaCosta, "Rethinking "The Internet of Things":A Scalable Approach to Connecting Everything", A press Publications, 1st Edition,2013.

XVIII COURSE PLAN:

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

Lec.No	Topics to be covered	CO's	Reference
1	Understanding the basics concepts of IoT	CO1	T1:19
2	Motivations of IoT and various Applications of IoT	CO1	T1:22
3	Describe the Things of IoT and characteristics of IoT	CO1	T1:24
4-6	Analysis and Design of IoT in physical view	CO2	T1:24
7-8	Understandings the Logical design of IoT	CO4	T1:31
9-10	Describing various IoT enabling technologies	CO4	T1:34-49
11-12	Identifying specific Domains IoTs	CO5	T1:53-72
13	Understanding the basic differences between IoT and M2M	CO5	T1: 6.16.4
14	Implementation of SDN and NFV architecture in IoT	CO6	T1:80-85
15	Identifying IoT system management with NETCONF-YANG	CO6	T1:91-92
16	Uses of SNMP in IoT protocols	CO7	T1:93-94
17-18	Implementation of NETCONF-YANG by using Python	CO7	T1:96-97
19-21	Development of IoT Architecture with standards	CO8	T3:170-86
22-27	Logical design of IoT using Python	CO9	T1:141-50
28-35	Describe the physical endpoints used in IoT	CO10	T1:186-96
36-38	Identifying the various IoT physical servers and cloud offerings	CO11	T1:197-98
39-45	Real time applications of IoT with Case studies design	CO12	T1:254-64

Course Coordinator **HOD, CSE**
Ms. B Anupama

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	ACSB14				
Program	B.Tech				
Semester	VI	CSE			
Course Type	Core				
Regulation	IARE-R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. V.Muniraju Naidu, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB08	III	Database Management System
B.Tech	AHSB12	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:

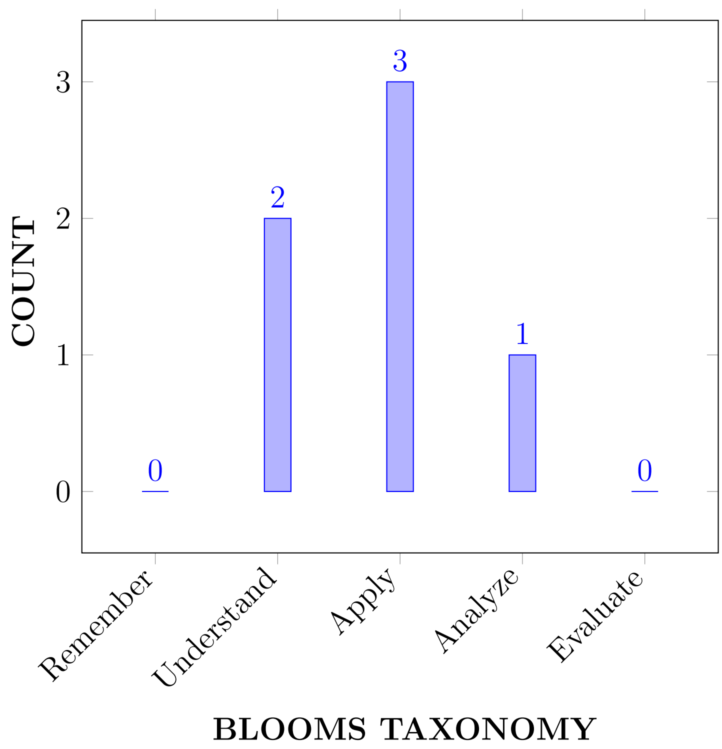
I	The scope and essentiality of data warehousing and mining.
II	The analysis of data, choosing relevant models and algorithms for respective applications.
III	The process and mining of complex data types such as streams, spatial, web and multimedia
IV	The research perspectives towards advances in data 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.	6
	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	6	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	60	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	2	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	13	11	8	9	-	-	-	-	5	-	2	8	6	8
AVERAGE	3	2.6	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 T1: 4.1
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

COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

Course Title	**DATA WAREHOUSING AND DATA MINING LABORATORY**				
Course Code	ACSB15				
Program	B.Tech				
Semester	VI	CSE			
Course Type	CORE				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1
Course Coordinator	Ms.M Geetha Yadav, Assistant Professor				

I COURSE OVERVIEW:

Data mining techniques allow predicting future trends and behaviors of businesses to make proactive, knowledge-driven decisions. The data mining laboratory course is designed to practice the data mining techniques such as classification, clustering, pattern mining etc. with varied datasets and dynamic parameters on weka machine learning tool.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB12	II	Probability and Statistics
B.Tech	ACSC08	III	Database Management Systems

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Warehousing and Data Mining 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:

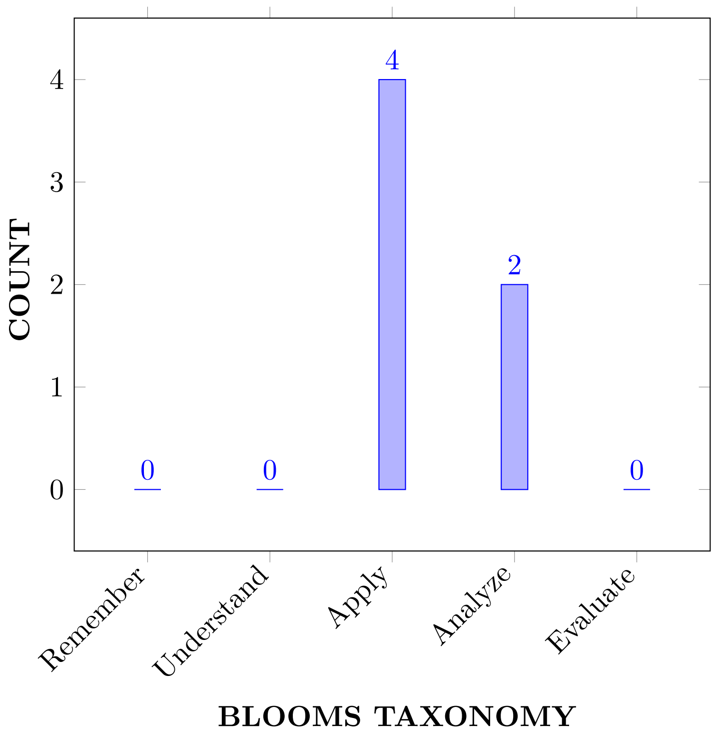
I	The data set understanding with visualizations and needed preprocessing.
II	The demonstration of data mining tasks such as classification.
III	The analysis on data models with variant parameters.

VII COURSE OUTCOMES:

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

CO 1	**Apply** pre-processing statistical methods for any given raw data. .	Apply
CO 2	**Apply** Association rule process for a given dataset by using Apriori algorithm.	Apply
CO 3	**Apply** Association rule process for a given dataset by using FP-Growth algorithm.	Apply
CO 4	**Analyze** Classification rule process for a given raw data Decision tree and ID3 algorithm..	Analyze
CO 5	**Analyze** Classification rule process for a given raw data Decision tree and ID3 algorithm..	Analyze
CO 6	**Apply** Clustering on a given dataset by using k-means algorithm.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Problem analysis:** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercise, 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 Exercise, 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 Exercise, 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 Exercise, 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 research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.	1	Lab Exercises
PSO 3	**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.	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 Pre-processing method for the given dataset by using mathematical and computer science and related methodologies.	3
	PO 2	**Analyze**the problem of a given dataset and apply the Pre-processing method to solve the problem.	3
	PO 3	**Apply** the Pre-processing method for the given dataset by using weka tool.	1

	PO 5	**Apply** the Pre-processing method for the given dataset by using weka tool.	1
CO 2	PO 3	**Analyze solution** for Association rule to the given dataset by applying Apriori algorithm	4
	PO 5	**Apply**the Association rule by using Apriori algorithm with weka tool.	1
	PSO1	**Analyze solution** for Association rule to the given dataset by applying Apriori algorithm.	2
	PSO3	**Apply**the Pre-processing method by using weka tool.	1
CO 3	PO 3	**Analyze solution** for Association rule to the given dataset by applying FP-Growth algorithm	4
	PO 5	**Apply**the Association rule by using FP-Growth algorithm with weka tool.	1
	PSO1	**Analyze solution** for Association rule to the given dataset by applying FP-Growth algorithm.	2
	PSO3	**Apply**the Pre-processing method by using weka tool.	1
CO 4	PO 2	**Analyze** the problem of a given dataset and apply the Classification method to solve the problem.	3
	PO 5	**Apply**the Classification method for a given raw dataset by using weka tool	1
	PSO3	**Apply**the Classification method for a given raw dataset by using weka tool	1
CO 5	PO 2	**Implement** Decision tree for the given raw dataset by using ID-3 algorithm.	2
	PO 3	**Analyze**solutions for Classification method to the given dataset by applying ID3-algorithm.	2
	PO 5	**Apply**the Classification method for a given raw dataset by using weka tool	1
	PSO1	**Analyze**solution for Classification method to the given dataset by applying ID-3 algorithml	1
	PSO3	**Apply**the Classification method for a given raw dataset by using weka tool	1
CO 6	PO 3	**Analyze solution** for Clustering method to the given dataset by applying K-means algorithm	3
	PO 5	**Apply**the Clustering method for a given raw dataset by using weka tool	1
	PSO 1	**Analyze solution** for Clustering method to the given dataset by applying K-means algorithm	2
	PSO 3	**Apply**the Clustering method for a given raw dataset by using weka tool	1

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

Course Outcomes	Program Outcomes				Program Specific Outcomes	
	PO1	PO2	P03	PO5	, PSO1	PSO3
CO1	3	3	2		1	
CO2	3	1	2		1	
CO3	2	2	2	1		1
CO4	3	3	2	1		
CO5	2	3	3			1
CO6	2	1	3		1	1

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, PO 2, PO 3, PO 5	SEE Exams	PO 1, 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	**PREPROCESSING**
	Simulate preprocessing methods dataset student and labor in weka..
WEEK II	**ASSOCIATION RULES**
	1. Simulate association rule process on dataset contact lenses. arff using apriori algorithm in weka
	2. Simulate Association rule process on dataset test. arff using apriori algorithm in weka
WEEK III	**CLASSIFICATION RULE BY J48**
	Simulate of classification rule process on dataset student. arff using j48 algorithm in weka
WEEK IV	**CLASSIFICATION RULE BY J48**
	Demonstration of classification rule process on dataset employee. arff using id3 algorithm.

