INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)

Dundigal, Hyderabad - 500 043, Telangana

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

BACHELOR OF TECHNOLOGY
MECHANICAL ENGINEERING

ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABI
(Based on AICTE Model Curriculum)

IARE - R18

B.Tech Regular Four Year Degree Program

(for the batches admitted from the academic year 2018- 2019)

&

B.Tech (Lateral Entry Scheme)

(for the batches admitted from the academic year 2019 - 2020)

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

CONTENTS

"Take up one idea.
Make that one idea your life-think of it, dream of it, live on that idea. Let the brain muscles, nerves, every part of your body be full of that idea and just leave every other idea alone.
This is the way to success"

Swami Vivekananda

PRELIMINARY DEFINITIONS AND NOMENCLATURES

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as Autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two main semesters i.e., (one odd + one even) and one supplementary semester.

Branch: Means specialization in a program like B.Tech degree program in Aeronautical Engineering, B.Tech degree program in Computer Science and Engineering etc.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Backlog Course: A course is considered to be a backlog course, if the student has obtained a failure grade (F) in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry etc., are considered to be foundational in nature.

Betterment: Betterment is a way that contributes towards improvement of the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Commission: Means University Grants Commission (UGC), New Delhi.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Certificate Course: It is a course that makes a student to have hands-on expertise and skills required for holistic development in a specific area/field.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Continuous Internal Examination: It is an examination conducted towards sessional assessment.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Course: A course is a subject offered by a department for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture/tutorial hour per week.

Credit point: It is the product of grade point and number of credits for a course.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff, and other resources in the process of study for a degree.

Detention in a Course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from Semester: Student who doesn't want to register for any semester can apply in writing in prescribed format before the commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and / or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Honours: An Honours degree typically refers to a higher level of academic achievement at an undergraduate level.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Courses (MOOC): MOOC courses inculcate the habit of self learning. MOOC courses would be additional choices in all the elective group courses.

Minor: Minor are coherent sequences of courses which may be taken in addition to the courses required for the B.Tech degree.

Pre-requisite: A specific course or subject, the knowledge of which is required to complete before student register another course at the next grade level.

Professional Elective: It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, UG degree program: Bachelor of Technology (B.Tech); PG degree program: Master of Technology (M.Tech) / Master of Business Administration (MBA).

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her final year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a program.

Regulations: The regulations, common to all B.Tech programs offered by Institute, are designated as "IARE Regulations - R18" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. Odd semester commences usually in July and even semester in December of every year.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

S/he: Means "she" and "he" both.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, is an affiliating University.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of odd or even semester (deadlines are different for summer sessions). However, s/he can choose a substitute course in place of it, by exercising the option within 5 working days from the date of withdrawal.

FOREWORD

The autonomy is conferred to Institute of Aeronautical Engineering (IARE), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies including J N T University Hyderabad (JNTUH), Hyderabad and AICTE, New Delhi. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system** and **monitoring mechanism**, independent of the affiliating University but under its observance.

IARE is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies such as Academic Council and Board of Studies (BOS) are constituted with the guidance of the Governing Body of the institute and recommendations of the JNTUH to frame the regulations, course structure, and syllabi under autonomous status.

The autonomous regulations, course structure, and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the institute in order to produce a quality engineering graduate to the society.

All the faculty, parents, and students are requested to go through all the rules and regulations carefully. Any clarifications needed are to be sought at appropriate time and from the principal of the institute, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The cooperation of all the stake holders is requested for the successful implementation of the autonomous system in the larger interests of the institute and brighter prospects of engineering graduates.

PRINCIPAL

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ACADEMIC REGULATIONS

B.Tech. Regular Four Year Degree Program
(for the batches admitted from the academic year 2018 - 19)
&
B.Tech. (Lateral Entry Scheme)
(for the batches admitted from the academic year 2019 - 20)

For pursuing four year undergraduate Bachelor of Technology degree program of study in Engineering (B.Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

Preamble:

All India Council for Technical Education (AICTE) has introduced Model Curriculum for Bachelor of Technology program with 160 credits in the entire program of 4 years, and additional 20 credits can be acquired for the degree of B.Tech with **Honours or additional Minor in Engineering**. These additional 20 credits will have to be acquired with online courses (MOOCs), perhaps for the first time in the country, to tap the zeal and excitement of learning beyond the classrooms. So, the students will have to complete additional 20 credits through MOOCs within 4 years of time. This creates an excellent opportunity for students to acquire the necessary skill set for employability through massive open online courses where the rare expertise of world famous experts from academics and industry are available.

Separate certificate will be issued in addition to regular degree program mentioning that the student has cleared Honours / Minor specialization in respective courses in addition to scheduled courses for B.Tech programs.

1. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEIs) are changing from the conventional course structure to Choice Based Credit System (CBCS) along with introduction to semester system in the first year itself. The semester system helps in accelerating the teaching-learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises lectures / tutorials / laboratory work / field work / project work / comprehensive Examination / seminars / assignments / MOOCs / alternative assessment tools / presentations / self-study etc., or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.

The CBCS permits students to:

1. Choose electives from a wide range of elective courses offered by the departments.
2. Undergo additional courses of interest.
3. Adopt an interdisciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2. MEDIUM OF INSTRUCTION

The medium of instruction shall be English for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course structure, in accordance with the prescribed syllabi.

3. PROGRAMS OFFERED

Presently, the institute is offering Bachelor of Technology (B.Tech) degree programs in the following disciplines:

1. Aeronautical Engineering
2. Computer Science and Engineering
3. Information Technology
4. Electronics and Communication Engineering
5. Electrical and Electronics Engineering
6. Mechanical Engineering
7. Civil Engineering

4. SEMESTER STRUCTURE

Each academic year is divided into three semesters, TWO being **MAIN SEMESTERS** (one odd + one even) and ONE being a **SUPPLEMENTARY SEMESTER**. Main semesters are for regular class work. Supplementary Semester is primarily for failed students i.e. registration for a course for the first time is generally not permitted in the supplementary semester.

4.1 Each main semester shall be of 21 weeks (Table 1) duration and this period includes time for registration of courses, course work, examination preparation, and conduct of examinations.

4.2 Each main semester shall have a minimum of 90 working days; out of which 75 days are for teaching / practical and 15 days for conduct of exams and preparation.

4.3 The supplementary semester shall be a fast track semester consisting of eight weeks and this period includes time for registration of courses, course work, and examination preparation, conduct of examinations, assessment, and declaration of final results.

4.4 All subjects may not be offered in the supplementary semester. The student has to pay a stipulated fee prescribed by the institute to register for a course in the supplementary semester. The supplementary semester is provided to help the student in not losing an academic year. It is optional for a student to make use of supplementary semester. **Supplementary semester is a special semester and the student cannot demand it as a matter of right** and will be offered based on availability of faculty and other institute resources.

4.5 The institute may use **supplementary semester** to arrange add-on courses for regular students and / or for deputing them for practical training / FSI model. A student can register for a maximum number of 15 credits during a supplementary semester.

4.5.1 The registration for the supplementary semester (during May – July, every year) provides an opportunity to students to clear their backlogs (‘F’ grade) or who are prevented from appearing for SEE examinations due to shortage of attendance less than 65% in each course (‘SA’ Grade) in the earlier semesters or the courses which he / she could not register (Drop / Withdraw) due to any reason.

Students will not be permitted to register for more than 15 credits (both I and II semester) in the supplementary semester. Students required to register for supplementary semester courses are to pay a nominal fee within the stipulated time. A separate circular shall be issued at the time of supplementary semester.

It will be optional for a student to get registered in the course(s) of supplementary semester; otherwise, he / she can opt to appear directly in supplementary examination. However, if a student gets registered in a course of supplementary semester, then it will be compulsory for a student to fulfill attendance criterion (≥90%) of supplementary semester and he / she will lose option to appear in immediate supplementary examination.

The students who have earlier taken SEE examination and register afresh for the supplementary semester may revoke the CIA marks secured by them in their regular/earlier attempts in the same course. Once revoked, the students shall not seek restoration of the CIA marks.

Supplementary semester will be at an accelerated pace e.g. one credit of a course shall require two hours/week so that the total number of contact hours can be maintained same as in normal semester.

Instructions and guidelines for the supplementary semester course:

- A minimum of 36 to 40 hours will be taught by the faculty for every course.
- Only the students registered and having sufficient percentage of attendance for the course will be permitted to write the examination.
- The assessment procedure in a supplementary semester course will be similar to the procedure for a regular semester course.
- Student shall register for the supplementary semester as per the schedule given in academic calendar.
- Once registered, students will not be allowed to withdraw from supplementary semester.

4.5.2 The academic calendar shown in Table 1 is declared at the beginning of the academic year.

Table 1: Academic Calendar

FIRST SEMESTER (21 weeks)	I Spell Instruction Period	8 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation and Practical Examinations	1 week	
	Semester End Examinations		2 weeks
Semester Break and Supplementary Exams			2 weeks
SECOND SEMESTER (21 weeks)	I Spell Instruction Period	8 weeks	19 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation & Practical Examinations	1 week	
	Semester End Examinations		2 weeks
Summer Vacation, Supplementary Semester and Remedial Exams			8 weeks

4.6 Students admitted on transfer from JNTUH affiliated institutes, Universities and other institutes in the subjects in which they are required to earn credits so as to be on par with regular students as prescribed by concerned 'Board of Studies'.

5.0 REGISTRATION / DROPPING / WITHDRAWAL

5.1. Each student has to compulsorily register for course work at the beginning of each semester as per the schedule mentioned in the Academic Calendar. It is compulsory for the student to register for courses in time. The registration will be organized departmentally under the supervision of the Head of the Department.

5.2. In ABSENTIA, registration will not be permitted under any circumstances.

5.3. At the time of registration, students should have cleared all the dues of Institute and Hostel for the previous semesters, paid the prescribed fees for the current semester and not been debarred from the institute for a specified period on disciplinary or any other ground.

5.4. The student has to normally register for a minimum of 17 credits and may register up to a maximum of 27 credits, in consultation with HOD/faculty mentor. On an average, a student is expected to register for 22 credits.

5.5. **Dropping of Courses:** Within one week after the last date of first internal assessment test or by the date notified in the academic calendar, the student may in consultation with his / her faculty mentor/adviser, drop one or more courses without prejudice to the minimum number of credits as specified in clause 5.4. The dropped courses are not recorded in the Grade Card. Student must complete the dropped subject by registering in the supplementary semester / forthcoming semester in order to earn the required credits. Student must complete the dropped subject by registering in the supplementary semester / forthcoming semester in order to earn the required credits.

5.6. **Withdrawal from Courses:** A student is permitted to withdraw from a course by the date notified in the academic calendar. Such withdrawals will be permitted without prejudice to the minimum number of credits as specified in clause 5.4. A student cannot withdraw a course more than once and withdrawal of reregistered subjects is not permitted.

5.7 After **Dropping and / or Withdrawal** of courses, minimum credits registered shall be 20.

6.0 UNIQUE COURSE IDENTIFICATION CODE

Every course of the B.Tech program will be placed in one of the seven groups of courses as listed in the Table 2. The various courses and their two-letter codes are given below;

Table 2: Group of Courses

S. No	Branch	Code
1	Aeronautical Engineering	AE
2	Computer Science and Engineering	CS
3	Information Technology	IT
4	Electronics and Communication Engineering	EC
5	Electrical and Electronics Engineering	EE
6	Mechanical Engineering	ME
7	Civil Engineering	CE

7.0 CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Theory Courses, Elective Courses, Laboratory Courses, Audit Courses, Mandatory Courses, Mini Project, Internship and Project work. The list of elective courses may also include subjects from allied discipline.

Contact Periods: Depending on the complexity and volume of the course, the number of contact periods per week will be assigned. Each Theory and Laboratory course carries credits based on the number of hours/week as follows:

- **Contact classes (Theory):** 1 credit per lecture hour per week, 1 credit per tutorial hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 practical hours per week.
- **Project Work:** 1 credit for 2 hours of project work per week.
- **Mini Project:** 1 credit for 2 hours per week

7.1 TYPES OF COURSES

Courses in a program may be of three kinds: **Foundation / Skill, Core and Elective Courses.**

7.1.0 Foundation / Skill Course:

Foundation courses are the courses based upon the content leads to enhancement of skill and knowledge as well as value based and are aimed at man making education. Skill subjects are those areas in which one needs to develop a set of skills to learn anything at all. They are fundamental to learning any subject.

7.1.1 Professional Core Courses:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in the said discipline of study.

7.1.2 Elective Course:

Electives provide breadth of experience in respective branch and application areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline / domain
- Nurturing student's proficiency / skill.

An elective may be Professional Elective, is a discipline centric focusing on those courses which add generic proficiency to the students or may be Open Elective, chosen from unrelated disciplines.

There are six professional elective tracks; students can choose not more than two courses from each track. Overall, students can opt for six professional elective courses which suit their project work in consultation with the faculty advisor/mentor. Nevertheless, one course from each of the four open electives has to be selected. A student may also opt for more elective courses in his/her area of interest.

7.1.3 Credit distribution for courses offered is given in Table 3.

Table 3: Credit distribution

S. No	Course	Hours	Credits
1	Theory Course	1 / 2 / 3 / 4	1 / 2 / 3 / 4
2	Elective Courses	3	3
3	MOOC Courses	-	2
4	Laboratory Courses	2 / 3 / 4	1 / 1.5 / 2
5	Audit Course / Mandatory Course	-	0
6	Project / Research based learning	-	4
7	Full Semester Internship (FSI) / Project Work	-	11

7.2 Course Structure

Every course of the B.Tech program will be placed in one of the eight categories with minimum credits as listed in the Table 4.