WEEK V	**CLASSIFICATION RULE BY J48**
	CDemonstration of classification rule process on dataset employee. arff using id3 algorithm.
WEEK VI	**CLASSIFICATION RULE BY NAIVE BAYES**
	Demonstration of classification rule process on dataset employee. arff using naıve bayes..
WEEK VII	**CLASSIFICATION RULE BY K-MEANS**
	Demonstration of clustering rule process on dataset student. arff using simple k- means this macro to print the elements of the array.
WEEK VIII	**CLUSTERING**
	Demonstration of clustering rule process on dataset iris. arff using simple k-means this macro to print the elements of the array..
WEEK IX	**CLUSTERING BY K-MEANS**
	Implement k-means algorithm.
WEEK X	**DECISION TREE**
	Implement decision tree classification algorithm
WEEK XI	**ASSOCIATION RULE MINING BY APRIORI ALGORITHM.**
	Implement Apriori algorithm.
WEEK XII	**ASSOCIATION RULE MINING BY FP- GROWTH ALGORITHM**
	Implement FP- growth algorithm.

TEXTBOOKS

1. J.Han, M.Kamber, Data Mining: Concept and Technique, Academic Press, Morgan Kanfman Publishers, 3rd Edition, 2008.

2. Alex Berson, Stephen J. Smith, —Data Warehousing, Data Mining and OLAP, Tata McGraw-Hill, 10th Edition, 2007

REFERENCE BOOKS:

1. Craig Larman, Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development‖, Pearson Education, 3rd Edition, 2005.

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	Preprocessing.	CO 1	R1: 1.1
2	Association rule.	CO 1, CO 2	R1: 2.3
3	Classification rule by j48.	CO 1, CO 2	R1: 4.1
4	Classification rule by j48	CO 1, CO 2	R1: 5.1
5	Classification rule by id3.	CO 3 ,CO 4	R2: 6.1
6	Classification rule by naive bayes.	C,CO 4 ,CO 5	R1: 7.1

7	Clustering rule by k-means.	CO 3, CO 5 ,CO 6	R2: 11.4
8	Clustering.	CO 3, CO 5 ,CO	R1: 12.5
9	Clustering rule by k-means.	CO 3, CO 5 ,CO	R2: 14.3
10	Decision tree.	CO 3, CO 5 ,CO 6	R1: 15.1
11	Association rule mining by apriori algorithm.	CO 3	R2:16.4
12	Association rule mining by fp-growth algorithm.	CO 6	R1:20.5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Finding** Association Rules for buying data.
2	**Finding**Association Rules for Banking data..
3	**Construct** Decision Tree for location.
4	**Write** a procedure for Visualization of Weather Table.
5	**Write** a procedure for Visualization of Banking Table.

Signature of Course Coordinator **HOD,CSE**
Ms .M Geetha Yadav
Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**E-COMMERCE**				
Course Code	AITB35				
Program	B. Tech				
Semester	Seven				
Course Type	Elective				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms.K.Aswini, 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	✘	MOOC
✓	LCD / PPT	✘	Seminars	✘	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 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	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:

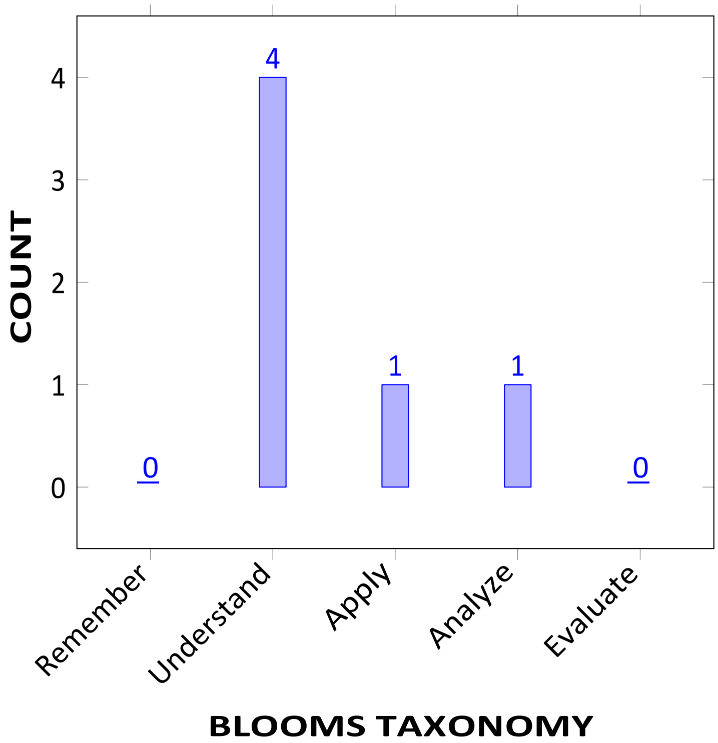
I	The foundations and importance of E-commerce and its technology for business.
II	The steps, tools, and network mechanisms needed to start selling online.
III	The techniques and principles in Electronic Payment System and its environment.
IV	The main business and marketplace models for Electronic Communications 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	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	Quiz
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	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≤ 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	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

Ms K.Aswini Assistant Professor **HOD,CSE**

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**CLOUD APPLICATION DEVELOPMENT**				
Course Code	ACSB17				
Program	B.Tech				
Semester	VII				
Course Type	CORE				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms K.Sreeveda , Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITB04	IV	Operating Systems
B.Tech	ACSB08	IV	Database Management Systems
B.Tech	AITB10	V	Computer Networks

II COURSE OVERVIEW:

This Course emphasizes on transformation of the IT industry with high elastic scalability (EC) in the delivery of enterprise applications and capabilities across the various cloud service models. This course covers the concepts of cloud infrastructures, cloud service providers, virtualization, software-defined networks and cloud storage, cloud resource scheduling and management, programming models, and cloud security.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Cloud Application Development	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	White board	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 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
20%	Remember
40 %	Understand
25%	Apply
15 %	Analyze

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:

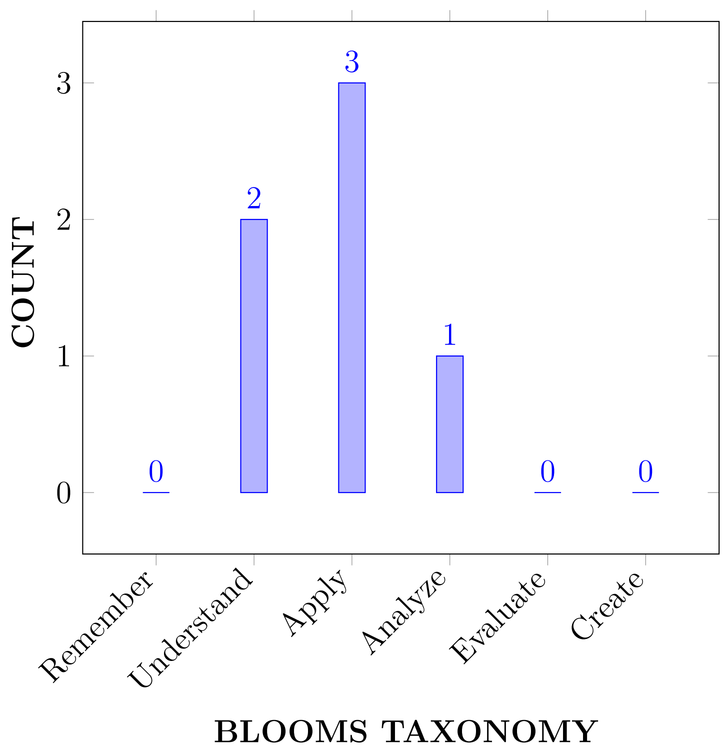
I	The fundamental concepts of various services deployed with cloud models for solving current and future challenges.
II	The principles in data centre design and services provided with virtualization techniques.
III	The scaling and load balancing solutions for developing business models with appropriate cloud infrastructure, services and programming models.

VII COURSE OUTCOMES:

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

CO 1	**Choose** appropriate CSP based on user demanded services among AWS, GCP, MS Azure, and Apache Cloud Stack.	Apply
CO 2	**Identify** the cloud architecture style and infrastructure in providing services with high elastic scalability as per user requirement.	Apply
CO 3	**Summarize** Virtual Machine concepts for running different applications on different operating systems concurrently.	Understand
CO 4	**Make use of** resource scheduling and management methods for finding the best match of combined resources as per user requirement.	Apply
CO 5	**Outline** system security issues and vulnerabilities for reducing system-specific attacks under a virtualization environment.	Understand
CO 6	**Inspect** various cloud services, programming models for developing a business model according to customer requirements.	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	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.	3	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	3	CIA/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	CIA/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.	2	Tech Talk/Concept Videos
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

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
PSO 2	Focus on improving software reliability, network security and information retrieval systems.	3	CIA/SEE
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

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 scientific principles and methodologies, other engineering disciplines in selection of best cloud service provider based on customer requirements.	2
	PO 2	Problem Analysis in selection of best cloud service provider based on customer requirements	7
	PO 10	Subject matter and speaking style assessed in explanation of selecting best cloud service provider based on customer requirements	2
	PO 12	Keeping current in CSE and advanced engineering concepts in selecting best cloud service provider based on customer requirements	1
	PSO 3	Make use of modern computer tools for selecting best cloud service provider based on customer requirements	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 1	Apply scientific principles and methodologies, other engineering disciplines to select infrastructures and architectural styles of the system as per cloud user and organizational requirements.	2
	PO 2	Problem Analysis in selecting infrastructures and architectural styles of the system as per cloud user and organizational requirements.	9
	PO 3	Design solutions for architectural styles and infrastructure for providing services with high elastic scalability as per user requirement.	8
	PO 10	Subject matter and speaking style assessed in selecting infrastructures and architectural styles of the system as per cloud user and organizational requirements.	2
	PO 12	Keeping current in CSE and advanced engineering concepts in selecting infrastructures and architectural styles of the system as per cloud user and organizational requirements by tech talk, concept videos and open ended experiments.	1
	PSO 2	Focus on improving Network Security and IRS in selecting infrastructures and architectural styles of the system as per cloud user and organizational requirements.	2
	PSO 3	Make use of modern computer tools in selecting infrastructures and architectural styles of the system as per cloud user and organizational requirements.	1
CO 3	PO 1	Understand scientific principles and methodologies, other engineering disciplines in developing virtual machines to run different applications on different OSs.	2
	PO 2	Problem Analysis in developing virtual machines to run different applications on different OSs.	5
	PO 3	Design solutions for development of virtual machines to run different applications on different operating systems concurrently.	8
	PO 10	Subject matter and speaking style assessed in developing virtual machines to run different applications on different OSs.	2
	PO 12	Keeping current in CSE and advanced engineering concepts of advanced topics on virtual machines by tech talk, concept videos and open ended experiments.	1
	PSO 2	Focus on improving Network Security and IRS in developing virtual machines to run different applications on different OSs.	2
CO 4	PO 1	Apply scientific principles and methodology, mathematical principles and, other engineering disciplines on different types of resource scheduling algorithms for efficient utilization of pool of resources.	3
	PO 2	Problem Analysis in selecting different types of resource scheduling algorithms for efficient utilization of pool of resources.	8

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	PO 3 Design solutions for resource scheduling and management methods to find the best match of combined resources as per user requirement.	8
	PO 10	Subject matter and speaking style assessed in explanation of resource scheduling algorithms for efficient utilization of pool of resources.	2
	PO 12	Keeping current in CSE and advanced engineering concepts of advanced topics on efficient utilization of pool of resources by tech talk, concept videos and open ended experiments	1
	PSO 1	Understand, Design and Analyze Computer Programs used in resource scheduling for efficient utilization of pool of resources.	6
	PSO 2	Focus on improving Network Security and in selecting different types of resource scheduling for efficient utilization of pool of resources.	1
	PSO 3	Make use of modern computer tools in selecting different types of resource scheduling algorithms for efficient utilization of pool of resources.	1
CO 5	PO 1	Understand scientific principles and methodologies, other engineering disciplines to handle security and vulnerabilities for reducing system-specific attacks.	2
	PO 10	Subject matter and speaking style assessed in explanation of security and vulnerabilities in virtualization environment	2
	PO 12	Keeping current in CSE and advanced engineering concepts of advanced topics on security and vulnerabilities by tech talk, concept videos and open ended experiments	1
	PSO 2	Focus on improving Network Security and IRS in handling security and vulnerabilities for reducing system-specific attacks.	1
CO 6	PO 1	Analyze scientific principles and methodology, mathematical principles and, other engineering disciplines to use various cloud services and programming models to develop business model based on customer requirements	3
	PO 2	Problem Analysis in various cloud services and programming models to develop business model based on customer requirements	10
	PO 3	Design solutions for various cloud services and programming models by Defining and understanding cloud user and organizational requirements, identifying various cloud infrastructure and services, managing design process and evaluate the outcomes.	9
	PO 5	Usage of Cloud Management tool for modeling simple to complex engineering activities with understanding cloud user requirements and limitations.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Subject matter and speaking style assessed in explanation of various cloud services and programming models to develop business model based on customer requirements	2
	PO 12	Keeping current in CSE and advanced engineering concepts of advanced topics on various cloud services and programming models by tech talk, concept videos and open ended experiments	4
	PSO 1	Understand, Design and Analyze Computer Programs used in various cloud services and programming models to develop business model based on customer requirements	6
	PSO 2	Focus on improving Network Security and IRS in various cloud services and programming models to develop business model based on customer requirements	2
	PSO 3	Make use of modern computer tools for various cloud services and programming models to develop business model based on customer requirements	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	7	-	-	-	-	-	-	-	2	-	1	-	-	1
CO 2	2	9	8	-	-	-	-	-	-	2	-	1	-	2	1
CO 3	2	5	4	-	-	-	-	-	-	2	-	1	-	2	-
CO 4	3	8	5	-		-	-	-	-	2	-	1	6	1	1
CO 5	2	-	-	-	-	-	-	-	-	2	-	1	-	1	-
CO 6	3	10	9	-	1	-	-	-	-	2	-	1	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	66.6	70.0	-	-	-	-	-	-	-	40.0	-	12.5	-		50.0
CO 2	66.6	90.0	80.0	-	-	-	-	-	-	40.0	-	12.5	-	100	50.0
CO 3	66.6	50.0	40.0	-	-	-	-	-	-	40.0	-	12.5	-	100	-
CO 4	100	80.0	50.0	-	-	-	-	-	-	40.0	-	12.5	100	50.0	50.0
CO 5	66.6	-	-	-	-	-	-	-	-	40.0	-	12.5	-	50.0	-
CO 6	100	100	90.0	-	100	-	-	-	-	40.0	-	12.5	100	100	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

1 -5 <C≤ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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	-	-	-	-	-	-	-	2	-	1	-	-	2
CO 2	3	3	3	-	-	-	-	-	-	2	-	1	-	3	2
CO 3	3	2	2	-	-	-	-	-	-	2	-	1	-	3	-
CO 4	3	3	2	-	-	-	-	-	-	2		1	3	2	2
CO 5	3	-	-	-	-	-	-	-	-	2	-	1	-	2	-
CO 6	3	3	3	-	3	-	-	-	-	2	-	1	3	3	2
TOTAL	18	14	10	-	3	-	-	-	-	12	-	6	6	15	8
AVERAGE	3.0	2.8	2.5	-	3.0	-	-	-	-	2.0	-	1	3	2.6	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:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	INTRODUCTION AND CLOUD APPLICATION DEVELOPMENT
	Introduction: Definition, Characteristics, Benefits, challenges of cloud computing, cloud models: IaaS (infrastructure as service),PaaS(platform as a service),SaaS(software as a service), deployment models-public, private, hybrid, community; Types of cloud computing: Grid computing utility computing, cluster; computing Cloud services: Amazon, Google, Azure, online services, open source private clouds, SLA; Applications of cloud computing: Healthcare, energy systems, transportation, manufacturing, education, government, mobile communication, application development.

MODULE II	**CLOUD ARCHITECTURE, PROGRAMMING MODEL**
	Cloud Architecture, programming model: NIST reference architecture, architectural styles of cloud applications, single, multi, hybrid cloud site, redundant, non redundant, 3 tier, multi tier architectures; Programming model: Compute and data intensive.
MODULE III	**CLOUD RESOURCE VIRTUALIZATION**
	Cloud resource virtualization: Basics of virtualization, types of virtualization techniques, merits and demerits of Virtualization. Full vs Para - virtualization, virtual machine monitor/hypervisor; Virtual machine basics, taxonomy of virtual machines, process vs system virtual machines.
MODULE IV	**CLOUD RESOURCE MANAGEMENT AND SCHEDULING**
	Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, resource bundling, combinatorial , fair queuing, start time fair queuing, borrowed virtual time, cloud scheduling subject to deadlines, scheduling map reduce applications subject to deadlines, resource management and application scaling.
MODULE V	**CLOUD SECURITY**
	Cloud Security: Risks, privacy and privacy impacts assessments; Multi-tenancy issues, security in VM, OS, virtualization system security issues and vulnerabilities; Virtualization system-specific attacks: Technologies for virtualization-based security enhancement, legal.

TEXTBOOKS

1. Dan Marinescu, Cloud Computing: Theory and Practice‖, M K Publishers, 1st Edition, 2013
2. Kai Hwang, Jack Dongarra, Geoffrey Fox, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things‖, M K Publishers, 1st Edition, 2011.

REFERENCE BOOKS:

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, - Cloud Computing: A Practical Approach‖, McGraw Hill, 1st Edition, 2009.
2. Arshdeep Bahga, Cloud Computing: A Hands on Approach‖, Vijay Madisetti Universities Publications, 1st Edition, 2013.

WEB REFERENCES:

1. https://www.oracle.com/in/cloud/application-development
2. http://computingcareers.acm.org/?page_id=12
3. http://en.wikibooks.org/wiki/cloud application

COURSE WEB PAGE:

https://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/cloud-application-development

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 Overview, Objectives , Course Outcomes and POs/PSOs		
CONTENT DELIVERY (THEORY)			
2-3	Cloud Computing definition, characteristics, benefits, challenges	CO 1, CO 6	T1: 1.1, 1.2
4-5	Cloud computing models and its deployment models	CO 1, CO 6	T1: 1.2
6-7	Types of cloud computing techniques	CO 1, CO 6	T1: 1.2
8-9	Different types of cloud services and Cloud Service Providers	CO 1, CO 6	T1: 1.3
10-11	Various applications of cloud computing	CO 1, CO 6	T1: 3.6
12-13	Cloud architecture concepts and selection criteria	CO 2, CO 6	T1: 1.1
14-15	NIST reference architecture and various architectural styles of cloud applications	CO 2, CO 6	T1: 1.1, 3.8
16	Programming model and Compute intensive model	CO 2, CO 6	T1: 4.2,4.3
17-18	Virtualization and types of virtualization techniques	CO 3	R2: 4.7
19-20	Merits and demerits of virtualization ; Full vs Para-virtualization	CO 3	T1: 4.9
21-22	Virtual machine monitor/hypervisor and its types	CO 3	T1: 4.9
23-24	Cloud resource management and scheduling	CO 4	T1: 6.1
25-26	Various policies and mechanisms for resource management, resource bundling, combinatorial	CO 4	T1: 6.1
27-28	Fair queuing, start time fair queuing, borrowed virtual time	CO 4	T1: 6.9, 6.10, 6.11
29-30	Map reduce applications subject to deadlines	CO 4	T1: 6.13
31-32	Resource management and application scaling.	CO 4	R1: 6.14
33-34	Cloud Security: Risks, privacy	CO 5	T1 : 9
35-36	Privacy impacts assessments; Multi-tenancy issues	CO 5	T1: 9.5
37-38	Security in VM, OS	CO 5	R2: 9.6
39-40	Virtualization system security issues	CO 5	T1: 9.1
41-42	Virtualization system security vulnerabilities	CO 5	T1: 9.1
43-44	Virtualization system-specific attacks: Technologies for virtualization-based security enhancement legal	CO 5	R1: 9.9