Table 4: Category Wise Distribution of Credits

S. No	Category	Breakup of Credits
1	Humanities and Social Sciences (HSMC), including Management.	12
2	Basic Science Courses (BSC) including Mathematics, Physics and Chemistry.	25
3	Engineering Science Courses (ESC), including Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Computer Engineering.	24
4	Professional Core Courses (PCC), relevant to the chosen specialization / branch.	48
5	Professional Electives Courses (PEC), relevant to the chosen specialization / branch.	18
6	Open Elective Courses (OEC), from other technical and/or emerging subject areas.	18
7	Project Based Learning, Research Based Learning and Project Work (PROJ) / Full Semester Internship (FSI)	15
8	Mandatory Courses / Audit Courses.	Non-Credit
TOTAL		**160**

7.3 Semester wise course break-up

Following are the **TWO** models of course structure out of which any student shall choose or will be allotted with one model based on their academic performance.

i. Full Semester Internship (FSI) Model and

ii. Non Full Semester Internship (NFSI) Model – Project work.

7.4 For Four year regular program (FSI Model):

In the FSI Model, out of the selected students - half of students shall undergo Full Semester Internship in VII semester and the remaining students in VIII semester. In the Non FSI Model,

all the selected students shall carry out the course work and Project work as specified in the course structure. A student who secures a minimum CGPA of 7.5 up to IV semester with no current arrears and maintains the CGPA of 7.5 till VI Semester shall be eligible to opt for FSI.

8.0 EVALUATION METHODOLOGY

8.1 Theory Course:

Each theory 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.

8.1.1 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 modules carries equal weightage in terms of marks distribution. The question paper pattern is as follows.

Two full questions with 'either' 'or' choice will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
50 %	To test the analytical skill of the concept OR to test the application skill of the concept

8.1.2 Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty / teacher handling the course as given in Table 5. 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).

Table 5: Assessment pattern for Theory Courses

COMPONENT	**THEORY**			**TOTAL MARKS**
Type of Assessment	CIE Exam	Quiz	AAT	
Max. CIA Marks	20	05	05	30

8.1.2.1 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. The valuation and verification of answer scripts of CIE exams shall be completed within a week after the conduct of the Examination.

8.1.2.2 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.

8.1.2.3 Alternative Assessment Tool (AAT)

In order to encourage innovative methods while delivering a course, the faculty members are encouraged to use the Alternative Assessment Tool (AAT). This AAT enables faculty to design own assessment patterns during the CIA. The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices. If properly applied, 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.

However, it is mandatory for a faculty to obtain prior permission from the concerned HOD and spell out the teaching/assessment pattern of the AAT prior to commencement of the classes.

8.2 Laboratory Course:

8.2.1 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. 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 the Chairman, BOS.

8.2.2 All the drawing related courses are evaluated in line with laboratory courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test of 10 marks in each semester.

8.3 Mandatory Courses (MC):

These courses are among the compulsory courses but will not carry any credits. However, a pass in each such course during the program shall be necessary requirement for the student to qualify for the award of Degree. Its result shall be declared as “Satisfactory” or “Not Satisfactory” performance.

8.4 Value Added Courses:

The value added courses are audit courses offered through joint ventures with various organizations providing ample scope for the students as well as faculty to keep pace with the latest technologies pertaining to their chosen fields of study. A plenty of value added programs will be proposed by the departments one week before the commencement of class work. The students are given the option to choose the courses according to their desires and inclinations as they choose the desired items in a cafeteria. The expertise gained through the value added programs should enable them to face the formidable challenges of the future and also assist them in exploring new opportunities. Its result shall be declared with “Satisfactory” or “Not Satisfactory” performance.

8.5 Project / Research Based Learning

This gives students a platform to experience a research driven career in engineering, while developing a device / systems and publishing in reputed SCI / SCOPUS indexed journals and/or filing an **Intellectual Property** (IPR-Patent/Copyright) to aid communities around the world. Students should work individually as per the guidelines issued by head of the department concerned. The benefits to students of this mode of learning include increased engagement, fostering of critical thinking and greater independence.

The topic should be so selected that the students are enabled to complete the work in the stipulated time with the available resources in the respective laboratories. The scope of the work be handling part of the consultancy work, maintenance of the existing equipment, development of new experiment setup or can be a prelude to the main project with a specific outcome.

Project report will be evaluated for 100 marks in total. Assessment will be done for 100 marks out of which, the supervisor / guide will evaluate for 30 marks based on the work and presentation / execution of the work. Subdivision for the remaining 70 marks is based on publication, report, presentation, execution and viva-voce. Evaluation shall be done by a committee comprising the supervisor, Head of the department and an examiner nominated by the Principal from the panel of experts recommended by Chairman, BOS in consultation with Head of the department.

8.6 Project work

The project work shall be evaluated for 100 marks out of which 30 marks for internal evaluation and 70 marks for semester end evaluation. The project work shall be spread over in VII semester and in VIII semester. The project work shall be somewhat innovative in nature and explore the research bent of the mind of the student. A student shall carry out the project work under the supervision of a member of the faculty or may undertake to execute the project in collaboration with an Industry, R&D organization or another academic institution/University where sufficient facilities exist to carry out the project work.

At the end of VII semester, students should submit synopsis summarizing the work done in VII semester. The project is expected to be completed by the end of VIII semester. In VII semester, a first mid review is conducted by Project Review Committee (PRC) (on the progress) for 10 marks.

In VIII semester, a second mid review is conducted by PRC (on the progress) for 10 marks. On completion of the project, a third evaluation is conducted for award of internal marks of another 10 marks before the report is submitted, making the total internal marks 30.

The end semester examination shall be based on the report submitted and a viva-voce exam for 70 marks by a committee comprising the Head of the Department, the project supervisor and an external examiner nominated by the Principal. A minimum of 40% of maximum marks shall be obtained to earn the corresponding credits.

8.7 Full Semester Internship (FSI)

FSI is a full semester internship program carrying 11 credits. The FSI shall be opted in VII semester or in VIII semester. During the FSI, student has to spend one full semester in an identified industry / firm / R & D organization or another academic institution/University

where sufficient facilities exist to carry out the project work.

Following are the evaluation guidelines:

- Quizzes: 2 times
- Quiz #1 - About the industry profile, weightage: 5%
- Quiz #2 - Technical-project related, weightage: 5%
- Seminars - 2 times (once in six weeks), weightage: 7.5% + 7.5%
- Viva-voce: 2 times (once in six weeks), weightage: 7.5% + 7.5%
- Project Report, weightage: 15%
- Internship Diary, weightage: 5 %
- Final Presentation, weightage: 40%

FSI shall be open to all the branches with a ceiling of maximum 10% distributed in both semesters. The selection procedure is:

- Choice of the students
- CGPA (> 7.5) up to IV semester
- Competency Mapping / Allotment

9.0 MAKEUP EXAMINATION

The make-up examination facility shall be available to students who may have missed to attend CIE exams in one or more courses in a semester for valid genuine reasons. The make-up examination shall have comprehensive online objective type questions. The syllabus for the make-up examination shall be the whole syllabus covered till the end of the semester under consideration and will be conducted at the end of the semester.

10.0 SUPPLEMENTARY EXAMINATIONS:

In addition to the Regular Semester End Examinations held at the end of each semester, Supplementary Semester End Examinations will be conducted within three weeks of the commencement of the teaching of the next semester. Candidates taking the Regular / Supplementary examinations as Supplementary candidates may have to take more than one Semester End Examination per day. A student can appear for any number of supplementary examinations till he/she clears all courses which he/she could not clear in the first attempt. However the maximum stipulated period for the course shall not be relaxed under any circumstances.

11.0 ATTENDANCE REQUIREMENTS AND DETENTION POLICY

11.1 It is desirable for a candidate to have 100% attendance in each course. In every course (theory/laboratory), student has to maintain a minimum of 75% attendance including the days of attendance in sports, games, NCC and NSS activities to be eligible for appearing in Semester End Examination of the course.

11.2 In case of medical issues, deficiency of attendance in each course to the extent of 10% may be condoned by the College Academic Committee (CAC) on the recommendation of the Head of the Department if the attendance is between 75% and 65% in every course, subjected to the submission of medical certificates, medical case file, and other needful documents to the concerned departments.

11.3 The basis for the calculation of the attendance shall be the period prescribed by the institute by its calendar of events. For late admission, attendance is reckoned from the date of admission to the program. However, in case of a student having less than 65%

attendance in any course, s/he shall be detained in the course and in no case such process will be relaxed.

11.4 A candidate shall put in a minimum required attendance in atleast 60% of (rounded to the next highest integer) theory courses for getting promoted to next higher class / semester. Otherwise, s/he shall be declared detained and has to repeat semester.

11.5 Students whose shortage of attendance is not condoned in any subject are not eligible to write their semester end examination of that courses and their registration shall stand cancelled.

11.6 A prescribed fee shall be payable towards condonation of shortage of attendance.

11.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fails to fulfill the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

11.8 Any student against whom any disciplinary action by the institute is pending shall not be permitted to attend any SEE in that semester.

12.0 CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

12.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

12.2 Question papers may be moderated for the coverage of syllabus, pattern of questions by a Semester End Examination Committee chaired by Head of the Department one day before the commencement of semester end examinations. Internal Examiner shall prepare a detailed scheme of valuation.

12.3 The answer papers of semester end examination should be evaluated by the internal examiner immediately after the completion of exam and the award sheet should be submitted to COE in a sealed cover before the same papers are kept for second evaluation by external examiner.

12.4 In case of difference of more than 15% of marks, the answer paper shall be re-evaluated by a third examiner appointed by the Examination Committee and marks awarded by this examiner shall be taken as final.

12.5 COE shall invite 3 - 9 external examiners to evaluate all the end-semester answer scripts on a prescribed date(s). Practical laboratory exams are conducted involving external examiners.

12.6 Examinations Control Committee shall consolidate the marks awarded by internal and external examiners and award grades.

13.0 SCHEME FOR THE AWARD OF GRADE

13.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures

i. Not less than 35% marks for each theory course in the semester end examination, and

ii. A minimum of 40% marks for each theory course considering both internal and semester end examination.

13.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Lab / Project based learning / Research based learning / Project work / FSI, if s/he secures

i. Not less than 40% marks for each Lab / Project based learning / Research based learning / Project work / FSI course in the semester end examination,

ii. A minimum of 40% marks for each Lab / Project based learning / Research based learning / Project work / FSI course considering both internal and semester end examination.

13.3 If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

14.0 LETTER GRADES AND GRADE POINTS

14.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10-point grading system with the following letter grades as given in the Table-6.

Table-6: Grade Points Scale (Absolute Grading)

Range of Marks	Grade Point	Letter Grade
100 – 90	10	S (Superior)
89 – 80	9	A+ (Excellent)
79 – 70	8	A (Very Good)
69 – 60	7	B+ (Good)
59 – 50	6	B (Average)
49 – 40	5	C (Pass)
Below 40	0	F (Fail)
Absent	0	AB (Absent)
Authorized Break of Study	0	ABS

14.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: “S”, “A+”, “A”, “B+”, “B”, “C”.

14.3 A student obtaining Grade F shall be considered Failed and will be required to reappear in the examination.

14.4 For non credit courses, ‘Satisfactory’ or “Not Satisfactory” is indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

14.5 “SA” denotes shortage of attendance (as per item 11) and hence prevention from writing Semester End Examination.

14.6 “W” denotes **withdrawal** from the exam for the particular course.

14.7 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

15.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the

previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and n represent the number of courses in which a student is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m} (C_j S_j) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

16.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA

16.1 Illustration for SGPA

Course Name	Course Credits	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 x 8 = 24
Course 2	4	B+	7	4 x 7 = 28
Course 3	3	B	6	3 x 6 = 18
Course 4	3	S	10	3 x 10 = 30
Course 5	3	C	5	3 x 5 = 15
Course 6	4	B	6	4 x 6 = 24
	20			**139**

$$Thus,\ SGPA = 139 / 20 = 6.95$$

16.2 Illustration for CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit: 20 SGPA: 6.9	Credit: 22 SGPA: 7.8	Credit: 25 SGPA: 5.6	Credit: 26 SGPA: 6.0
Semester 5	**Semester 6**		
Credit: 26 SGPA: 6.3	Credit: 25 SGPA: 8.0		

$$Thus,\ CGPA = \frac{20x6.9 + 22x7.8 + 25x5.6 + 26x6.0 + 26x6.3 + 25x8.0}{144} = 6.73$$

17.0 PHOTOCOPY / REVALUATION

A student, who seeks the re-valuation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s), within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through

the Head of the department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

18.0 PROMOTION POLICIES

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no. 11.

18.1 For students admitted into B.Tech (Regular) program

18.1.1 A student will not be promoted from II semester to III semester unless s/he fulfills the academic requirement of securing 50% of the total credits (rounded to the next lowest integer) from I and II semester examinations, whether the candidate takes the examination(s) or not.

18.1.2 A student will not be promoted from IV semester to V semester unless s/he fulfills the academic requirement of securing 50% of the total credits (rounded to the next lowest integer) upto III semester **or** 50% of the total credits (rounded to the next lowest integer) up to IV semester, from all the examinations, whether the candidate takes the examination(s) or not.

18.1.3 A student shall be promoted from VI semester to VII semester only if s/he fulfills the academic requirements of securing 50% of the total credits (rounded to the next lowest integer) up to V semester **or** 50% of the total credits (rounded to the next lowest integer) up to VI semester from all the examinations, whether the candidate takes the examination(s) or not.

18.1.4 A student shall register for all the 160 credits and earn all the 160 credits. Marks obtained in all the 160 credits shall be considered for the award of the Grade.

18.2 For students admitted into B.Tech (lateral entry students)

18.2.1 A student will not be promoted from IV semester to V semester unless s/he fulfills the academic requirement of securing 50% of the total credits (rounded to the next lowest integer) up to IV semester, from all the examinations, whether the candidate takes the examination(s) or not.

18.2.2 A student shall be promoted from VI semester to VII semester only if s/he fulfills the academic requirements of securing 50% of the total credits (rounded to the next lowest integer) up to V semester **or** 50% of the total credits (rounded to the next lowest integer) up to VI semester from all the examinations, whether the candidate takes the examination(s) or not.