PROBLEM SOLVING/ CASE STUDIES			
1	Cloud computing delivery models with security and the reliability of each model. Peer-to-peer systems and clouds the in terms of architecture, resource management, scope, and security	CO 1, CO 2	T1:3.6
2	Is cloud elasticity based on over provisioning sustainable? Give arguments to support. Debating whether to install a private cloud or to use a public cloud (e.g., the AWS) for its computational and storage needs for an organization.	CO 1, CO 2	T1:3.6
3	Mobile devices could benefit from cloud computing; explain the reasons.	CO 1, CO 2	T1:3.6
4	Tips for managing multi-cloud environment with real time example. Deploying a multi-tenant application across multiple cloud platforms.	CO 2, CO 6	T1:4.3
5	Usage of apache zookeeper to build distributed apps and describe how Zookeeper works. Case study on Hadoop distributed file system used in cloud Computing. Solving redundancy problems using different architectural styles	CO 2, CO 6	T1:4.3
6	Create a Map Reduce Application model by using data intensive model. Compare the latest Top 500 list with the Top 500 Green List of HPC systems based on publicly reported data.	CO 2, CO 6	T1:4.3
7	Discuss Virtualization Middleware for Scientific Cloud Computing in Open Source Offerings. Identify a hybrid cloud allows a company to maintain critical, confidential data and money on the new resources. Design a large-scale virtual cluster system	CO 3	T1:4.9, R2:4.7
8	VMs practically share all resources of the virtual infrastructure including virtual switch. Using Virtualization analyze memory virtualization, processor virtualization, and virtualization of a communication channel. Analyze the results of the performance comparison by using virtual machines.	CO 3	T1:4.9, R2:4.7
9	Virtualization of the processor combined with virtual Memory management poses multiple challenges. Describe the approaches used to exchange data among the domains of Xen and design experiments to compare the performance of data communication between the domains.	CO 3	T1:4.9, R2:4.7
10	Implementation of resource management policies: control theory, machine learning, utility-based, and market-oriented. Optimal strategies for one could be in conflict with optimal strategies for one or more of the other classes.	CO 4	T1:6.1, R1:6.14

11	Relationship between the scale of a system and the policies and the mechanisms for resource management. Workflow of cloud application use XML to describe this workflow, including the instances and the storage required for each task.	CO 4	T1:6.1, R1:6.14
12	Set up Hadoop-YARN cluster with ports to start each worker. Itanium architecture , and identify several possible reasons.	CO 4	T1:6.1, R1:6.14
13	Identify the main security threats for the SaaS cloud delivery model on a Public cloud. Analyze Amazon's privacy policies and design a service-level agreement. Cloud service to analyze images and sign them before being listed and made available to the general public.	CO 5	T1:9.1, R1:9.9
14	Analyze the implications of the two-level security model of commodity operating systems. Virtualization security on public, private, and hybrid clouds. Security risk posed by XenStore?	CO 5	T1:9.1, R1:9.9
15	Six attack surfaces are illustrated cloud delivery models. Impact of international agreements regarding privacy laws on cloud computing. Security and functionality in a hypervisor" and discuss the performance of the system. Virtual machine security and its application with an real time example by considering any one cloud service provider.	CO 5	T1:9.1, R1:9.9
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definition, characteristics, benefits, challenges of cloud computing, cloud models, deployment models, types of cloud computing, cloud service provider, applications of cloud computing.	CO 1, CO 6	T1:3.6
2	Cloud architecture, architectural styles, programming models.	CO 2, CO 6	T1:4.3
3	Basics of virtualization, types of virtualization techniques, merits and demerits of virtualization, virtual machine basics, taxonomy of virtual machines, process vs system virtual machines.	CO 3	T1:4.9, R1:4.7
4	Policies and mechanisms for resource management, resource bundling, combinatorial , fair queuing, start time fair queuing, borrowed virtual time.	CO 4	T1:6.1, R1:6.14
5	Multi-tenancy issues, security in VM, OS, virtualization system security issues and vulnerabilities, technologies for virtualization.	CO 5	T1:9.1, R1:9.9

DISCUSSION OF QUESTION BANK			
1	Challenges of cloud computing ,Cloud services and Applications of cloud computing	CO 1, CO 6	R4:2.1
2	Cloud Architecture and programming model	CO 2, CO 6	T4:7.3
3	Cloud resource virtualization	CO 3	R4:5.1
4	Cloud Resource Management and Scheduling	CO 4	T1:7.5
5	Cloud Security	CO 5	T1: 4.1

Signature of Course Coordinator **HOD,CSE**

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**ADVANCED DATABASES**				
Course Code	ACSB26				
Program	B.TECH				
Semester	VI				
Course Type	ELECTIVE				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms P.Harika,Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACS005	III	Database Management Systems

II COURSE OVERVIEW:

This course provides theoretical knowledge and practical skills in advanced topics in database systems, big data and modern data-intensive systems. The specific topics include indexing methods, query processing and optimization strategies for relational database systems, Object Relational Mapping and Object Database design, distributed database systems, spatial access and uncertainty in databases.It provides tools and techniques to implement and administer complex database systems including backup and recovery.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Advanced Databases	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
20%	Remember
20 %	Understand
40 %	Apply
20 %	Analyze
0 %	Evaluate

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:

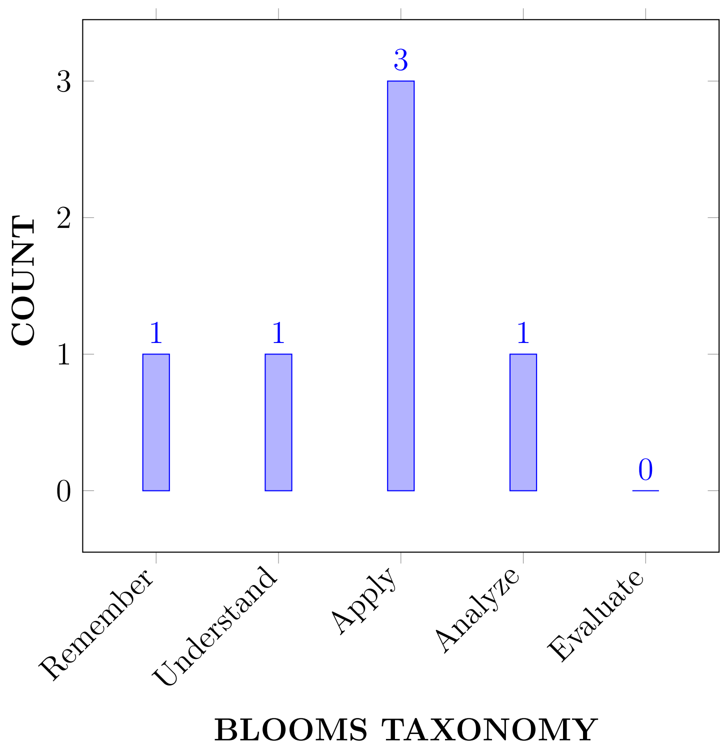
I	Query languages to support temporal and object databases.
II	Internals of database management system.
III	Data processing paradigms.
IV	Research and usage of emerging technologies for solving existing database problems.

VII COURSE OUTCOMES:

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

CO 1	**Compare** different database techniques to defining the concept of Time domain and associating facts with time for representing queries for constructing a database	Under-stand
CO 2	**Model** the real world database systems for open problems from the requirement specification for optimal real world databases.	Apply
CO 3	**Implement** queries in transact-SQL and recursive queries using query optimization techniques for retrieving desired information from hierarchical data	Remember
CO 4	**Describe** spatial data access methods to apply different data processing techniques for satisfying the exact need of the user for effective data retrieval	Apply
CO 5	**Compare** different lattice based and probabilistic based approaches for efficient relational databases	Apply
CO 6	**Analyze** a full real size database system for an industry or business scenario	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.	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.	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	8	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.	8	Assignments/ SEE /CIE, AAT, QUIZ
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.	4	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 2	Focus on improving software reliability, network security and information retrieval systems.	2	Quiz
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies	2	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	Compare different database techniques for constructing a database **using the knowledge of mathematics, science, and engineering fundamentals.**	3
	PO 4	**Demonstrate open problems on active databases** by applying Workshop and laboratory skills, through understanding of contexts, in which engineering knowledge can be applied, by understanding of appropriate codes of practice and industry standards and by understanding of and ability to apply a systems approach to engineering problems.	4
CO 2	PO 1	Model the real world database systems by discussing open problems from the requirement specification using the **knowledge of mathematics, science, and engineering fundamentals.**	3
	PO 2	Model active databases and its various applications,with the **Problem statement , system definition, Problem formulation , abstraction , Information , data collection and model translation.**	4
	PO 3	Identify a real world scenario **to Investigate and define a problem and identify constraints, Manage the design process and evaluate outcomes**	2
	PO 12	Identify open issues related to various databases by **working on advanced degree , keeping current in CSE and advanced engineering concepts ,personal continuing education efforts and by ongoing learning - stays up with industry trends/ new technology**	4
	PSO 2	Identify open issues related to various databases by **keeping focus emerging technologies and frameworks in demand with employers and contemporary challenges.**	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Identify open issues related to various databases by **by making use of computational and experimental tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.**	2
CO 3	PO 1	Describe concept of time domain and associating facts with time **using principles of mathematics, science, and engineering fundamentals.**	3
CO 4	PO 1	Build queries in transact-SQL the using **knowledge ofmathematics , science and engineering fundamentals.**	3
	PO 2	Build queries in different databases with the **Problem statement and system definition, Problem formulation, abstraction, Information and data collection**	3
	PO 3	Apply temporal query language support for TSQL2 by **investigating and defining a problem, identifying constraints, managing the design process and evaluating the outcomes**	3
	PO 4	Identify different levels of queries by applying Workshop and laboratory skills, through understanding of contexts, in which engineering knowledge can be applied, by understanding of appropriate codes of practice and industry standards and by understanding of and ability to apply a systems approach to engineering problems	4
	PO 12	Choose query optimization techniques by working on advanced degree , keeping current in CSE and **advanced engineering concepts ,personal continuing education efforts and by ongoing learning – stays up with industry trends/ new technology**	4
	PSO 2	Apply query languages by keeping focus e **emerging technologies and frameworks in demand with employers and contemporary challenges.**	4
CO 5	PO 1	Apply hierarchical data concept **with knowledge of mathematics, science and Engineering Fundamentals.**	3
	PO 2	Use recursive queries in SQL with respect to the **Problem statement and system definition**	1
CO 6	PO 2	Identify query optimization technique with respect to the **Problem statement, system definition, Problem formulation, abstraction , Information, data collection and model translation**	4
	PO 3	Analyze optimization process by **identifying constraints, manage the design process and evaluate outcomes**	2
	PO 4	Examine different levels of queries by **understanding contexts in which engineering knowledge can be applied**	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	-	-	-	-	-	-	-	-	-	-		-	2	-
CO 2	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	5	-	-		-	-	-	-	-	-		2	2	-
CO 5	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	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	100	-	-	-	-	-	-	-	-	-	-		-	100	-
CO 2	100	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	50	-	-		-	-	-	-	-	-		100	100	-
CO 5	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	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	-	-	-	-	-	-	-	-	-	-	-	-	3	
CO 2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	-
CO 5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	28	16	2	4	-	-	-	-	-	-	-	-	3	9	6
AVERAGE	2.9	1.6	2	2	-	-	-	-	-	-	-	-	3	3	3