18.2.3 A student shall register for all the 123 credits and earn all the 123 credits. Marks obtained in all the 123 credits shall be considered for the award of the Grade.

19.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of the B.Tech degree.

19.1 Student shall register and acquire minimum attendance in all courses and secure 160 credits for regular program and 123 credits for lateral entry program.

19.2 A student of a regular program, who fails to earn 160 credits within eight consecutive academic years from the year of his/her admission with a minimum CGPA of 4.0, shall forfeit his/her degree and his/her admission stands cancelled.

19.3 A student of a lateral entry program who fails to earn 123 credits within six consecutive academic years from the year of his/her admission with a minimum CGPA of 4.0, shall forfeit his/her degree and his/her admission stands cancelled.

20.0 BETTERMENT OF MARKS IN THE COURSES ALREADY PASSED

Students who clear all the courses in their first attempt and wish to improve their CGPA shall register and appear for betterment of marks for one course of any theory courses within a period of subsequent two semesters. The improved marks shall be considered for classification / distinction but not for ranking. If there is no improvement, there shall not be any change in the original marks already awarded.

21.0 AWARD OF DEGREE

21.1 Classification of degree will be as follows:

CGPA ≥ 7.5	CGPA ≥ 6.5 and < 7.5	CGPA ≥ 5.0 and < 6.5	CGPA ≥ 4.0 and < 5.0	CGPA < 4.0
First Class with Distinction	**First Class**	**Second Class**	**Pass Class**	**Fail**

21.2 In order to extend the benefit to the students with one/two backlogs after either VI semester or VIII semester, GRAFTING option is provided to the students enabling their placements and fulfilling graduation requirements. Following are the guidelines for the Grafting:

a. Grafting will be done among the courses within the semester shall draw a maximum of 7 marks from the any one of the cleared courses in the semester and will be grafted to the failed course in the same semester.

b. Students shall be given a choice of grafting only once in the 4 years program, either after VI semester (Option #1) or after VIII semester (Option #2).

c. Option#1: Applicable to students who have maximum of TWO theory courses in V and / or VI semesters.

Option#2: Applicable to students who have maximum of TWO theory courses in VII and / or VIII semesters.

d. Eligibility for grafting:

i. Prior to the conduct of the supplementary examination after the declaration of VI or VIII semester results.

ii. S/he must appear in all regular or supplementary examinations as per the provisions laid down in regulations for the courses s/he appeals for grafting.

iii. The marks obtained by her/him in latest attempt shall be taken into account for grafting of marks in the failed course(s).

21.3 Student, who clears all the courses upto VII semester, shall have a chance to appear for Quick Supplementary Examination to clear the failed courses of VIII semester.

21.4 By the end of VI semester, all the students (regular and lateral entry students) shall complete one of the audit course and mandatory course with acceptable performance.

21.5 In case, a student takes more than one attempt in clearing a course, the final marks secured shall be indicated by * mark in the grade sheet.

All the candidates who register for the semester end examination will be issued grade sheet by the institute. Apart from the semester wise grade sheet, the institute will issue the provisional certificate and consolidated grade sheet subject to the fulfillment of all the academic requirements.

22 B.TECH WITH HONOURS OR ADDITIONAL MINORS IN ENGINEERING

Students acquiring 160 credits are eligible to get B.Tech degree in Engineering. A student will be eligible to get B.Tech degree with Honours or additional Minors in Engineering, if s/he completes an additional 20 credits (3/4 credits per course). These could be acquired through MOOCs from SWAYAM / NPTEL / edX / Coursera / Udacity /PurdueNext / Khan Academy / QEEE etc. The list for MOOCs will be a dynamic one, as new courses are added from time to time. Few essential skill sets required for employability are also identified year wise. Students interested in doing MOOC courses shall register the course title at their department office at the start of the semester against the courses that are announced by the department. Any expense incurred for the MOOC course / summer program should be met by the students.

Only students having no credit arrears and a CGPA of 7.5 or above at the end of the fourth semester are eligible to register for B.Tech (Honours / Minor). After registering for the B.Tech (Honours / Minor) program, if a student fails in any course, s/he will not be eligible for B.Tech (Honours / Minor).

Every Department to develop and submit a Honours / Minors – courses list of 5 - 6 theory courses.

Honours Certificate for Vertical in his/her OWN Branch for Research orientation; Minor in any OTHER branch for Improving Employability.

For the MOOCs platforms, where examination or assessment is absent (like SWAYAM) or where certification is costly (like Coursera or edX), faculty members of the institute prepare the examination question papers, for the courses undertaken by the students of respective Institutes, so that examinations Control Office (ECO) can conduct examination for the course. There shall be one Continuous Internal Examination (Quiz exam for 30 marks) after 8 weeks of the commencement of the course and semester end examination (Descriptive exam for 70 marks) shall be done along with the other regular courses.

A student can enroll for both Minor & Honours or for two Minors. The final grade sheet will only show the basic CGPA corresponding to the minimum requirement for the degree. The Minors/Honours will be indicated by a separate CGPA. The additional courses taken will also find separate mention in the grade sheet.

If a student drops (or terminated) from the Minor/Honours program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the grade sheet (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “Pass (P)” grade and also choose to omit the mention of the course as for the following:

- All the courses done under the dropped Minor/Honours will be shown in the grade sheet
- None of the courses done under the dropped Minor/Honours will be shown in the grade sheet.

Honours will be reflected in the degree certificate as “B.Tech (honours) in XYZ Engineering”. Similarly, Minor as “B.Tech in XYZ Engineering with Minor in ABC”. If a student has done both honours & minor, it will be acknowledged as “B.Tech (honours) in XYZ Engineering with Minor in ABC”. And two minors will be reflected as “B.Tech in XYZ Engineering with Minor in ABC and Minor in DEF”.

22.1. B.Tech with Honours

The total of 20 credits required to be attained for B.Tech Honours degree are distributed

from V semester to VII semester in the following way:

For V semester	:	4 – 8 credits
For VI semester	:	4 – 8 credits
For VII semester	:	4 – 8 credits

Following are the details of such Honours which include some of the most interesting areas in the profession today:

S. No	Department	Honours scheme
1	Aeronautical Engineering	Aerospace Engineering / Space Science etc.
2	Computer Science and Engineering / Information Technology	Big data and Analytics / Cyber Physical Systems, Information Security / Cognitive Science / Internet of Things (IoT) etc.
3	Electronics and Communication Engineering	Digital Communication / Signal Processing / Communication Networks / VLSI Design / Embedded Systems etc.
4	Electrical and Electronics Engineering	Renewable Energy systems / Energy and Sustainability / IoT Applications in Green Energy Systems etc.
5	Mechanical Engineering	Industrial Automation and Robotics / Manufacturing Sciences and Computation Techniques etc.
6	Civil Engineering	Structural Engineering / Environmental Engineering etc.

22.2 B.Tech with additional Minor in Engineering

Every Department to develop and submit Minor Courses List of 5 - 6 Theory courses. Student from any department is eligible to apply for Minor from any other department. The total of 20 credits to complete the B.Tech (Minor) program by registering for MOOC courses each having a minimum of 3/4 credits offered by reputed institutions / organization with the approval of the department. Registration of the student for B.Tech (Minor), is from V Semester to VII Semester of the program in the following way:

For V semester	:	4 – 8 credits
For VI semester	:	4 – 8 credits
For VII semester	:	4 – 8 credits

Only students having no credit arrears and a CGPA of 7.5 or above at the end of the fourth semester are eligible to register for B.Tech (Minor). After registering for the B.Tech (Minor) program, if a student fails in any course, s/he will not be eligible for B.Tech (Minor).

Every student shall also have the option to do a minor in engineering. A major is a primary focus of study and a minor is a secondary focus of study. The minor has to be a subject offered by a department other than the department that offers the major of the student or it can be a different major offered by the same department. For example, a student with the declared major in Computer Science and Engineering (CSE) may opt to do a minor in Physics; in which case, the student shall receive the degree B.Tech, Computer Science and Engineering with a minor in Physics. A student can do Majors in chosen filed as per the career goal, and a minor may be chosen to enhance the major thus adding the diversity, breadth and enhanced skills in the field.

Advantages of Minor in Engineering:

The minors mentioned above are having lots of advantages and a few are listed below:

1. To apply the inter-disciplinary knowledge gained through a Major (Stream) + Minor.

2. To enable students to pursue allied academic interest in contemporary areas.
3. To provide an academic mechanism for fulfilling multidisciplinary demands of industries.
4. To provide effective yet flexible options for students to achieve basic to intermediate level competence in the Minor area.
5. Provides an opportunity to students to become entrepreneurs and leaders by taking business/ management minor.
6. Combination in the diverse fields of engineering e.g., CSE (Major) + Electronics (Minor) combination increases placement prospects in chip designing companies.
7. Provides an opportunity to Applicants to pursue higher studies in an inter-disciplinary field of study.
8. Provides opportunity to the Applicants to pursue interdisciplinary research.
9. To increase the overall scope of the undergraduate degrees.

Following are the details of such Minor / Honours which include some of the most interesting areas in the profession today:

1. Space Science
2. Information Security
3. Data Analytics
4. Cyber Physical Systems
5. Electronic System Design
6. Renewable Energy Sources
7. Energy and Sustainability
8. Industrial Automation and Robotics
9. Aerospace Engineering
10. Manufacturing Sciences and Computation Techniques
11. Structural Engineering
12. Environmental Engineering
13. Internet of Things
14. Computer Science and Engineering
15. Technological Entrepreneurship
16. Materials Engineering
17. Physics (Materials / Nuclear / Optical / Medical)
18. Mathematics (Combinatorics / Logic / Number theory / Dynamical systems and differential equations./ Mathematical **physics /** Statistics and Probability).

23.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAM

23.1 A candidate is normally not permitted to take a break from the study. However, if a candidate intends to temporarily discontinue the program in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the program in a later respective semester, s/he shall seek the approval from the Principal in advance. Such application shall be submitted before the last date for payment of examination fee of the semester in question and forwarded through the Head of the Department stating the reasons for such withdrawal together with supporting documents and endorsement of his / her parent / guardian.

23.2 The institute shall examine such an application and if it finds the case to be genuine, it may permit the student to temporarily withdraw from the program. Such permission is accorded only to those who do not have any outstanding dues / demand at the College / University level including tuition fees, any other fees, library materials etc.

23.3 The candidate has to rejoin the program after the break from the commencement of the respective semester as and when it is offered.

23.4 The total period for completion of the program reckoned from the commencement of the semester to which the candidate was first admitted shall not exceed the maximum period specified in clause 19. The maximum period includes the break period.

23.5 If any candidate is detained for any reason, the period of detention shall not be considered as 'Break of Study'.

24.0 TERMINATION FROM THE PROGRAM

The admission of a student to the program may be terminated and the student is asked to leave the institute in the following circumstances:

a. The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.
b. A student shall not be permitted to study any semester more than three times during the entire program of study.
c. The student fails to satisfy the norms of discipline specified by the institute from time to time.

25.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the institute / if any case of indiscipline / malpractice is pending against him, the results and the degree of the candidate will be withheld.

26.0 GRADUATION DAY

The institute shall have its own annual Graduation Day for the award of degrees to the students completing the prescribed academic requirements in each case, in consultation with the University and by following the provisions in the Statute. The college shall institute prizes and medals to meritorious students and award them annually at the Graduation Day. This will greatly encourage the students to strive for excellence in their academic work.

27.0 DISCIPLINE

Every student is required to observe discipline and decorum both inside and outside the institute and are expected not to indulge in any activity which will tend to bring down the honour of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations, he/she shall be liable for punitive action as prescribed by the institute from time to time.

28.0 GRIEVANCE REDRESSAL COMMITTEE

The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

29.0 TRANSITORY REGULATIONS

A candidate, who is detained or has discontinued a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins

subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

a) Four Year B.Tech Regular course:

A student who is following Jawaharlal Nehru Technological University (JNTUH) curriculum and detained due to the shortage of attendance at the end of the first semester shall join the autonomous batch of first semester. Such students shall study all the courses prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

A student who is following JNTUH curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute courses will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits up to previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

b) Three Year B.Tech program under Lateral Entry Scheme:

A student who is following JNTUH curriculum and detained due to the shortage of attendance at the end of the first semester of second year shall join the autonomous batch of third semester. Such students shall study all the courses prescribed for the batch in which the student joins and considered on par with Lateral Entry regular candidates of Autonomous stream and will be governed by the autonomous regulations.

A student who is following JNTUH curriculum, if detained due to lack of credits or shortage of attendance at the end of the second semester of second year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute courses are offered in place of them as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits up to previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

c) Transfer candidates (from non-autonomous college affiliated to JNTUH):

A student who is following JNTUH curriculum, transferred from other college to this institute in third semester or subsequent semesters shall join with the autonomous batch in the

appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute courses are offered in their place as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be the sum of the credits up to the previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

d) Transfer candidates (from an autonomous college affiliated to JNTUH):

A student who has secured the required credits up to previous semesters as per the regulations of other autonomous institutions shall also be permitted to be transferred to this institute. A student who is transferred from the other autonomous colleges to this institute in third semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester as per the regulations of the college from which he is transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

e) Readmission from IARE-R16 to IARE-R18 regulations

A student took admission in IARE-R16 Regulations, detained due to lack of required number of credits or percentage of attendance at the end of any semester is permitted to take re-admission at appropriate level under any regulations prevailing in the institute subject to the following rules and regulations.

1. Student shall pass all the courses in the earlier scheme of regulations (IARE - R16). However, in case of having backlog courses, they shall be cleared by appearing for supplementary examinations conducted under IARE - R16 regulations from time to time.
2. After rejoining, the student is required to study the courses as prescribed in the new regulations for the re-admitted program at that level and thereafter.
3. If the student has already passed any course(s) of readmitted program in the earlier regulation / semester of study, such courses are exempted in the new scheme to appear for the course(s).
4. The courses that are not done in the earlier regulations / semester as compared with readmitted program need to be cleared after readmission by appearing for the examinations conducted time to time under the new regulations.
5. In general, after transition, course composition and number of credits / semester shall be balanced between earlier and new regulations on case to case basis.

6. In case, the students who do not have option of acquiring required credits with the existing courses offered as per the new curriculum, credit balance can be achieved by clearing the additional courses offered by the respective departments (approved in Academic Council meeting). The additional courses that are offered can be of theory or laboratory courses and shall be offered during semester.
7. Students re-joined in III semester shall be treated on par with "Lateral Entry" students for credits and graduation requirements. However, the student shall clear all the courses in B.Tech I Semester and B.Tech II Semester as per IARE-R16 regulations.

30.0 REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

MECHANICAL ENGINEERING

COURSE STRUCTURE

I SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHSB02	Linear Algebra and Calculus	BSC	Foundation	3	1	0	4	30	70	100
AHSB04	Waves and Optics	BSC	Foundation	3	1	0	4	30	70	100
ACSB01	Programming for Problem Solving	ESC	Foundation	3	0	0	3	30	70	100
PRACTICAL										
AHSB10	Engineering Physics Laboratory	BSC	Foundation	0	0	3	1.5	30	70	100
ACSB02	Programming for Problem Solving Laboratory	ESC	Foundation	0	0	4	2	30	70	100
AMEB01	Workshop / Manufacturing Practices Laboratory	ESC	Foundation	0	0	3	1.5	30	70	100
Total				**09**	**02**	**10**	**16**	**180**	**420**	**600**

II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AHSB01	English	HSMC	Foundation	2	0	0	2	30	70	100
AHSB11	Mathematical Transform Techniques	BSC	Foundation	3	1	0	4	30	70	100
AHSB03	Engineering Chemistry	BSC	Foundation	3	1	0	4	30	70	100
AEEB04	Basic Electrical and Electronics Engineering	ESC	Foundation	3	1	0	4	30	70	100
PRACTICAL										
AHSB08	English Language and Communication Skills Laboratory	HSMC	Foundation	0	0	2	1	30	70	100
AHSB09	Engineering Chemistry Laboratory	BSC	Foundation	0	0	3	1.5	30	70	100
AMEB02	Engineering Graphics and Design Laboratory	ESC	Foundation	1	0	4	3	30	70	100
AEEB08	Basic Electrical and Electronics Engineering Laboratory	ESC	Foundation	0	0	3	1.5	30	70	100
Total				**12**	**03**	**12**	**21**	**240**	**560**	**800**

III SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AMEB03	Engineering Mechanics	ESC	Foundation	3	1	0	4	30	70	100
AMEB04	Thermodynamics	PCC	Core	3	1	0	4	30	70	100
AMEB05	Manufacturing Processes	PCC	Core	3	0	0	3	30	70	100
AHSB12	Probability and Statistics	BSC	Foundation	3	1	0	4	30	70	100
ACSB03	Data Structures	PCC	Core	3	0	0	3	30	70	100
PRACTICAL										
AMEB06	Manufacturing Processes Laboratory	PCC	Core	0	0	2	1	30	70	100
AMEB07	Machine Drawing through CAD Laboratory	PCC	Core	0	0	3	1.5	30	70	100
ACSB05	Data Structures Laboratory	PCC	Core	0	0	3	1.5	30	70	100
Total				**15**	**03**	**08**	**22**	**240**	**560**	**800**

IV SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AMEB08	Fluid Mechanics and Machines	PCC	Core	3	1	0	4	30	70	100
AMEB09	Applied Thermodynamics - I	PCC	Core	3	1	0	4	30	70	100
AMEB10	Kinematics of Machines	PCC	Core	3	1	0	4	30	70	100
AMEB11	Materials and Mechanics of Solids	PCC	Core	3	1	0	4	30	70	100
AMEB12	Optimization Techniques	PCC	Core	3	0	0	3	30	70	100
AHSB07	Environmental Science	MC-II	---	0	0	0	0	30	70	100
PRACTICAL										
AMEB13	Fluid Machinery and I.C Engines Laboratory	PCC	Core	0	0	2	1	30	70	100
AMEB14	Materials and Mechanics of Solids Laboratory	PCC	Core	0	0	2	1	30	70	100
AMEB15	Optimization Techniques Laboratory	PCC	Core	0	0	2	1	30	70	100
Total				**15**	**04**	**06**	**22**	**270**	**630**	**900**

V SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AMEB16	Manufacturing Technology	PCC	Core	3	0	0	3	30	70	100
AMEB17	Dynamics of Machinery	PCC	Core	2	1	0	3	30	70	100
AMEB18	Applied Thermodynamics-II	PCC	Core	2	1	0	3	30	70	100
AHSB14	Business Economics and Financial Analysis	PCC	Core	3	0	0	3	30	70	100
	Professional Elective - I	PEC	Elective	3	0	0	3	30	70	100
	Open Elective - I	OEC	Elective	3	0	0	3	30	70	100
AHSB15	Project Based Learning (Prototype / Design Building)	PCC	Core	2	0	0	2	30	70	100
PRACTICAL										
AMEB19	Manufacturing Technology Laboratory	PCC	Core	0	0	2	1	30	70	100
AMEB20	Theory of Machines Laboratory	PCC	Core	0	0	2	1	30	70	100
Total				**18**	**02**	**04**	**22**	**270**	**630**	**900**

VI SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AMEB21	Heat Transfer	PCC	Core	3	0	0	3	30	70	100
AMEB22	Finite Element Methods	PCC	Core	2	1	0	3	30	70	100
AMEB23	Design of Machine Elements	PCC	Core	2	1	0	3	30	70	100
	Professional Elective - II	PEC	Elective	3	0	0	3	30	70	100
	Professional Elective - III	PEC	Elective	3	0	0	3	30	70	100
	Open Elective - II	OEC	Elective	3	0	0	3	30	70	100
AHSB16	Research Based Learning (Fabrication / Model Development)	PCC	Core	2	0	0	2	30	70	100
PRACTICAL										
AMEB24	Heat Transfer Laboratory	PCC	Core	0	0	2	1	30	70	100
AMEB25	Fluid Thermal Modeling and Simulation Laboratory	PCC	Core	0	0	2	1	30	70	100
Total				**18**	**02**	**04**	**22**	**270**	**630**	**900**

VII SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
AMEB26	CAD/CAM	PCC	Core	3	0	0	3	30	70	100
AMEB27	Instrumentation and control Systems	PCC	Core	3	0	0	3	30	70	100
	Professional Elective –IV	PEC	Elective	3	0	0	3	30	70	100
	Professional Elective - V	PEC	Elective	3	0	0	3	30	70	100
	Open Elective - III	OEC	Elective	3	0	0	3	30	70	100
AHSB17	Essence of Indian Traditional Knowledge	MCC	----	0	0	0	0	30	70	100
PRACTICAL										
AMEB28	CAD/CAM Laboratory	PCC	Core	0	0	3	1.5	30	70	100
AMEB29	Instrumentation control Systems and PDP Laboratory	PCC	Core	0	0	3	1.5	30	70	100
AMEB58	Project work – I	PROJ	Project	0	0	10	5	30	70	100
Total				**15**	**00**	**16**	**23**	**270**	**630**	**900**

VIII SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
	Professional Elective -VI	PCC	Core	3	0	0	3	30	70	100
	Open Elective - IV	OEC	Elective	3	0	0	3	30	70	100
PRACTICAL										
AMEB59	Project Work – II / Full Semester Internship	PROJ	Project	0	0	12	6	30	70	100
Total				**06**	**00**	**12**	**12**	**90**	**210**	**300**

PROFESSIONAL ELECTIVES COURSES

PROFESSIONAL ELECTIVE I: THERMAL ENGINEERING

Course Code	Course Title
AMEB30	Turbo Machines
AMEB31	Refrigeration and Air-Conditioning
AMEB32	Power Plant Engineering
AMEB33	Automobile Engineering

PROFESSIONAL ELECTIVE II: FLUID DYNAMICS

Course Code	Course Title
AMEB34	Gas Dynamics
AMEB35	Computational Fluid Dynamics
AMEB36	Gas Turbines and Jet Propulsion Technology
AMEB37	Boundary Layer Theory

PROFESSIONAL ELECTIVE III: ENGINEERING MATERIALS

Course Code	Course Title
AMEB38	Tribology
AMEB39	Additive Manufacturing Processes
AMEB40	Composite Materials
AMEB41	Nano Materials

PROFESSIONAL ELECTIVE IV: MACHINE DESIGN

Course Code	Course Title
AMEB42	Advanced Machine Design
AMEB43	Mechanical Vibrations
AMEB44	Tool Design
AMEB45	Experimental Stress Analysis

PROFESSIONAL ELECTIVE V: AUTOMATION AND MECHATRONICS

Course Code	Course Title
AMEB46	Precision Engineering
AMEB47	Mechatronics
AMEB48	Design for Manufacturing
AMEB49	Robotics

PROFESSIONAL ELECTIVE VI: PRODUCTION AND INDUSTRIAL MANAGEMENT

Course Code	Course Title
AMEB50	Unconventional Machining Process
AMEB51	Operation Research
AMEB52	Production Planning and Control
AMEB53	Plant Layout and Material Handling

OPEN ELECTIVE - I

Course Code	Course Title
AAEB53	Flight Control Theory
AAEB54	Airframe Structural Design
AMEB54	Mechanical Properties of Materials
AMEB55	Automation in Manufacturing
ACEB50	Remote Sensing and GIS
ACEB51	Project Safety Management

OPEN ELECTIVES – II

Course Code	Course Title
ACSB32	Computer Architecture
ACSB33	Analysis of Algorithms and Design
ACSB34	Relational Database Management Systems
AITB30	Advanced Data Structures
AITB31	Data Communications and Networks
AITB32	Network Security

OPEN ELECTIVE - III

Course Code	Course Title
AHSB18	Soft Skills and Interpersonal Communication
AHSB19	Cyber Law and Ethics
AHSB20	Economic Policies in India
AHSB21	Global Warming and Climate Change
AHSB22	Intellectual Property Rights
AHSB23	Entrepreneurship

OPEN ELECTIVE - IV

Course Code	Course Title
AECB55	Microprocessors and Interfacing
AECB56	Principles of Communication
AECB57	Image Processing
AEEB55	Electrical Engineering Materials
AEEB56	Non Conventional Energy Sources
AEEB57	Nanotechnology

MANDATORY COURSES

Course Code	Course Title
AHSB07	Environmental Science
AHSB17	Essence of Indian Traditional Knowledge

SYLLABUS

LINEAR ALGEBRA AND CALCULUS

I Semester: AE / CSE / IT / ECE / EEE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB02	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Determine rank of a matrix and solve linear differential equations of second order.
II. Determine the characteristic roots and apply double integrals to evaluate area.
III. Apply mean value theorems and apply triple integrals to evaluate volume.
IV. Determine the functional dependence and extremum value of a function.
V. Analyze gradient, divergence, curl and evaluate line, surface, volume integrals over a vector field.

Module-I	THEORY OF MATRICES AND HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS	Classes: 09

THEORY OF MATRICES: Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew-Hermitian and unitary matrices; Elementary row and column transformations; Rank of a matrix: Echelon form and normal form; Inverse by Gauss-Jordan method.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS: Linear differential equations of second and higher order with constant coefficients, non-homogeneous term of the type $f(x) = e^{ax}, \sin ax, \cos ax$ and $f(x) = x^n, e^{ax}v(x), xv(x)$; Method of variation of parameters.

Module-II	LINEAR TRANSFORMATIONS AND DOUBLE INTEGRALS	Classes: 09

LINEAR TRANSFORMATIONS: Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Eigen values and Eigen vectors of a matrix and Properties (without proof); Diagonalization of matrix by linear transformation.

DOUBLE INTEGRALS: Evaluation of double integrals in Cartesian coordinates and Polar coordinates; Change of order of integration; Area as a double integral; Transformation of coordinate system.

Module-III	FUNCTIONS OF SINGLE VARIABLES AND TRIPLE INTEGRALS	Classes: 09

FUNCTIONS OF SINGLE VARIABLES: Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof and geometrical interpretation.

TRIPLE INTEGRALS: Evaluation of triple integrals in Cartesian coordinates; volume of a region using triple integration.

Module-IV	FUNCTIONS OF SEVERAL VARIABLES AND EXTREMA OF A FUNCTION	Classes: 09

FUNCTIONS OF SEVERAL VARIABLES: Partial differentiation, functional dependence, Jacobian.
EXTREMA OF A FUNCTION: Maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers.

Module-V	VECTOR DIFFERENTIAL AND INTEGRAL CALCULUS	Classes: 09

VECTOR DIFFERENTIAL CALCULUS: Scalar and vector point functions; Definitions of Gradient, divergent and curl with examples; Solenoidal and irrotational vector point functions; Scalar potential function.

VECTOR INTEGRAL THEOREMS: Line integral, surface integral and volume integral, Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics" for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune, First Edition, 2016.

Web References:

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

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re

WAVES AND OPTICS

I Semester: AE / ECE / ME | II Semester: EEE / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB04	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Enrich knowledge in principals of quantum mechanics and semiconductors.
II. Correlate principles and applications of lasers and fiber optics.
III. Acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.
IV. Develop strong fundamentals of transverse, longitudinal waves and harmonic waves.

MODULE - I	QUANTUM MECHANICS	Classes: 08

Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, De-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Time-independent Schrodinger equation for wave function, Born interpretation of the wave function, Schrodinger equation for one dimensional problems–particle in a box.

MODULE - II	INTRODUCTION TO SOLIDS AND SEMICONDUCTORS	Classes: 10

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, Carrier generation and recombination, Hall effect.

MODULE - III	LASERS AND FIBER OPTICS	Classes: 10

Characteristics of lasers, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby laser, He-Ne laser and applications of lasers.

Principle and construction of an optical fiber, Acceptance angle, Numerical aperture, Types of optical fibers (Single mode, multimode, step index, graded index), Attenuation in optical fibers, Optical fiber communication system with block diagram.