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Tech Talk	✓	Concept Video	✓	Open Ended Experiments	-
Assignments					

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**ACTIVE DATABASES**
	Syntax and Semantics (Starburst, Oracle, DB2): Taxonomy, applications, integrity management, workflow management, business rules, design principles, properties, rule modularization, rule debugging, IDEA methodology, open problems.
MODULE II	**TEMPORAL AND OBJECT DATABASES**
	Overview: Time domain, data types, associating facts with time, temporal query language; Transact - SQL (T-SQL): Time ontology, data model, language constructs; Implementation: System architecture,temporal support, support for TSQL2.
MODULE III	**COMPLEX QUERIES AND REASONING**
	Logic of Query Languages: Relational calculi, relational algebra, recursive rules, syntax and semantics of data log, fix point semantics. Implementation Rules and Recursion: Rule rewriting methods, compilation and optimization, recursive queries in SQL, open issues.
MODULE IV	**SPATIAL, TEXT AND MULTIMEDIA DATABASE**
	Traditional Indexing Methods: Secondary keys, spatial access methods, text retrieval; Multimedia indexing: 1D time series, 2D color images, sub pattern matching.
MODULE V	**UNCERTAINTY IN DATABASES AND KNOWLEDGE BASES**
	Introduction: Uncertainty in image database, uncertainty in temporal database, uncertainty in null value;Models of uncertainty; Uncertainty in relational databases: Lattice based relational databases, probabilistic relational databases

TEXTBOOKS

1. Carlo Zaniolo, Stefano Ceri, -Advanced Database Systems‖, Morgan Kauffmann Publishers,VLDB Journal, 1st Edition, 1997
2. Abraham Silberschatz, Henry F. Korth and S.Sudarshan, -Database System Concepts, Tata McGraw-Hill, 6thEdition, 2010

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1. Raghu Ramakrishnan, Database Management System‖, McGraw-Hill Publications, 3rd Edition, 2000

2. Silberschatz A, Database Systems Concepts‖ McGraw-Hill Publications, 6 th Edition, 2000

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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	Outcome based eductaion, course outcomes, course objectives		
CONTENT DELIVERY (THEORY)			
2	Syntax and Semantics Starburst, Syntax and Semantics Starburst	CO 1	T2: 1.1-1.3, T1: 4.1
3-4	Syntax and Semantics DB2, Taxonomy.	CO 1	T2: 1.4,1.5, R1: 3.1
5-6	Applications ,integrity management, Workflow management	CO 1	T2: 1.8, T2: 1.8.1
7-8	Business rules, Design principles, properties	CO 1	T2: 1.10, T1: 2.1
9-10	Rule modularization, rule debugging, IDEA methodology	CO 1	T2: 2.2, T1: 2.4
11-12	Open problems, Overview: temporal and object databases	CO 2	T1: 3.2, T1: 19.1, 19.1.3
13-14	Time domain, data types	CO 3	T1: 3.5
15-16	Associating facts with time, temporal query language, Overview :Transact-SQL (T-SQL)	CO3, CO4	T1: 3.7, T1: 4.1
17-18	Time ontology, data model, language constructs, Implementation: System architecture, temporal support, support for TSQL2	CO 04	T1: 4.2.2 - 4.2.5, T1:4.3, 4.4
19-21	Logic of Query Languages, Relational calculi, relational algebra, recursive rules,	CO5	T1: 19.1, T1:19.1.3
22-25	Syntax and semantics of data log, fix point semantics.	CO 5	T1: 19.4
26-29	Implementation Rules and Recursion	CO 5	T1:19.4, 19.5
30-33	Compilation and optimization, recursive queries in SQL	CO 6	T1: 19.7, 19.8.1
34-37	Open issues, Traditional Indexing Methods, Secondary keys, spatial access methods	CO 4	T1: 19.8.2, T2: 15.1-15.3

38-39	Text retrieval, Multimedia indexing, 1D time series, 2D color images, sub pattern matching	CO 5	T2: 15.4 - 15.6, 16.1-16.4
40-42	Uncertainty in image database, uncertainty in temporal database, Uncertainty in null value, Models of uncertainty	CO 6	T2: 17.1-17.6
43-45	Uncertainty in relational databases, Lattice based relational databases, Probabilistic relational databases	CO 5, CO6	T2: 17.7, 17.8, T1: 8.1,8.3.1
PROBLEM SOLVING/ CASE STUDIES			
1	Syntax and Semantics (Starburst, Oracle, DB2): Taxonomy, applications, integrity management, workflow management, business rules, design principles, properties, rule modularization, rule debugging, IDEA methodology, open problems.	CO 1	R4:2.1
2	Overview: Time domain, data types, associating facts with time, temporal query language; Transact - SQL (T-SQL): Time ontology, data model, language constructs; Implementation: System architecture,temporal support, support for TSQL2.	CO 2	R:8.1
3	Logic of Query Languages: Relational calculi, relational algebra, recursive rules, syntax and semantics of data log, fix point semantics. Implementation Rules and Recursion: Rule rewriting methods, compilation and optimization, recursive queries in SQL, open issues.	CO3, CO4	R:9.4
4	Traditional Indexing Methods: Secondary keys, spatial access methods, text retrieval; Multimedia indexing: 1D time series, 2D color images, sub pattern matching.	CO5	R:11.6
5	Introduction: Uncertainty in image database, uncertainty in temporal database, uncertainty in null value;Models of uncertainty; Uncertainty in relational databases: Lattice based relational databases, probabilistic relational databases	CO6	R: 13.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Syntax and Semantics (Starburst, Oracle, DB2): Taxonomy, applications, integrity management, workflow management, business rules, design principles, properties, rule modularization, rule debugging, IDEA methodology, open problems.	CO 1	R4:2.1
2	Overview: Time domain, data types, associating facts with time, temporal query language; Transact - SQL (T-SQL): Time ontology, data model, language constructs; Implementation: System architecture,temporal support, support for TSQL2.	CO 2	R:8.1
3	Logic of Query Languages: Relational calculi, relational algebra, recursive rules, syntax and semantics of data log, fix point semantics. Implementation Rules and Recursion: Rule rewriting methods, compilation and optimization, recursive queries in SQL, open issues.	CO3, CO4	R:9.4
4	Traditional Indexing Methods: Secondary keys, spatial access methods, text retrieval; Multimedia indexing: 1D time series, 2D color images, sub pattern matching.	CO5	R:11.6

5	Introduction: Uncertainty in image database, uncertainty in temporal database, uncertainty in null value;Models of uncertainty; Uncertainty in relational databases: Lattice based relational databases, probabilistic relational databases	CO6	R: 13.6
DISCUSSION OF QUESTION BANK			
1	Syntax and Semantics (Starburst, Oracle, DB2): Taxonomy, applications, integrity management, workflow management, business rules, design principles, properties, rule modularization, rule debugging, IDEA methodology, open problems.	CO 1	R4:2.1
2	Overview: Time domain, data types, associating facts with time, temporal query language; Transact - SQL (T-SQL): Time ontology, data model, language constructs; Implementation: System architecture,temporal support, support for TSQL2.	CO 2	R:8.1
3	Logic of Query Languages: Relational calculi, relational algebra, recursive rules, syntax and semantics of data log, fix point semantics. Implementation Rules and Recursion: Rule rewriting methods, compilation and optimization, recursive queries in SQL, open issues.	CO3, CO4	R:9.4
4	Traditional Indexing Methods: Secondary keys, spatial access methods, text retrieval; Multimedia indexing: 1D time series, 2D color images, sub pattern matching.	CO5	R:11.6
5	Introduction: Uncertainty in image database, uncertainty in temporal database, uncertainty in null value;Models of uncertainty; Uncertainty in relational databases: Lattice based relational databases, probabilistic relational databases	CO6	R: 13.6

Course Coordinator **HOD,CSE**
Ms P.Harika, Assistant Professor

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 - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms .M Geetha Yadav, 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 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
33.30%	Remember
50%	Understand
16.66%	Apply
0 %	Analyze

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:

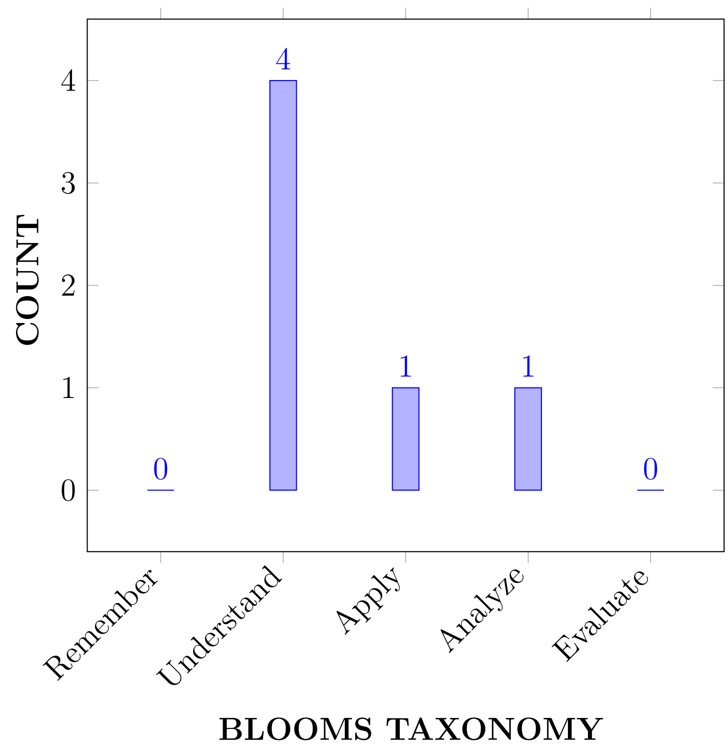
I	Learn how to elicitate requirements and develop software life cycles.
II	Understand the design considerations for enterprise integration and deployment.
III	Analyze quality assurance techniques and testing methodologies.
IV	Prepare a project plan for a software project that includes estimates of size 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	PO 1,PO 2, PO 3, PO 4	SEE Exams	PO 1,PO 2, PO 3, PO 4	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 4	Open Ended Experiments	-
Assignments	PO 1, PO 2, PO 3, PO 4				

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. M Geetha Yadav, Assistant Professor

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

COMPUTER SCIENCE AND ENGINEERING
COURSE DESCRIPTION

Course Title	**CLOUD APPLICATION DEVELOPMENT LABORATORY**				
Course Code	ACSB19				
Program	B.Tech				
Semester	VII	CSE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms K Sreeveda, 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	AITB13	VI	Linux Programming Laboratory
B.Tech	ACSB09	IV	Database Management Systems Laboratory
B.Tech	ACSB02	IV	Programming for Problem Solving 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:

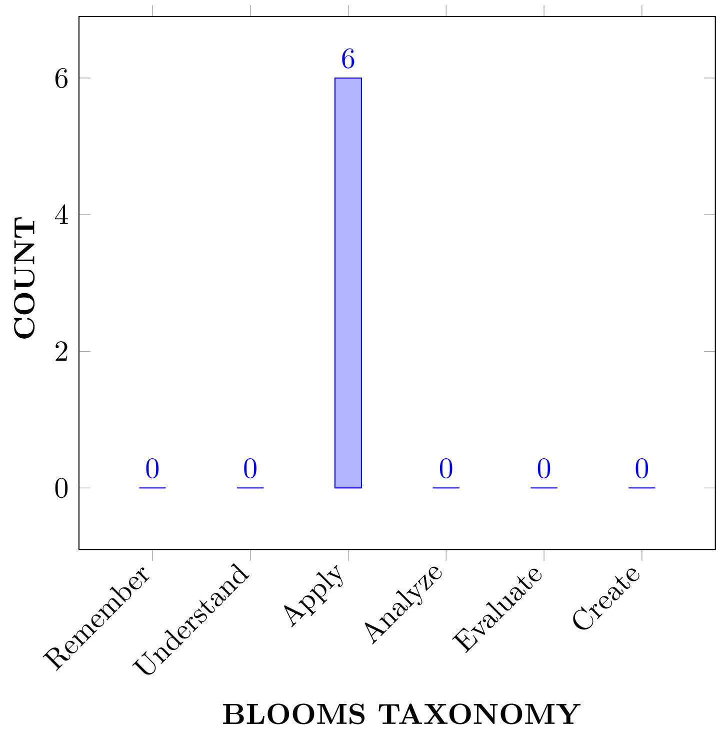
I	To run virtual machines of different configuration.
II	Big data application using Hadoop under cloud environment.
III	The developing web applications in cloud framework.

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**
Ms K Sreeveda, Assistant Professor

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

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	**SOFT COMPUTING**				
Course Code	ACSB30				
Program	B.Tech				
Semester	VIII				
Course Type	Elective				
Regulation	R-18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	K.Aswini,Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B TECH	AHSB12	II	Probability and Statistic
B TECH	AITB05	IV	Design and Analysis of Algorithms

II COURSE OVERVIEW:

Soft computing course provides students with fundamental theory and applications of heuristics, meta heuristics and evolutionary computations. It is used for approximate calculations to provide imprecise but useable solutions to complex problems. This includes intelligence systems, artificial neural network models, fuzzy logic and its inference system, and neuro-fuzzy system. The applications of Soft Computing across different industries such as kinematics, automobile, image processing and data compression, Decision Support System, Power System Analysis and investment and trading.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Soft Computing	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	x	Chalk & Talk	x	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 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
%	Remember
%	Understand
%	Apply
0 %	Analyze

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:

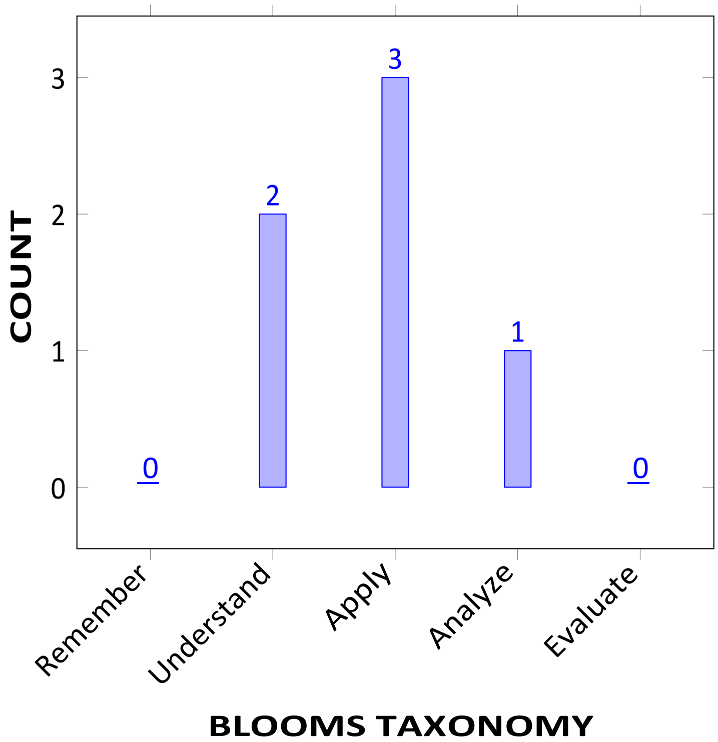
I	The basics of intelligence techniques and methodologies of soft computing that differs from conventional artificial computations.
II	The design and analysis of problem solving using concepts of neural networks, neuro-modeling, several neural networks paradigms and its applications.
III	The concepts of fuzzy logic and inference systems, neuro-fuzzy system, and applications to handle uncertainity in engineering problems.
IV	The soft computing techniques used in different applications for optimization.

VII COURSE OUTCOMES:

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

CO 1	**Demonstrate** the constituents and models of artificial neural network systems for classification of soft computing problems.	Understand
CO 2	**Compare** the importance of auto and hetero associative memories for distinct cases of neural network systems.	Understand
CO 3	**Make use of** fuzzy logic and fuzzy inference systems for modeling and decision making of soft computing systems.	Apply
CO 4	**Choose** the appropriate ANFIS/CANFIS hybrid learning algorithms to solve applications for regression.	Apply
CO 5	**Build a** fuzzy system for information retrieval and pattern recognition applications.	Apply
CO 6	**Categorize** the soft computing and intelligent based learning approaches for solving the scientific and engineering 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	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 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 have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	Short Term Course

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	SEE/CIE /AAT /Seminar
PSO2	Focus on improving software reliability, network security / information retrieval systems.	2	SEE/CIE /AAT /Semi-nar/Project

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies	2	SEE/CIE /AAT /Seminar /Project