MODULE - IV	LIGHT AND OPTICS	Classes: 07

Huygens' principle, Superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer; Fraunhofer diffraction from a single slit, circular aperture and diffraction grating.

MODULE - V	HARMONIC OSCILLATIONS AND WAVES IN ONE DIMENSION	Classes: 10

Mechanical and electrical simple harmonic oscillators, Damped harmonic oscillator, Forced mechanical and electrical oscillators, Impedance, Steady state motion of forced damped harmonic oscillator; Transverse wave on a string, the wave equation on a string, Harmonic waves, Reflection and transmission of waves at a boundary, Longitudinal waves and the wave equation for them, acoustics waves.

Text Books:

1. Dr. K Vijay Kumar and Dr. S Chandralingam, "Modern Engineering Physics" Volume-1&2, S Chand.Co, 2018.
2. I. G. Main, "Vibrations and Waves in Physics", Cambridge University Press, 1993.
3. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001.

Reference Books:

1. H.J. Pain, "The Physics of Vibrations and Waves", Wiley, 2006.
2. A. Ghatak, "Optics", McGraw Hill Education, 2012.
3. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.

Web References:

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

E-Text Books:

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

PROGRAMMING FOR PROBLEM SOLVING

I Semester: AE / ME | II Semester: CSE / IT / ECE / EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB01	Foundation	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

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.

MODULE - I	INTRODUCTION	Classes: 10

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 STRUCTURES	Classes: 08

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	Classes: 10

Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays; Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions.

Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directive

MODULE - IV	STRUCTURES, UNIONS AND POINTERS	Classes: 09

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 BASICALGORITHMS	Classes: 08

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).

Text Books:

1. Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rd Edition, 2017.
2. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education, 6th Edition, 2012.

Reference Books:

1. W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd Edition, 1988.
2. YashavantKanetkar, "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, 2nd 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.bfoit.org/itp/Programming.html
2. https://www.khanacademy.org/computing/computer-programming
3. https://www.edx.org/course/programming-basics-iitbombayx-cs101-1x-0
4. https://www.edx.org/course/introduction-computer-science-harvardx-cs50x

E-Text Books:

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

MOOC Course

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

ENGINEERING PHYSICS LABORATORY

I Semester: AE / ECE / ME | II Semester: CSE / IT / CE / EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB10	Foundation	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Upgrade practical knowledge in optics.
II. Analyze the behavior and characteristics of various materials for its optimum utilization.
III. Enrich the knowledge of electric and magnetic properties.

LIST OF EXPERIMENTS

Week-l	**INTRODUCTION TO PHYSICS LABORATORY**
Do's and Don'ts in physics laboratory. Precautions to be taken in laboratory.	
Week-2	**HALL EFFECT (LORENTZ FORCE)**
Determination of charge carrier density.	
Week-3	**MELDE'E EXPERIMENT**
Determination of frequency of a given tuning fork.	
Week-4	**STEWART GEE'S APPARATUS**
Magnetic field along the axis of current carrying coil-Stewart and Gee's method.	
Week-5	**B-H CURVE WITH CRO**
To determine the value of retentivity and coercivity of a given magnetic material.	
Week-6	**ENERGY GAP OF A SEMICONDUCTOR DIODE**
Determination of energy gap of a semiconductor diode.	
Week-7	**PIN AND AVALANCHE DIODE**
Studying V-I characteristics of PIN and Avalanche diode.	
Week-8	**OPTICAL FIBER**
Evaluation of numerical aperture of a given optical fiber.	
Week-9	**WAVE LENGTH OF LASER LIGHT**
Determination of wavelength of a given laser light using diffraction grating.	

Week-10	**PLANK'S CONSTANT**
Determination of Plank's constant using LED.	
Week-11	**LIGHT EMITTING DIODE**
Studying V-I characteristics of LED	
Week-12	**NEWTONS RINGS**
Determination of radius of curvature of a given plano-convex lens.	
Week-13	**SINGLE SLIT DIFFRACTION**
Determination of width of a given single slit.	
Manuals:	
1. C. L. Arora, "Practical Physics", S. Chand & Co., New Delhi, 3rd Edition, 2012. 2. Vijay Kumar, Dr. T. Radhakrishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014.	
Web Reference:	
http://www.iare.ac.in	

PROGRAMMING FOR PROBLEM SOLVING LABORATORY

I Semester: AE / ME | II Semester: CSE / IT / ECE / EEE / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB02	Foundation	-	-	4	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 48				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Formulate problems and implement algorithms using C programming language.
II. Develop programs using decision structures, loops and functions.
III. Learn memory allocation techniques using pointers.
IV. Use structured programming approach for solving of computing problems in real world.

LIST OF EXPERIMENTS

Week-1 OPERATORS AND EVALUATION OF EXPRESSIONS

a. Write a C program to check whether a number is even or odd using ternary operator.
b. Write a C program to perform the addition of two numbers without using +operator.
c. Write a C program to evaluate the arithmetic expression ((a + b / c * d - e) * (f - g)). Read the values a, b, c, d, e, f, g from the standard input device.
d. Write a C program to find the sum of individual digits of a 3 digit number.
e. Write a C program to read the values of x and y and print the results of the following expressions in one line:
   i. (x + y) / (x -y)
   ii. (x + y)(x - y)

Week-2 CONTROL STRUCTURES

a. Write a C program to find the sum of individual digits of a positive integer.
b. A Fibonacci sequence is defined as follows: The first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of these sequences.
c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
d. A character is entered through keyboard. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if-else and switch case. The following table shows the range of ASCII values for various characters.

Characters	ASCII values
A–Z	65 –90
a – z	97 –122
0 – 9	48 – 57
Special symbols	0 – 47, 58 – 64, 91 – 96, 123 –127

e. If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Write a C program to determine how much profitor loss incurred in percentage.

Week-3	CONTROL STRUCTURES

a. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use switch statement).
b. Write a C program to calculate the following sum:

$$sum = 1 - x^2/2! + x^4/4! - x^6/6! + x^8/8! - x^{10}/10!$$

c. Write a C program to find the roots of a quadratic equation.
d. Write a C program to check whether a given 3 digit number is Armstrong number or not.
e. Write a C program to print the numbers in triangular form

```
1
1 2
1 2 3
1 2 3 4
```

Week-4	ARRAYS

a. Write a C program to find the second largest integer in a list of integers.
b. Write a C program to perform the following:
   i. Addition of two matrices
   ii. Multiplication of two matrices
c. Write a C program to count and display positive, negative, odd and even numbers in an array.
d. Write a C program to merge two sorted arrays into another array in a sorted order.
e. Write a C program to find the frequency of a particular number in a list of integers.

Week-5	STRINGS

a. Write a C program that uses functions to perform the following operations:
   i. To insert a sub string into a given main string from a given position.
   ii. To delete n characters from a given position in a given string.
b. Write a C program to determine if the given string is a palindrome or not.
c. Write a C program to find a string within a sentence and replace it with another string.
d. Write a C program that reads a line of text and counts all occurrence of a particular word.
e. Write a C program that displays the position or index in the string S where the string T begins, or 1if S doesn‘t contain T.

Week-6	FUNCTIONS

a. Write C programs that use both recursive and non-recursive functions
   i. To find the factorial of a given integer.
   ii. To find the greatest common divisor of two given integers.
b. Write C programs that use both recursive and non-recursive functions
   i. To print Fibonacci series.
   ii. To solve towers of Hanoi problem.
c. Write a C program to print the transpose of a given matrix using function.
d. Write a C program that uses a function to reverse a given string.

Week-7	POINTERS

a. Write a C program to concatenate two strings using pointers.
b. Write a C program to find the length of string using pointers.
c. Write a C program to compare two strings using pointers.
d. Write a C program to copy a string from source to destination using pointers.
e. Write a C program to reverse a string using pointers.

Week-8	STRUCTURES AND UNIONS

a. Write a C program that uses functions to perform the following operations:
   i. Reading a complex number
   ii. Writing a complex number
   iii. Addition and subtraction of two complex numbers
   iv. Multiplication of two complex numbers. Note: represent complex number using a structure.
b. Write a C program to compute the monthly pay of 100 employees using each employee‘s name, basic pay. The DA is computed as 52% of the basic pay. Gross-salary (basic pay + DA). Print the employees name and gross salary.
c. Create a Book structure containing book_id, title, author name and price. Write a C program to pass a structure as a function argument and print the book details.
d. Create a union containing 6 strings: name, home_address, hostel_address, city, state and zip. Write a C program to display your present address.
e. Write a C program to define a structure named DOB, which contains name, day, month and year. Using the concept of nested structures display your name and date of birth.

Week-9	ADDITIONAL PROGRAMS

a. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: $1+x+x^2+x^3+\ldots\ldots\ldots\ldots+x^n$. For example: if n is 3 and x is 5, then the program computes 1+5+25+125. Print x, n, the sum. Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too.
b. 2‘s complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2‘s complement of 11100 is 00100. Write a C program to find the 2‘s complement of a binary number.
c. Write a C program to convert a Roman numeral to its decimal equivalent. E.g. Roman number CD is equivalent to400.

Week-10	PREPROCESSOR DIRECTIVES

a. Define a macro with one parameter to compute the volume of a sphere. Write a C program using this macro to compute the volume for spheres of radius 5, 10 and 15meters.
b. Define a macro that receives an array and the number of elements in the array as arguments. Write a C program for using this macro to print the elements of the array.
c. Write symbolic constants for the binary arithmetic operators +, -, *, and /. Write a C program to illustrate the use of these symbolic constants.

Week-11	FILES

a. Write a C program to display the contents of a file.
b. Write a C program to copy the contents of one file to another.
c. Write a C program to reverse the first n characters in a file, where n is given by the user.
d. Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are put in the third file.
e. Write a C program to count the no. of characters present in the file.

Week-12	COMMAND LINE ARGUMENTS AND NUMERICAL METHODS

a. Write a C program to read two numbers at the command line and perform arithmetic operations on it.
b. Write a C program to read a file name at the command line and display its contents.
c. Write a C program to solve numerical methods problems (root finding, numerical differentiation and numerical integration)

Reference Books:

1. Yashavant Kanetkar, "Let Us C", BPB Publications, New Delhi, 13th Edition, 2012.
2. Oualline Steve, "Practical C Programming", O'Reilly Media, 3rd Edition, 1997.
3. King KN, "C Programming: A Modern Approach", Atlantic Publishers, 2nd Edition, 2015.
4. Kochan Stephen G, "Programming in C: A Complete Introduction to the C Programming Language", Sam's Publishers, 3rd Edition, 2004.
5. Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994.

Web References:

1. http://www.sanfoundry.com/c-programming-examples
2. http://www.geeksforgeeks.org/c
3. http://www.cprogramming.com/tutorial/c
4. http://www.cs.princeton.edu

WORKSHOP / MANUFACTURING PRACTICES LABORATORY

I Semester: AERO / CSE / IT / MECH | II Semester: ECE / EEE / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB01	Foundation	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Identify and use of tools, types of joints in carpentry, fitting, tin smithy and plumbing operations.
II. Understand of electrical wiring and components.
III. Observation of the function of lathe, shaper, drilling, boring, milling, grinding machines.

LIST OF EXPERIMENTS

Week-1	**MACHINE SHOP-Turning and other machines**
Batch I: Working on central lathe and shaping machine. Batch II: Working on drilling, grinding machines.	
Week-2	**MACHINE SHOP-Milling and other machines**
Batch I: Working on milling machine. Batch II: Working on milling and shaping machine.	
Week-3	**ADVANCED MACHINE SHOP**
Batch I: Working on CNC Turning machines. Batch II: Working on CNC Vertical Drill Tap Center.	
Week-4	**FITTING**
Batch I: Make a straight fit and straight fit for given dimensions. Batch II: Make a square fit for straight fit for given sizes.	
Week-5	**CARPENTRY-I**
Batch I: Preparation of lap joint as per given dimensions. Batch II: Preparation of dove tail joint as per given taper angle.	
Week-6	**CARPENTRY-II**
Batch I: Preparation of dove tail joint as per given taper angle. Batch II: Preparation of lap joint as per given dimensions.	
Week-7	**ELECTRICAL AND ELECTRONICS**
Batch I & II: Make an electrical connection to demonstrate domestic voltage and current sharing. Make an electrical connection to control one bulb with two switches-stair case connection.	

Week-8	**WELDING**
Batch I: Arc welding & Gas Welding. Batch II: Gas welding & Arc Welding.	
Week-9	**MOULD PREPARATION**
Batch I: Prepare a wheel flange mould using a given wooden pattern. Batch II: Prepare a bearing housing using an aluminum pattern.	
Week-10	**MOULD PREPARATION**
Batch I: Prepare a bearing housing using an aluminum pattern. Batch II: Prepare a wheel flange mould using a given wooden pattern.	
Week-11	**BLACKSMITHY- I, TINSMITHY- I,**
Batch I: Prepare S-bend & J-bend for given MS rod using open hearth furnace. Batch II: Prepare the development of a surface and make a rectangular tray and a round tin.	
Week-12	**TINSMITHY- I, BLACKSMITHY- I**
Batch I: Prepare the development of a surface and make a rectangular tray and a round tin. Batch II: Prepare S-bend & J-bend of given MS rod using open hearth furnace.	
Week-13	**PLASTIC MOULDING, INJECTION MOULDING, GLASS CUTTING**
Batch I: Plastic Moulding and Glass cutting. Batch II: Plastic Moulding and Glass cutting.	
Week-14	**BLOW MOULDING**
Batch I& II: Blow Moulding.	

Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S, Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4th Edition, 2002.
3. Gowri P. Hariharan, A. Suresh Babu," Manufacturing Technology – I", Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", Prentice Hall India, 4th Edition, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

Web References:

http://www.iare.ac.in

ENGLISH

I Semester: ECE / EEE /CE | II Semester: AE / CSE / IT / ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB01	Foundation	2	-	-	2	30	70	100
Contact Classes: 30	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 30		

OBJECTIVES:

The course should enable the students to:

I. Communicate in an intelligible English accent and pronunciation.
II. Use the four language skills i.e., Listening, Speaking, Reading and Writing effectively.
III. Develop the art of writing accurate English with correct spelling, grammar and punctuation.

MODULE - I	GENERAL INTRODUCTION AND LISTENIG SKILLS	Classes: 07

Introduction to communication skills; Communication process; Elements of communication; Soft skills vs hard skills; Importance of soft skills for engineering students; Listening skills; Significance; Stages of listening; Barriers to listening and effectiveness of listening; Listening comprehension.

MODULE - II	SPEAKING SKILLS	Classes: 09

Significance; Essentials; Barriers and effectiveness of speaking; Verbal and non-verbal communication; Generating talks based on visual prompts; Public speaking; Addressing a small group or a large formal gathering; Oral presentation; Power point presentation.

MODULE - III	VOCABULARY & GRAMMAR	Classes: 10

Vocabulary:

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.

Grammar:

Sentence structure; Uses of phrases and clauses; Punctuation; Subject verb agreement; Modifiers; Articles; Prepositions.

MODULE - IV	READING SKILLS	Classes: 09

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 SKILLS	Classes: 10

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.

Text Books:

Handbook of English for Communication (Prepared by Faculty of English, IARE)

Reference Books:

1. Sanjay Kumar and Pushp Lata. “Communications Skills”. Oxford University Press. 2011.
2. Michael Swan. “Practical English Usage”, Oxford University Press, 1995.
3. F.T. Wood. “Remedial English Grammar”, Macmillan. 2007.
4. William Zinsser. “On Writing Well”. Harper Resource Book, 2001.
5. Raymond Murphy, “Essential English Grammar with Answers”, Cambridge University Press, 2nd Edition.

Web References:

1. www.edufind.com
2. www.myenglishpages.com
3. http://grammar.ccc.comment.edu
4. http://owl.english.prudue.edu

E-Text Books:

1. http://bookboon.com/en/communication-ebooks-zip
2. http://www.bloomsbury-international.com/images/ezone/ebook/writing-skills-pdf.pdf
3. https://americanenglish.state.gov/files/ae/resource_files/developing_writing.pdf
4. http://learningenglishvocabularygrammar.com/files/idiomsandphraseswithmeaningsandexamplespdf.pdf
5. http://www.robinwood.com/Democracy/General Essays/CriticalThinking.pdf

MATHEMATICAL TRANSFORM TECHNIQUES

II Semester: AE / ECE / EEE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB11	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Enrich the knowledge solving algebra and transcendental equations and understanding Laplace transforms.
II. Determine the unknown values of a function by interpolation and applying inverse Laplace transforms.
III. Fitting of a curve and determining the Fourier transform of a function.
IV. Solving the ordinary differential equations by numerical techniques.
V. Formulate to solve partial differential equation.

Module-I	ROOT FINDING TECHNIQUES AND LAPLACE TRANSFORMS	Classes: 09

ROOT FINDING TECHNIQUES: Root finding techniques: Solving algebraic and transcendental equations by bisection method, method of false position, Newton-Raphson method.

LAPLACE TRANSFORMS: Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace transform, function of exponential order, first and second shifting theorems, change of scale property, Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of periodic functions.

Module-II	INTERPOLATION AND INVERSE LAPLACE TRANSFORMS	Classes: 09

INTERPOLATION: Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton's forward interpolation, Newton's backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange's interpolation.

INVERSE LAPLACE TRANSFORMS: Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and applications.

Module-III	CURVE FITTING AND FOURIER TRANSFORMS	Classes: 09

CURVE FITTING: Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares.

FOURIER TRANSFORMS: Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms.

Module-IV	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	Classes: 09

STEP BY STEP METHOD: Taylor's series method; Euler's method, modified Euler's method for first order differential equations.

MULTI STEP METHOD: Runge-Kutta method for first order differential equations.

Module-V	PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS	Classes: 09

PARTIAL DIFFERENTIAL EQUATIONS: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equation by Lagrange method.

APPLICATIONS: Method of separation of variables; One dimensional heat and wave equations under initial and boundary conditions.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 36th Edition, 2010.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics" for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune, First Edition, 2016.

Web References:

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

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re

ENGINEERING CHEMISTRY

I Semester: CSE / IT/ EEE | **II Semester:** AE / ECE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB03	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Apply the electrochemical principles in batteries, understand the fundamentals of corrosion.
II. Analysis of water for its various parameters and its significance in industrial and domestic Applications.
III. Analyze microscopic chemistry in terms of atomic, molecular orbitals and Intermolecular forces
IV. Analysis of major chemical reactions that are used in the synthesis of molecules.
V. Understand the chemistry of various fuels and their combustion.

MODULE-I	ELECTROCHEMISTRY AND CORROSION	Classes: 09

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	Classes: 08

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	Classes: 08

Shapes of Atomic orbitals, Linear Combination of Atomic orbitals (LCAO), molecular orbitals of diatomic molecules; Molecular orbital energy level diagrams of N_2, O_2,F_2 ,CO and NO molecules.

Crystal Field Theory (CFT): Salient Features of CFT-Crystal Fields; 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	Classes: 12
Introduction to representation of 3-dimensional structures: Structural and stereoisomers, configurations, symmetry and chirality; Enantiomers, diastereomers, optical activity and Absolute configuration; Confirmation analysis of n- butane. Substitution reactions: Nucleophilic substitution reactions, Mechanism of SN^1, SN^2 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 $KMnO_4$ and chromicacid; Reduction reactions: Reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$; Hydroboration of olefins; Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.		
MODULE –V	**FUELS AND COMBUSTION**	**Classes: 08**
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.		

Text Books:

1. P. C. Jain, Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, 2017.
2. Shasi Chawla, "Text Book of Engineering Chemistry", Dhantpat Rai Publishing Company, New Delhi, 2017.
2. R.T. Morrison, RN Boyd and SK Bhattacharya "Organic Chemistry", Pearson, 7th Edition, 2011.
3. 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.
2. B. H. Mahan, "University Chemistry", Narosa Publishers, 4th Edition, 2009.

Web References:

1. Engineering Chemistry (NPTEL Web-book), by B.L.Tembe, Kamaluddin and M.S.Krishnan.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I Semester: CE | II Semester: ME | III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB04	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand Kirchhoff laws and their application in series and parallel electric circuits.
II. Discuss principle and operation of measuring instruments.
III. Analyze the characteristics of alternating quantities, DC and AC machines.
IV. Illustrate the V-I characteristics of various diodes and bi-polar junction transistor.

MODULE -I	ELECTRIC CIRCUITS, ELECTROMAGNETISM AND INSTRUMENTS	Classes: 10

Electrical Circuits: Basic definitions, types of elements, Ohm's Law, resistive networks, inductive networks, capacitive networks, Kirchhoff's Laws, series, parallel circuits and star delta transformations, simple problems, Faradays law of electromagnetic induction; **Instruments:** Basic principles of indicating instruments, permanent magnet moving coil and moving iron instruments.

MODULE -II	DC MACHINES	Classes: 10

DC Machines: Principle of operation of DC generator, EMF equation, principle of operation of DC motors, torque equation, types of DC machines, applications, three point starter.

MODULE -III	ALTERNATING QUANTITIES AND AC MACHINES	Classes: 08

Alternating quantities: Sinusoidal AC voltage, average and RMS values, form and peak factor, concept of three phase alternating quantity; Transformer: Principle of operation, EMF equation, losses, efficiency and regulation.

Three phase induction motor: Principle of operation, slip, slip torque characteristics, efficiency, applications; Alternator: Principle of operation, EMF Equation, efficiency, regulation by synchronous impedance method.

MODULE-IV	SEMICONDUCTOR DIODE AND APPLICATIONS	Classes: 09

Semiconductor diode: P-N Junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, Zener diode as a voltage regulator.

MODULE-V	BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS	Classes: 08

Bipolar junction transistor: Working principle of transistors, DC characteristics, CE, CB, CC configurations, biasing, load line, applications.

Text Books:

1. A Chakrabarti, “Circuit Theory”, Dhanpat Rai Publications, 6th Edition, 2004.
2. K S Suresh Kumar, “Electric Circuit Analysis”, Pearson Education, 1st Edition, 2013.
3. Willianm Hayt, Jack E Kemmerly S M Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill, 7th Edition, 2010.
4. J P J Millman, C C Halkias, Satyabrata Jit, “Millman‟s Electronic Devices and Circuits”, Tata McGraw Hill, 2nd Edition, 1998. 5 R L Boylestad, Louis Nashelsky, “Electronic Devices and Circuits”, PEI / PHI, 9th Edition, 2006.
5. R L Boylestad, Louis Nashelsky, “Electronic Devices and Circuits”, PEI / PHI, 9th Edition, 2006.
6. V K Mehta, Rohit Mehta, “Principles of electrical engineering”, S CHAND, 1st Edition, 2003.

Reference Books:

1. David A Bell, “Electric Circuits”, Oxford University Press, 9th Edition, 2016.
2. M Arshad, “Network Analysis and Circuits”, Infinity Science Press, 9th Edition, 2016.
3. A Bruce Carlson, “Circuits”, Cengage Learning, 1st Edition, 2008.
4. M Arshad, “Network Analysis and Circuits”, Infinity Science Press, 9th Edition, 2016.
5. A Bruce Carlson, “Circuits”, Cengage Learning, 1st Edition, 2008.

Web References:

1. https://www.kuet.ac.bd/webportal/ppmv2/uploads/1364120248DC%20Machines2.pdftextofvideo.nptel.iitm.ac.in
2. https://www.eleccompengineering.files.wordpress.com/2014/08/a-textbook-of-electrical-technology-volume-ii-ac-and-dc-machines-b-l-thferaja.pdf
3. https://www.geosci.uchicago.edu/~moyer/GEOS24705/Readings/Klempner_Ch1.pdf
4. https://www.ibiblio.org/kuphaldt/electricCircuits/DC/DC.pdf
5. https://www.users.ece.cmu.edu/~dwg/personal/sample.pdf.
6. https://www.djm.cc/library/Principles_of_Alternating_Current_Machinery_Lawrence_edited.pdf

E-Text Books:

1. https://www.kisi.deu.edu.tr/aytac.goren/ELK2015/w10.pdfwww.bookboon.com.
2. https://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j-introduction-to-electronics-signals-and-measurement-spring-2006/lecture-notes/19_bjt_1.pdf.
3. https://www.google.co.in/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=half+and+full+wave+rectifier+pdf.
4. https://www.leka.lt/sites/default/files/vaizdai/concepts-in-electric-circuits.pdf.
5. https://www.ktustudents.in

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY

I Semester: ECE / EEE /CE | II Semester: AE / CSE / IT / ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB08	Foundation	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The course enables the students to:

I. Improve their ability to listen and comprehend a given text.
II. Upgrade the fluency and acquire a functional knowledge of English Language.
III. Enrich thought process by viewing a problem through multiple angles.

LIST OF ACTIVITIES

Week-l	**LISTENING SKILL**

a. Listening to conversations and interviews of famous personalities in various fields; Listening practice related to the TV talk shows and news.
b. Listening for specific information; Listening for summarizing information – Testing.

Week-2	**LISTENING SKILL**

a. Listening to films of short duration and monologues for taking notes; Listening to answer multiple choice questions.
b. Listening to telephonic conversations; Listening to native Indian: Abdul Kalam, British: Helen Keller and American: Barrack Obama speakers to analyze intercultural differences – Testing.

Week-3	**SPEAKING SKILL**

a. Functions of English Language; Introduction to pronunciation; Vowels and Consonants
b. Tips on how to develop fluency, body language and communication; Introducing oneself: Talking about yourself, others, leave taking.

Week-4	**SPEAKING SKILL**

a. Sounds - Speaking exercises involving the use of Vowels and Consonant sounds in different contexts; Exercises on Homophones and Homographs
b. Just a minute (JAM) session.

Week-5	**SPEAKING SKILL**

a. Stress patterns.
b. Situational Conversations: common everyday situations; Acting as a compere and newsreader; Greetings for different occasions with feedback preferably through video recording.

Week-6	**READING SKILL**
a. Intonation. b. Reading newspaper and magazine articles; Reading selective autobiographies for critical commentary.	
Week-7	**READING SKILL**
a. Improving pronunciation through tongue twisters. b. Reading advertisements, pamphlets; Reading comprehension exercises with critical and analytical questions based on context.	
Week-8	**WRITING SKILL**
a. Listening to inspirational short stories. b. Writing messages, leaflets, Notice; Writing tasks; Flashcards – Exercises.	
Week-9	**WRITING SKILL**
a. Write the review on a video clipping of short duration (5 to 10minutes). b. Write a slogan related to the image; Write a short story of 6-10 lines based on the hints given.	
Week-10	**WRITING SKILL**
a. Minimizing Mother Tongue Influence to improve fluency through watching educational videos. b. Writing practices – précis writing; Essay writing.	
Week-11	**THINKING SKILL**
a. Correcting common errors in day to day conversations. b. Practice in preparing thinking blocks to decode diagrammatical representations into English words, expressions, idioms, proverbs.	
Week-12	**THINKING SKILL**
a. Correcting common errors in day to day conversations. b. Making pictures and improvising diagrams to form English words, phrases and proverbs.	
Reference Books:	
1. Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles and Practices", Oxford University Press, New Delhi, 3rd Edition, 2015. 2. Rhirdion, Daniel, "Technical Communication", Cengage Learning, New Delhi, 1st Edition, 2009.	
Web References:	
1. http://learnenglish.britishcouncil.org 2. http://www.esl-lab.com/ 3. http://www.elllo.org/	

EQUIPMENT REQUIRED FOR A BATCH OF 60 STUDENTS (ORAL AND MULTIMEDIA)

1. Career laboratory: 1 Room
2. Server computer for the laboratory with high configuration: 1 no
3. Computers: 30 nos
4. Software: K Van Solution
5. LCD Projector: 1 no
6. Speakers with amplifiers, one wireless mic and one collar mic
7. Podium: 1
8. Chairs: 30
9. Discussion Tables: 2
10. White board: 1

ENGINEERING CHEMISTRY LABORATORY

I Semester: CSE / IT / EEE | II Semester: AE / ECE / ME / CE							
Course Code	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**	
AHSB09	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		-	-	3	1.5	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

OBJECTIVES:

The course should enable the students to:

I. Analyze, interpret, and draw conclusions from experimental data.
II. Describe the fluid property of surface tension and viscosity.
III. Perform a complexometric titration to determine the hardness of water from various sources.
IV. Comprehend the experimental results.