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	Demonstrate the constituents and models of artificial neural network systems by using scientific, mathematical and own engineering principles for classification of soft computing problems.	3
	PO2	Identify, formulate, data collection, translation, design and develop solution for the constituents and models of artificial neural network systems of soft computing problems.	7
	PO3	Understand customer and user needs of the requirement for the engineering activities to develop solution of artificial neural network systems for classification of soft computing problems	2
	PO10	Communicate effectively on engineering activities with engineering community orally for constituents and models of artificial neural network systems for classification of soft computing problems	2
	PO12	Keeping current and advanced engineering concepts with on-going learning for continued personal development to model artificial neural network systems for classification of soft computing problems	3
	PSO2	Focus on to design and develop of information retrieval systems to model artificial neural network systems for classification of soft computing problems.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO3	Make use of technical skills and knowledge on advanced frame works to model artificial neural network systems for classification of soft computing problems	1
CO 2	PO 1	Illustrate the importance of auto and hetero associative memories for distinct cases of neural network systems by using scientific, mathematical and own engineering principles.	3
	PO 2	Identify, formulate, data collection, translation, design and develop solution to outline the importance of auto and hetero associative memories for distinct cases of neural network systems.	6
	PO10	Communicate effectively on engineering activities with engineering community orally to interpret the importance of auto and hetero associative memories for distinct cases of neural network systems.	2
	PO12	Keeping current and advanced engineering concepts on the importance of auto and hetero associative memories for distinct cases of neural network systems with on-going learning for continued personal development	3
	PSO2	Focus on design and develop of information retrieval systems to relate the importance of auto and hetero associative memories for distinct cases of neural network systems.	1
	PSO3	Make use of technical skills and knowledge on advanced frame works to summarize the importance of auto and hetero associative memories for distinct cases of neural network systems.	1
CO 3	PO 1	Make use of fuzzy logic and fuzzy inference systems for modeling and decision making of soft computing by using scientific, mathematical and own engineering principles.	3
	PO 2	Identify, formulate, data collection, translation, design and develop solution for modeling and decision making of soft computing systems using fuzzy logic and fuzzy inference systems.	8
	PO 3	Define and identify problem constraints to understand customer and user needs of the requirement for the engineering activities for modeling and decision making of soft computing systems using fuzzy logic and fuzzy inference systems.	6
	PO 10	Communicate effectively on engineering activities with engineering community orally for modeling and decision making of soft computing systems using fuzzy logic and fuzzy inference systems.	2
	PO12	Keeping current and advanced engineering concepts for modeling and decision making of soft computing systems with on-going learning for continued personal development using fuzzy logic and fuzzy inference systems.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO2	Focus on design and develop of information retrieval systems for modeling and decision making of soft computing systems using fuzzy logic and fuzzy inference systems.	1
	PS O3	Make use of technical skills and knowledge on advanced frame works for modeling and decision making of soft computing systems using fuzzy logic and fuzzy inference systems.	1
CO 4	PO 1	Choose the appropriate ANFIS/CANFIS hybrid learning algorithms to solve applications for regression by using scientific, mathematical and own engineering principles.	3
	PO 2	Identify, formulate, data collection, translation, design and develop solution to solve applications for regression by using appropriate ANFIS/CANFIS hybrid learning algorithms.	7
	PO 3	Define and identify problem constraints to understand customer and user needs of the requirement for the engineering activities to solve applications for regression by using appropriate ANFIS/CANFIS hybrid learning algorithms.	4
	PO 10	Communicate effectively on engineering activities with engineering community orally to solve applications for regression by using appropriate ANFIS/CANFIS hybrid learning algorithms.	2
	PO 12	Keeping current and advanced engineering concepts with on-going learning for continued personal development the appropriate ANFIS/CANFIS hybrid learning algorithms to solve applications for regression.	3
	PSO 1	Understand, design and analyze computer programs in the areas related to soft computing to solve applications for regression by using appropriate ANFIS/CANFIS hybrid learning algorithms.	6
	PSO 3	Make use of technical skills and knowledge on advanced frame works to solve applications for regression by using appropriate ANFIS/CANFIS hybrid learning algorithms.	1
CO 5	PO 1	Construct fuzzy system for information retrieval and pattern recognition applications by using scientific, mathematical and own engineering principles.	3
	PO 3	Define and identify problem constraints to understand customer and user needs of the requirement for the engineering activities of fuzzy system for information retrieval and pattern recognition applications.	6
	PO 10	Communicate effectively on engineering activities with engineering community orally to design fuzzy system for information retrieval and pattern recognition applications.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	Keeping current and advanced engineering concepts to design fuzzy system for information retrieval and pattern recognition applications with on-going learning for continued personal development.	3
	PSO 1	Understand, design and analyze computer programs in the areas related to soft computing fuzzy system for information retrieval and pattern recognition applications.	6
	PSO 2	Focus on design and develop of information retrieval and pattern recognition applications using fuzzy systems.	1
	PSO 3	Make use of technical skills and knowledge on advanced frame works to design fuzzy system for information retrieval and pattern recognition applications.	1
CO 6	PO 1	Categorize the soft computing and intelligent based learning approaches for solving the scientific and engineering problems by using scientific, mathematical and own engineering principles.	3
	PO 2	Identify, formulate, data collection, translation, design and develop solution for solving the scientific and engineering problems using soft computing and intelligent based learning approaches.	6
	PO 3	Define and identify problem constraints to understand customer and user needs of the requirement for the engineering activities for solving the scientific and engineering problems using soft computing and intelligent based learning approaches.	4
	PO 10	Communicate effectively on engineering activities with engineering community orally for solving the scientific and engineering problems using soft computing and intelligent based learning approaches.	2
	PO 12	Keeping current and advanced engineering concepts for solving the scientific and engineering problems using soft computing and intelligent based learning approaches with on-going learning for continued personal development.	3
	PSO 1	Understand, design and analyze computer programs in the areas related to soft computing for solving the scientific and engineering problems using soft computing and intelligent based learning approaches.	6
	PSO 2	Focus on design and develop of information retrieval systems for solving the scientific and engineering problems using soft computing and intelligent based learning approaches.	1
	PSO 3	Make use of technical skills and knowledge on advanced frame works for solving the scientific and engineering problems using soft computing and intelligent based learning approaches.	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	7	2	-	-	-	-	-	-	2	-	3	-	1	1
CO 2	3	6	-	-	-	-	-	-	-	2	-	3	-	1	1
CO 3	3	8	6	-	-	-	-	-	-	2	-	3	-	1	1
CO 4	3	7	4	-	-	-	-	-	-	2	-	3	6	-	1
CO 5	3	-	6	-	-	-	-	-	-	2	-	3	6	1	1
CO 6	3	6	4	-	-	-	-	-	-	2	-	3	6	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	100.	70.0	20.0	-	-	-	-	-	-	40.0	-	37.5	-	50.0	50.0
CO 2	100.	60.0	-	-	-	-	-	-	-	40.0	-	37.5	-	50.0	50.0
CO 3	100.	80.0	60.0	-	-	-	-	-	-	40.0	-	37.5	-	50.0	50.0
CO 4	100.	70.0	40.0	-	-	-	-	-	-	40.0	-	37.5	100.0	-	50.0
CO 5	100.	-	60.0	-	-	-	-	-	-	40.0	-	37.5	100.0	50.0	50.0
CO 6	100.	60.0	40.0	-	-	-	-	-	-	40.0	-	37.5	100.0	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 ≤ C≤ 5% – No correlation

1 -5 <C≤ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

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	-	-	-	-	-	-	2	-	3	-	2	2
CO 2	3	3	-	-	-	-	-	-	-	2	-	3	-	2	2
CO 3	3	3	3	-	-	-	-	-	-	2	-	3	-	2	2
CO 4	3	3	2	-	-	-	-	-	-	2	-	3	3	2	2
CO 5	3	-	3	-	-	-	-	-	-	2	-	3	3	2	2
CO 6	3	3	3	-	-	-	-	-	-	2	-	3	3	2	2
TOTAL	18	15	12	-	-	-	-	-	-	12	-	6	9	10	12
AVERAGE	3.0	3.0	2.4	-	-	-	-	-	-	2.0	-	1.0	3.0	2.0	2.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1, PO 2,PO 3,PO 12	SEE Exams	PO 1, PO 2,PO 3,PO 12,PSO 1,PSO 2,PSO 3	Assignments	-
Seminars	PSO 1,PSO 2,PSO 3	Laboratory Practices	-	Student Viva	-
Certification	PO12	Term Paper	-	Mini Project	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO SOFT COMPUTING**
	Characteristic behavior of intelligent systems, knowledge based systems, knowledge representation and processing, soft computing characteristics; Constitutes of soft computing: Fuzzy logic and computing, neural computing, evolutionary computing, rough sets, probabilistic reasoning and machine learning
MODULE II	**NEURAL NETWORKS**
	Fundamental concepts and models of artificial neural systems: Biological neurons and their artificial models, models of artificial neural networks, neural processing, learning and adaptation, neural network learning rules and comparison; Linearly and non-linearly separable pattern classification; Perception convergence theorem; Multi-layer feed forward network: Delta learning rule for Multi perceptron layer, generalized delta learning rule, feed forward recall and error back propagation training, learning factors, character recognition application; Associative memory: Hopfield network, bidirectional associative memory, radial basis function networks.
MODULE III	**FUZZY LOGIC AND FUZZY SYSTEMS**
	Evolution of fuzzy logic, fuzzy sets, fuzzy logic operations, fuzzy relations, fuzzy arithmetic and fuzzy measures, fuzzy rules and reasoning. Fuzzy inference systems: mamdani fuzzy model, sugeno fuzzy model, tsukamoto fuzzy model, fuzzy modeling and decision making, neuro-fuzzy modeling, input space partitioning and fuzzy modeling.
MODULE IV	**HYBRID SYSTEMS**
	ANFIS (Adaptive neuro-fuzzy inference systems): Introduction, ANFIS Architecture, and hybrid learning algorithm; Advantages and limitations of ANFIS; Application of ANFIS/CANFIS for regression.
MODULE V	**APPLICATIONS OF SOFT COMPUTING TECHNIQUES**

	Applications of fuzzy in pattern recognition: Printed character recognition, inverse kinematics problems, automobile fuel efficiency prediction, soft computing for color recipe prediction, applications of evolutionary computing in image processing and computer vision, soft computing in mobile ad-hoc networks, soft computing in information retrieval and semantic web, soft computing in software engineering.

TEXTBOOKS

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2. Timothy J. Ross, — Fuzzy Logic with Engineering Applications, Wiley India, 3rd Edition, 2004.
3. S. N. Sivanandam, S. N. Deepa, — Principles of Soft Computing, Wiley India, 2nd Edition, 2005.
4. Laurene Fausett, —Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Pearson Education, Inc, 1st Edition, 2008.

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1. Hagan T. Martin, H. B. Demuth, Mark Beale, — Neural Network Design, Thomson Learning. 1st Edition, 2004.
2. Satish Kumar,— Neural Networks – A Classroom Approach, Tata McGraw-Hill, 2nd Edition, 2005.
3. Kishan Mehrotra, Chilukuri. K. Mohan, Sanjay Ranka, — Elements of Artificial Neural Networks, Penram International Publishing India, 2nd Edition, 2004.
4. H. J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Ltd, 1st Edition, 2004.
5. 5. John Hertz, Anders Krogh, Richard Palmer Introduction to The Theory of Neural Computation, Addison – Wesley Publishing Company, 1st Edition, 1991.