LIST OF EXPERIMENTS

Week-l	**INTRODUCTION TO CHEMISTRY LABORATORY**
Introduction to chemistry laboratory. Do's and Don'ts in chemistry laboratory.	
Week-2	**PREPARATION OF ORGANIC COMPOUNDS**
Synthesis of Aspirin.	
Week-3	**VOLUMETRIC ANALYSIS**
Estimation of Total hardness of water by complexometric method using EDTA.	
Week-5	**INSTRUMENTATION**
Estimation of an HCl by conductometric titrations.	
Week-6	**INSTRUMENTATION**
Estimation of HCl by potentiometric titrations.	
Week-7	**INSTRUMENTATION**
Estimation of Acetic acid by Conductometric titrations.	
Week-8	**INSTRUMENTATION**
Estimation of Fe^{2+} by Potentiometry using $KMnO_4$titrations.	

Week-9	**VOLUMETRIC ANALYSIS**
Determination of chloride content of water by Argentometry.	
Week-10	**PHYSICAL PROPERTIES**
Determination of surface tension of a given liquid using Stalagmometer.	
Week-11	**PHYSICAL PROPERTIES**
Determination of viscosity of a given liquid using Ostwald's viscometer.	
Week-12	**PHYSICAL PROPERTIES**
Verification of freundlich adsorption isotherm-adsorption of acetic and on charcoal.	
Week-13	**ANALYSIS OF ORGANIC COMPOUNDS**
Thin layer chromatography calculation of R_f values .Eg: ortho and para nitro phenols.	
Week-14	**REVISION**
Revision.	

Reference Books:

1. Vogel's, "Quantitative Chemical Analysis", Prentice Hall, 6th Edition, 2000.
2. Gary D. Christian, "Analytical Chemistry", Wiley India, 6th Edition, 2007.

Web References:

http://www.iare.ac.in

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 30 STUDENTS:

S. No	Name of the Apparatus	Apparatus Required	Quantity
1	Analytical balance	04	100 gm
2	Beaker	30	100 ml
3	Burette	30	50 ml
4	Burette Stand	30	Metal
5	Clamps with Boss heads	30	Metal
6	Conical Flask	30	250 ml
7	Conductivity cell	10	K=1
8	Calomel electrode	10	Glass
9	Digital Potentiometer	10	EI
10	Digital Conductivity meter	10	EI
11	Digital electronic balance	01	RI

12	Distilled water bottle	30	500 ml
13	Funnel	30	Small
14	Glass rods	30	20 cm length
15	Measuring Cylinders	10	10 ml
16	Oswald Viscometer	30	Glass
17	Pipette	30	20 ml
18	Platinum Electrode	10	PP
19	Porcelain Tiles	30	White
20	Reagent bottle	30	250 ml
21	Standard Flask	30	100 ml
22	Stalagmo meter	30	Glass
23	TLC Plates	40	--
24	UV Chamber	02	--

ENGINEERING GRAPHICS AND DESIGN LABORATORY

I Semester: ECE / EEE / CE | II Semester: AE / ME / CSE / IT

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB02	Foundation	1	-	4	3	30	70	100
Contact Classes: 15	Tutorial Classes: Nil	Practical Classes: 48				Total Classes: 63		

OBJECTIVES:

The course should enable the students to

I. Understand the basic principles of engineering drawing and construction of curves used in engineering field.
II. Apply the knowledge of interpretation of projection in different quadrants.
III. Understand the projections of solids, when it is inclined to both planes simultaneously.
IV. Convert the pictorial views into orthographic view and vice versa.
V. Create intricate details of components through sections and develop its surfaces.

LIST OF EXPERIMENTS

MODULE - I **INTRODUCTION TO ENGINEERING DRAWING**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales-Plain, Diagonal and Vernier Scales.

MODULE - II **OVERVIEW OF COMPUTER GRAPHICS, CUSTOMIZATION & CAD DRAWING, ANNOTATIONS, LAYERING & OTHER FUNCTIONS, DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids].

Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

MODULE - III	ORTHOGRAPHIC PROJECTIONS

Principles of Orthographic Projections-Conventions-Projections of Points and lines inclined to both planes.

Projections of planes inclined Planes-Auxiliary Planes.

MODULE - IV	PROJECTIONS OF REGULAR SOLIDS AND SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS

Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale.Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
Draw the sectional orthographic views of geometrical solids ofPrism, Pyramid, Cylinder and Cone; Objects from industry and dwellings (foundation to slab only).

MODULE - V	DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;
Principles of Isometric projection–Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.
DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT:
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text Books

1. N. D. Bhatt (2012), "Engineering Drawing", Charotar Publications, New Delhi, 49th Edition, 2010.
2. C.M. Agarwal, Basant Agarwal, "Engineering Drawing", Tata McGrawHill, 2nd Edition, 2013.

Reference Books:

1. K. Venugopal, "Engineering Drawing and Graphics". New Age Publications, 2nd Edition, 2010.
2. Dhananjay. A. Johle, "Engineering Drawing", Tata McGraw Hill, 1st Edition, 2008.
3. S.Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International Publishers, 3rd Edition, 2011.
4. A. K. Sarkar, A.P Rastogi, "Engineering graphics with Auto CAD", PHI Learning, 1st Edition, 2010.

Web References:

1. http://nptel.ac.in/courses/112103019
2. http://www.autocadtutorials.net/
3. http://gradcab.com/questions/tutorial-16-for -beginner-engineering-drawing-I

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: AUTOCAD 2016
HARDWARE: 30 numbers of Intel Desktop Computers with 2 GB RAM

BASIC ELECTRICAL AND ELCTRONICS ENGINEERING LABORATORY

I Semester: CE | II Semester: ME

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB08	Foundation	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Analysis the basic concepts of electric circuits.
II. Study the performance of DC machines and AC machines.
III. Understand the characteristics of electronic components.

LIST OF EXPERIMENTS

Expt - 1	**KIRCHOFF'S CURRENT LAW AND VOLTAGE LAW**

Verification of Kirchhoff's current and voltage laws.

Expt - 2	**OHM' S LAW**

Verification of Ohm's law.

Expt - 3	**OPEN CIRCUIT CHARACTERISTICS OF DC SHUNT GENERATOR**

Study the magnetization characteristics of DC shunt generator.

Expt - 4	**SWINBURNE'S TEST**

Predetermination of efficiency (Swinburne's test) of DC shunt machine.

Expt - 5	**OPEN CIRCUIT AND SHORT CIRCUIT TEST**

Determination of efficiency of single phase transformer by conducting open circuit and short circuit test.

Expt - 6	**BRAKE TEST ON THREE PHASE INDUCTION MOTOR**

Plot the performance characteristics of three phase induction motor by conducting brake test.

Expt - 7	**REGULATION OF ALTERNATOR**

Determine the regulation of alternator using synchronous impedance method.

Expt - 8	**PN JUNCTION DIODE**

Study the characteristics of PN junction diode.

Expt - 9	**ZENER DIODE**
Study the characteristics of Zener diode and breakdown mechanism.	
Expt - 10	**HALF WAVE RECTIFIER CIRCUIT**
Determine the efficiency of, regulation of half wave rectifier circuit.	
Expt - 11	**FULL WAVE RECTIFIER CIRCUIT**
Determine the efficiency of, regulation of full wave rectifier circuit.	
Expt - 12	**TRANSISTOR**
Study the characteristics of Transistor with common emitter (CE) configuration.	
Expt - 13	**TRANSISTOR**
Study the characteristics of Transistor with common base (CB) configuration.	
Expt - 14	**CATHODE RAY OSCILLOSCOPE (CRO)**
Check the features and limitations of cathode ray oscilloscope.	

Reference Books:

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 2004.
2. J P J Millman, C C Halkias, Satyabrata Jit, "Millman's Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition, 1998.
3. R L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits", PEI/PHI, 9th Edition, 2006.

Web References:

1. https://www.nptel.ac.in/Courses/117106108
2. https://www.gnindia.dronacharya.info/EEEDept/labmanuals.html
3. https://www.textofvideo.nptel.iitm.ac.in
4. https://www.textofvideo.nptel.iitm.ac.in/

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: Microsoft Windows 7 and MATLAB – V 8.5
HARDWARE: 01 numbers of Intel Desktop Computer with 2 GB RAM

ENGINEERING MECHANICS

II Semester: AE | III Semester: ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB03	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Ability to work comfortably with basic engineering mechanics concepts required for analyzing static structures.
II. Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free-body diagrams and accurate equilibrium equations.
III. Identify and model various types of loading and support conditions that act on structural systems, apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem.
IV. Understand the meaning of center of gravity (mass)/centroid and moment of Inertia using integration methods and method of moments.

MODULE-I	INTRODUCTION TO ENGINEERING MECHANICS	Classes: 10

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

MODULE -II	FRICTION AND BASICS STRUCTURAL ANALYSIS	Classes: 09

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

MODULE -III	CENTROID AND CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD	Classes: 10

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

MODULE -IV	PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS	Classes: 08

Particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar

coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

MODULE -V	**MECHANICAL VIBRATIONS**	**Classes: 08**

Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Text Books:

1. Irving H. Shames (2006), "Engineering Mechanics", Prentice Hall, 4th Edition, 2013
2. F. P. Beer and E. R. Johnston (2011), "Vector Mechanics for Engineers", Vol I - Statics, Vol II, – Dynamics, Tata McGraw Hill , 9th Edition, 2013.
3. R. C. Hibbler (2006), "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press.

Reference Books:

1. S.Bhavikatti, "A Text Book of Engineering Mechanics", New Age International, 1st Edition, 2012.
2. A.K.Tayal, "Engineering Mechanics", Uma Publications, 14th Edition, 2013.
3. R. K. Bansal "Engineering Mechanics", Laxmi Publication, 8th Edition, 2013.
4. Basudeb Bhattacharya, "Engineering Mechanics", Oxford University Press, 2nd Edition, 2014.
5. K.Vijay Reddy, J. Suresh Kumar, "Singer's Engineering Mechanics Statics and Dynamics", B S Publishers, 1st Edition, 2013.

Web References:

1. https://en.wikipedia.org/wiki/Dynamics_(mechanics)
2. https://www.youtube.com/playlist?list=PLUl4u3cNGP62esZEwffjMAsEMW_YArxYC

E-Text Books:

1. http://www.freeengineeringbooks.com/Civil/Engineering-Mechanics-Books.php
2. http://www.textbooksonline.tn.nic.in/books/11/stdxi-voc-ema-em-2.pdf
3. http://www.faadooengineers.com/threads/17024-Engineering-mechanics-pdf-Free-Download

THERMODYNAMICS

III Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB04	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the laws of thermodynamics and determine thermodynamic properties, gas laws.
II. Knowledge of properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.
III. Understand the direction law and concept of increase in entropy of universe.
IV. Understand the working of ideal air standard, vapor cycles and evaluate their performance in open systems like steam power plants, internal combustion engines, gas turbines and refrigeration systems.

MODULE-I	BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS	Classes: 09

System, control volume, surrounding, boundaries, universe, types of systems, macroscopic and microscopic viewpoints, concept of continuum, thermodynamic equilibrium, state, property, process, cycle, reversibility, quasi static process, irreversible process, causes of irreversibility, various flow and non-flow processes ,energy in state and in transition, types-work and heat, point and path function, Zeroth law of thermodynamics, concept of quality of temperature, Principles of thermometry, reference points, constant volume gas thermometer, ideal gas scale, PMMI Joule‘s experiments, first law of thermodynamics, corollaries first law applied to a process, applied to a flow system, steady flow energy equation.

MODULE-II	SECOND LAW OF THERMODYNAMICS	Classes: 09

Thermal reservoir, heat engine, heat pump, parameters of performance, second Law of thermodynamics, Kelvin Planck and Clausius statements and their equivalence, Corollaries, PMM of second kind, Carnot‘s principle, Carnot cycle and its specialties, thermodynamic scale of temperature, Clausius inequality, Entropy, principle of Entropy increase, availability and irreversibility, thermodynamic potentials, Gibbs and Helmholtz functions, Maxwell relations, elementary treatment of the Third Law of thermodynamics.

MODULE-III	PURE SUBSTANCES	Classes: 09

Phase transformations, T-S and H-S diagrams, P-V-T surfaces, triple point at critical state properties during change of phase, dryness fraction, Mollier charts, various thermodynamic processes and energy transfer, steam calorimeter.

Equation of state, specific and universal gas constants, throttling and free expansion processes, deviations from perfect gas model, Vander Waals equation of state.

MODULE-IV	MIXTURES OF PERFECT GASES	Classes: 09

Mole fraction, mass friction, gravimetric and volumetric analysis, volume fraction, Dalton‘s law of partial pressure, Avogadro‘s laws of additive volumes, and partial pressure, equivalent gas constant, internal

energy, enthalpy, specific heats and entropy of mixture of perfect gases; psychometric properties, dry bulb temperature, wet bulb temperature, dew point temperature, thermodynamic wet bulb temperature, specific humidity, relative humidity, saturated air, vapor pressure, degree of saturation, adiabatic saturation, Carrier's equation, Psychometric chart.

MODULE-V	**POWER CYCLES**	**Classes: 09**

Otto, Diesel, Dual combustion cycles, description and representation on P-V and T-S diagram, thermal efficiency, mean effective pressures on air standard basis, comparison of cycles, introduction to Brayton cycle and Bell Coleman cycle.

Text Books:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill, 4th Edition, 2008.
2. Yunus Cengel, Michael A. Boles, "Thermodynamics-An Engineering Approach", Tata McGraw Hill, 7th Edition, 2011.