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2. http://www.rkala.in/softcomputingvideos.php
3. http://www.sharbani.org/home2/soft-computing
4. http://www.myreaders.info/html/soft_computing.html

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	Characteristic behavior of intelligent systems, knowledge based systems	CO1	T2: 1.1-1.8, 2.2
2	knowledge based systems	CO 1	T2: 1.1-1.8, 2.2
3	knowledge representation and processing, soft computing characteristics.	CO 1	T2: 1.1-1.8, 2.2
4	Constitutes of soft computing: Fuzzy logic computing.	CO 1	T2:1.10
5	neural computing computing.	CO 1	T2:1.10
6	Evolutionary computing, rough sets, probabilistic reasoning and machine learning. computing.	CO 1	T2:1.10
7	, probabilistic reasoning and machine learning. computing.	CO 1	T2:1.10
8	Fundamental concepts and models of artificial neural systems	CO 1	T2:2.7
9	Biological neurons and their artificial models	CO 1	T2:2.7
10	models of artificial neural networks, neural processing, learning and adaptation.	CO 1	T2:2.7
11	neural network learning rules and comparison	CO 2	T2:2.8
12	Linearly and non-linearly separable pattern classification	CO 2	T2:2.8
13	Perception convergence theorem; Multi-layer feed forward network	CO 2	T2:2.8
14	Delta learning rule for Multi perceptron layer, generalized delta learning rule.	CO 2	T2:2.8
15	Feed forward recall and error back propagation training, learning factors character recognition application; Associative memory: Hopfield network, bidirectional associative memory, radial basis function networks.	CO 2	T2:2.8
16	, learning factors character recognition application; Associative memory: Hopfield network, bidirectional associative memory, radial basis function networks.	CO 2	T2:2.8
17	character recognition application; Associative memory	CO 2	T2:2.8
18	Hopfield network, bidirectional associative memory, radial basis function networks.	CO 2	T2:2.8
19	Evolution of fuzzy logic, fuzzy sets, fuzzy logic operationsfuzzy relations, fuzzy arithmetic and fuzzy ,measures, fuzzy rules and reasoning.	CO 3	T2: 3.1-3.2
20	fuzzy logic operationsfuzzy relations	CO 3	T2: 3.1-3.2
21	fuzzy arithmetic and fuzzy ,measures	CO 3	T2: 3.1-3.2
22	fuzzy rules and reasoning.	CO 3	T2: 3.1-3.2

23	Fuzzy inference systems mamdani fuzzy model	CO 3	T2: 3.3-3.7
24	sugeno fuzzy model, tsukamo to fuzzy model	CO 3	T2: 3.3-3.7
25	fuzzy modeling and decision making.	CO 3	T2: 3.3-3.7
26	neuro-fuzzy modeling, input space partitioning and fuzzy modeling.	CO 3	T2: 3.3-3.7
27	Adaptive neuro-fuzzy inference systems (ANFIS)	CO 8	T2:4.2,7.1-7.4, R3:1.1-1.4
28	Introduction, ANFIS Architecture, and hybrid learning algorithm.	CO 8	T2:4.2,7.1-7.4, R3:1.1-1.4
29	Advantages and limitations of ANFIS	CO 4	T2: 7.6 7.7
30	Application of ANFIS/CANFIS for regression	CO 4	T3:1.1
31	Applications of fuzzy in pattern recognition	CO 5	T3:1.1-1.2 ,R3:1.5-1.7
32	Printed character recognition, inverse kinematics problems	CO 5	T3:1.1-1.2 ,R3:1.5-1.7
33	automobile fuel efficiency prediction	CO 5	T3:1.1-1.2 ,R3:1.5-1.7
35	soft computing for color recipe prediction.	CO 5	T3:1.1-1.2 ,R3:1.5-1.7
36	Applications of evolutionary computing in image processing and computer vision	CO 6	T3:1.3 ,R3:1.7,7.4
37	soft computing in mobile ad-hoc networks	CO 6	T3:1.3 ,R3:1.7,7.4
38	soft computing in information retrieval	CO 6	T3:1.3 ,R3:1.7,7.4
39	semantic web, soft computing in software engineering.	CO 6	T3:1.3 ,R3:1.7,7.4
40	soft computing in software engineering.	CO 6	T3:1.3 ,R3:1.7,7.4
PROBLEM SOLVING/ CASE STUDIES			
1	What are the characteristics of soft computing and explain the uncertainity in handling .	CO 1	T2: 1.1-1.8, 2.2

2	How the input data can be handle with knowledge base for producing the output in rule base system. explain with an example?	CO 1	T2: 1.1-1.8, 2.2
3	Translate the output of u from the network with input x=$[-1, 2]^T$ W=[-1,2] with activation function in hidden layer as: a) Unipolar activation function b) Bipolar sigmoidal function	CO 2	T2:1.10
4	Solve the back propagation algorithm for 2-3-1 neural network with the activation function. $\frac{1}{(1+e^{-N})}$	CO 2	T2:1.10
5	Solve the outputs of u from the perception activation function for the following input vectors x and weight vectors w: a) x=$[-1, 0, 2]^T$ w=$[-1, -3, 2, -5]^T$	CO 2	T2:2.8
6	Find the output of u using activation function as defined for the 3-3 neural network with given input x=[3, 0, 1] and $w = \begin{bmatrix} 3 & -1 & 1 \\ 1 & -2 & -2 \\ -1 & 0 & -3 \end{bmatrix}$ $u = \begin{cases} 1, & u > 0 \\ 0, & u < 0 \end{cases}$	CO 2	T2:2.8
7	Explain the extension principle and min-max fuzzy relations in problem solving.	CO 4	T2: 3.1-3.2
8	List the components of fuzzy logic system. Explain each component in detail.	CO 3	T2: 3.1-3.2
9	Draw the typical membership function to predict the values using fuzzy relations.	CO 3	T2: 3.1-3.2
10	Construct an ANFIS that is equivalent to a two-input two-rule mamdani fuzzy model with min max composition and centroid defuzzification. Explain the function user use to approximate the centroid defuzzification.	CO 4	T2: 3.1-3.2
11	Construct an ANFIS that is equivalent to a two-input two-rule mamdani fuzzy model with sum-product composition and centroid defuzzification.	CO 4	T2:4.2,7.1-7.4, R3:1.1-1.4
12	Demonstrate the different premise and consequent parameters are there in ANFIS architecture (imagine generalized bell function is used for all the membership functions).	CO 5	T3:1.1
13	Explain in detail about indirect kinematics of a two joint planar robot arm.	CO 6	T3:1.3 ,R3:1.7,7.4
14	Explain the logic of applying ANFIS to MPG prediction.	CO 4	T3:1.1
15	Explain in detail about evolutionary computing.	CO 1	T3:1.3 ,R3:1.7,7.4
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Discussion of definition and terminology on introduction to soft computing	CO 1	T2: 1.1-1.8, 2.2
2	Discussion of definition and terminology on neural networks	CO 2	T2:2.7

3	Discussion of definition and terminology on fuzzy logic and fuzzy systems	CO 3	T2:2.8
4	Discussion of definition and terminology on hybrid systems	CO 4	T2:4.2,7.1-7.4, R3:1.1-1.4
5	Discussion of definition and terminology on applications of soft computing techniques	CO 5	T3:1.1-1.2 ,R3:1.5-1.7
DISCUSSION OF QUESTION BANK			
1	Discussion of Question on introduction to soft computing	CO 1	T2: 1.1-1.8, 2.2
2	Discussion of Question on neural networks	CO 2	T2:2.7
3	Discussion of question on fuzzy logic and fuzzy systems	CO 3	T2:2.8
4	Discussion of question on hybrid systems	CO 4	T2:4.2,7.1-7.4, R3:1.1-1.4
5	Discussion of question on applications of soft computing techniques	CO 5	T3:1.1-1.2 ,R3:1.5-1.7

Signature of Course Coordinator **HOD,CSE**

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

Department	**COMPUTER SCIENCE AND ENGINEERING**				
Course Title	ENERGY FROM WASTE				
Course Code	ACEB52				
Program	B.Tech				
Semester	VIII				
Course Type	Open Elective				
Regulation	IARE - R18				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. S.Selvaprakash, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSB07	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:

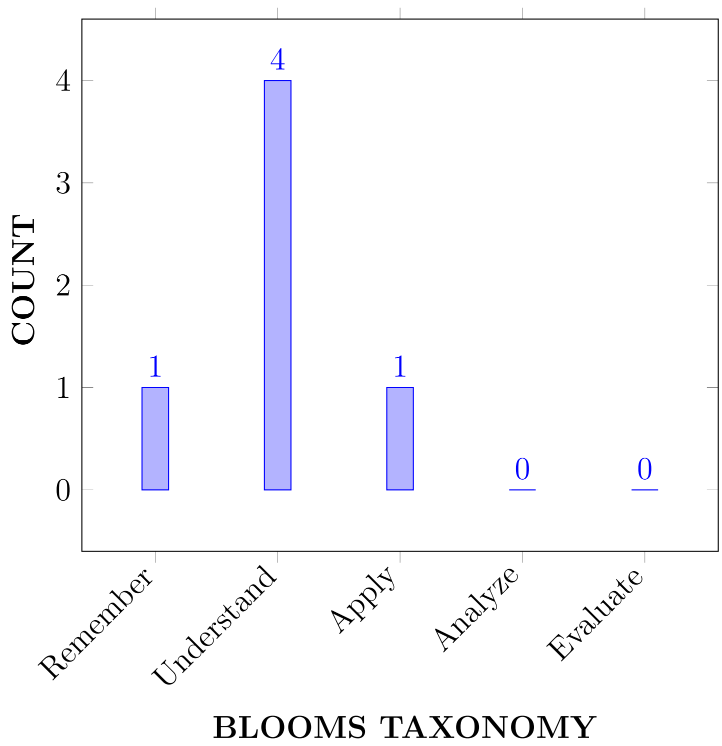
I	The principles of solid waste management in reducing and eliminating dangerous impacts of waste materials on human health and the environment to contribute economic development and superior quality of life.
II	The insight of the design and operations of a municipal solid waste landfill by collection, 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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	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
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

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
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
	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:

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

XVIII SYLLABUS:

MODULE - 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
MODULE-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.
MODULE-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.

MODULE-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
MODULE-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.

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	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	Explain the composition of Municipal solid waste and various types of solid waste in detail.	CO 1	T1:3.3, T2:1.2, R2: 2.2
2	Explain the various phases of municipal solid waste decomposition in a closed landfill cell.	CO 2	T 1.4:7.3
3	Explain in-detail step by step procedure of bio-chemical conversion	CO 3	T1:6.2, T2:5.6
4	Discuss in detail the process of biogas production in thermo chemical conversion.	CO 4	T1:6.7, T2:5.3
5	Discuss in detail about regulations by government on e-waste management	CO 5, CO 6	T1:2.4, R1:5.5

Signature of Course Coordinator **HOD, CSE**
Mr. S.Selvaprakash, Assistant Professor