Reference Books:

1. J. B. Jones, R. E. Dugan, "Engineering Thermodynamics", Prentice Hall of India Learning, 1st Edition, 2009.
2. Y. V. C. Rao, "An Introduction to Thermodynamics", Universities Press, 3rd Edition, 2013.
3. K. Ramakrishna, "Engineering Thermodynamics", Anuradha Publishers, 2nd Edition, 2011.
4. Holman. J.P, "Thermodynamics", Tata McGraw Hill, 4th Edition, 2013.

Web References:

1. http://www.livescience.com/50776-thermodynamics.html
2. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf

E-Text Books:

1. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf
2. http://www.ebookdownloadz.net/2014/08/engineering-thermodynamics-by-pknag.html

MANUFACTURING PROCESSES

III Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB05	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand and develop an appreciation of the manufacturing processes in correlation with material properties.
II. Learn the material properties which change the shape, size and form of the raw materials into the desirable product.
III. Understand the processes for creating products by conventional or unconventional manufacturing methods.

MODULE-I	CASTING	Classes: 09

Casting: Steps involved in making a casting, its applications, patterns and types of patterns, pattern allowances and their construction, types of casting processes, solidification of casting.

MODULE-II	WELDING	Classes: 09

Welding: Welding types, Oxy-fuel gas welding, cutting, standard time and cost calculations, arc welding Process, forge welding, resistance welding, thermit welding.
Inert gas welding, TIG welding, MIG welding, friction welding, induction pressure welding, explosive welding, electron beam welding, laser welding, soldering and brazing. Heat affected zone in welding, welding defects, causes and remedies, destructive and non-destructive testing of welds.

MODULE-III	METAL FORMING	Classes: 09

Forming: Hot working, cold working, strain hardening, recovery, re-crystallization and grain growth, comparison of properties of cold and hot worked parts, rolling fundamentals, theory of rolling, types of rolling mills and products; Forces in rolling and power requirements, stamping, forming and other cold.

Working processes: Blanking and piercing, bending and forming, drawing and its types, wire drawing and tube drawing; coining; hot and cold spinning, types of presses and press tools, forces and power requirements for the above operations.

MODULE-IV	EXTRUSION AND RAPID PROTOTYPING	Classes: 09

Extrusion of Metals: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, forward extrusion and backward extrusion, impact extrusion, extruding equipment, tube extrusion and Pipe making, hydrostatic extrusion, forces in extrusion; Additive manufacturing: Rapid prototyping and rapid tooling

MODULE-V	FORGING	Classes: 09
Forging processes: Forging operations and principles, tools, forging methods, Smith forging, drop forging, roll forging, forging hammers: Rotary forging, forging defects, cold forging, swaging, forces in forging operations.		
Text Books:		
1. Kalpakjian and Schmid, Manufacturing processes for engineering materials -Pearson India, 5th Edition 2014.		
Reference Books:		
1. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems John Wiley & Sons Inc., 4th Edition, 2008. 2. Degarmo, Black &Kohser, Materials and Processes in Manufacturing (9th Edition) John Wiley & Sons Inc., 7th Edition, 2012.		
Web References:		
1.https://books.google.co.in/books/about/Manufacturing_Processes_Reference_Guide.html?id=6x1smAf_PAcC		
E-Text Books:		
1. https://books.google.co.in/books?id=6wFuw6wufTMC&printsec=frontcover#v=onepage&q&f=false		

PROBABILITY AND STATISTICS

IV Semester: AE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB12	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

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

MODULE-I	**PROBABILITY AND RANDOM VARIABLES**	**Classes: 09**

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**	**Classes: 09**

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	**CORRELATIONS AND REGRESSION**	**Classes: 09**

Correlation: Karle 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**	**Classes: 09**

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**	**Classes: 09**

Small sample tests: Student t-distribution, its properties: Test of significance difference between sample mean and population mean; difference between means of two small samples. Snedecor's F-distribution and its properties; Test of equality of two population variances Chi-square distribution and it's properties; Test of equality of two population variances Chi-square distribution, it's properties, Chi-square test of goodness of fit.

Text Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.

Reference Books:

1. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand & Co., 10th Edition, 2000.
2. N. P. Bali, "Engineering Mathematics", Laxmi Publications, 9th Edition, 2016.
3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

Web References:

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

E-Text Books:

1. http://www.keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktu-ebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks

DATA STRUCTURES

III Semester: ME / CSE / IT / ECE / CE | IV Semester AE / EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB03	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn the basic techniques of algorithm analysis.
II. Demonstrate searching and sorting algorithms and analyze their time complexities.
III. Implement linear data structures viz. stack, queue and linked list.
IV. Demonstrate non-linear data structures viz. tree and graph traversal algorithms.
V. Study and choose appropriate data structure to solve problems in real world.

MODULE – I	INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING	Classes: 09

Basic concepts: Introduction to data structures, classification of data structures, operations on data structures; Searching techniques: Linear search and Binary search; Sorting techniques: Bubble sort, selection sort, insertion sort and comparison of sorting algorithms.

MODULE - II	LINEAR DATA STRUCTURES	Classes: 09

Stacks: Primitive operations, implementation of stacks using arrays, 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	Classes: 09

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 and Queue.

MODULE - IV	NON LINEAR DATA STRUCTURES	Classes: 09

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 implementation, graph traversals, Application of graphs.

MODULE - V	BINARY TREES AND HASHING	Classes: 09

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.

Text Books:
1. Rance D. Necaise, “Data Structures and Algorithms using Python”, Wiley, John Wiley & Sons, INC., 2011. 2. Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishing Ltd., 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. https://www.tutorialspoint.com/data_structures_algorithms/algorithms_basics.htm 2. https://www.codechef.com/certification/data-structures-and-algorithms/prepare 3. https://www.cs.auckland.ac.nz/software/AlgAnim/dsToC.html 4. https://online-learning.harvard.edu/course/data-structures-and-algorithms

MANUFACTURING PROCESS LABORATORY

III Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB06	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The courses should enable the students to:

I. Understand practical orientation of manufacturing processes.
II. Knowledge on different kinds of production processes and practices available for shaping or molding several daily used parts for industries.
III. Selection of equipments for various manufacturing processes will be understood.

LIST OF EXPERIMENTS

Week-1	**PATTERN MAKING**
Pattern design and making, casting drawing.	
Week-2	**SAND PROPERTIES TESTING**
Sand properties testing for strengths and permeability.	
Week-3	**METAL CASTING**
Moulding, melting and casting.	
Week-4	**ARC WELDING**
ARC welding lap and butt joint.	
Week-5	**SPOT WELDING**
Spot welding, TIG welding.	
Week-6	**PLASMA WELDING AND BRAZING**
Plasma welding and brazing (water plasma device).	
Week-7	**APPLICATION OF SIMPLE AND COMPOUND DIE**
Blanking and piercing,	
Week-8	**APPLICATION OF PROGRESSIVE DIE**
Hydraulic press: Operation and study of simple, compound and progressive press tool.	
Week-9	**MECHANICAL PRESS WORKING**
Bending and other operation.	

Week-10	**PROCESSING OF PLASTICS**
Injection moulding.	
WeeK-11	**PROCESSING OF PLASTICS**
Blow moulding.	
Week-12	**BEYOND SYLLABUS**
Riveting of a plates.	
Week-13	**EXAMINATIONS**

Reference Books:

1. R. K. Jain, "Production Technology", Khanna Publishers, 18th Edition, 2013.
2. T. V. Ramana Rao, "Metal Casting", New Age, 1st Edition, 2010.
3. Philips Rosenthal, "Principles of Metal Castings", TMH, 2nd Edition, 2001.
4. B. S.Raghuwamshi, "A Course in Workshop Technology", Dhanpat Rai & Sons, 2014.
5. Kalpakjin S, "Manufacturing Engineering and Technology", Pearson Education, 7th Edition,2014.
7. HMT, "Production Technology", McGraw-Hill Education, 1st Edition, 2013.

Web References:

1. http://www.iare.ac.in

MACHINE DRAWING THROUGH CAD LABORATORY

III Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB07	Core	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable students to

I. Understand Code of drawing practice as per BIS conventions for mechanical elements using AutoCAD.
II. Practice the drawing methods for sectioning of joints, couplings, bearings, keys.
III. Prepare assembly drawings, sectional views and bill of materials for selected assemblies.

LIST OF EXERCISES

Week-1	**CONVENTIONAL REPRESENTATION**

Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs and ribs; Introduction to AutoCAD.

Week-2	**SECTIONAL VIEWS**

Types of sections, selection of section planes and drawing of sections and auxiliary sectional views, parts not usually sectioned.

Week-3	**DIMENSIONING**

Methods of dimensioning, general rules for sizes, and placement of dimensions for holes, centers, and curved and tapered features.

Week-4	**WORKING DRAWINGS**

Types of drawings–working drawings for machine parts.

Week-5	**MACHINE ELEMENTS**

Drawing of machine elements and simple parts; Selection of orthogonal views and additional views for the following machine elements and parts with drawing proportion, popular forms of screw threads, bolts, nuts and stud bolts.

Week-6	**KEYS AND COTTER JOINTS**

Keys, cotter joints, and knuckle joint.

Week-7	**RIVETED JOINTS**

Riveted joints for plates.

Week-8	**COUPLINGS**

Shaft couplings and spigot joint.

Week-9	**BEARINGS**
Journal, pivot, and collar bearing.	
Week-10	**ASSEMBLY DRAWINGS-ENGINE PARTS**
Assembly drawings Assembly drawings for the following, using conventions and drawing proportions: Engine parts–stuffing box.	
Week-11	**CONNECTING ROD AND ECCENTRIC**
Eccentrics, I.C. engine connecting rod.	
WeeK-12	**SCREW JACK**
Screw jack.	
Week-13	**TAIL STOCK AND MACHINE VICE**
Machine vice and tailstock.	
Week-14	**SAFETY VALVES**
Rams-bottom Safety Valve, feed check valve.	

Text Books:

1.K.L. Narayana, P. Kannaiah, K. Venkata Reddy, "Machine Drawing", New Age Publishers, 3rd Edition, 2012.
2. K.C. John, "Text book of Machine Drawing", PHI Eastern Economy, 1st Edition, 2010.
3. P.S Gill, "Machine Drawing", S.K Kataria & Sons, 1stEdition, 2013.
4. Junnarkar N.D, "Machine Drawing", Pearson Education, 1st Edition, 2007.
5. Basudeb Bhattacharya, "Machine Drawing", Oxoford University Press, 1st Edition, 2011.
6. N. D. Bhatt, V. M Pancahal, "Machine Drawing", Charotar, 1st Edition, 2014.
7. R. K. Dhavan, "A Text book of Machine drawing", S.Chand Publication & Co, New Delhi, 2nd Edition, 2008.

Web References:

1. http://web.iitd.ac.in/~achawla/public_html/201/sheets/sheet5/sheet5.pdf
2. https://drive.google.com/file/d/0B_GCh7LMfHf6Z0VNWTNHU3pMSTg/view?pref=2&pli=1
3. http://www.uiet.co.in/downloads/20140911122818-Machine20Drawing.pdf
4. http://listpdf.com/ma/machine-drawing-book-pdf.html

DATA STRUCTURES LABORATORY

III Semester: ME / CSE / IT / ECE / CE | IV Semester AE / EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB05	Core	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

COURSE OBJECTIVES:

The course should enable the students to:

I. Understand various data representation techniques in the real world.
II. Implement linear and non-linear data structures.
III. Analyze various algorithms based on their time and space complexity.
IV. Develop real-time applications using suitable data structure.
V. Identify suitable data structure to solve various computing problems.

LIST OF EXPERIMENTS

Week-1 BASICS OF PYTHON

Write Python programs for the following:

a. To find the biggest of given n numbers using control statements and lists
b. To print the Fibonacci series using functions
c. To find GCD of two numbers

Week-2 SEARCHING TECHNIQUES

Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.

a. Linear search
b. Binary search

Week-3 SORTING TECHNIQUES

Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.

a. Bubble sort
b. Insertion sort
c. Selection sort

week-4 IMPLEMENTATION OF STACK AND QUEUE

Write Python programs to for the following:

a. Design and implement Stack and its operations using List.
b. Design and implement Queue and its operations using List.

Week-5 APPLICATIONS OF STACK

Write Python programs for the following:

a. Uses Stack operations to convert infix expression into postfix expression.
b. Uses Stack operations for evaluating the postfix expression.

Week-6	IMPLEMENTATION OF SINGLE LINKED LIST
Write Python programs for the following operations on Single Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal	
Week-7	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
Write Python programs for the following operations on Circular Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal	
Week-8	**IMPLEMENTATION OF DOUBLE LINKED LIST**
Write Python programs for the following operations on Double Linked List. (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.	
Week-9	**IMPLEMENTATION OF STACK USING LINKED LIST**
Write a Python program to implement Stack using linked list.	
Week-10	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
Write a Python program to implement Linear Queue using linked list.	
Week-11	**GRAPH TRAVERSAL TECHNIQUES**
Write Python programs to implement the following graph traversal algorithms: a. Depth first search. b. Breadth first search.	
Week-12	**IMPLEMENTATION OF BINARY SEARCH TREE**
Write a Python program to perform the following: a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.	

LIST OF REFERENCE BOOKS:

1. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley, John Wiley & Sons, INC., 2011.
2. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt Publishing Ltd., 2017.

WEB REFERENCES:

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

FLUID MECHANICS AND MACHINES

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB08	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Learn about the application of mass and momentum conservation laws for fluid flows.
II. Understand the importance of dimensional analysis.
III. Obtain the velocity and pressure variations in various types of simple flows.
IV. Analyze the flow in water pumps and turbines.

MODULE-I	FLUID STATICS	Classes: 09

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow.

MODULE-II	FLUID KINEMATICS AND DYNAMICS	Classes: 09

Fluid Kinematics: Kinematics of fluid flow- Eulerian and Lagrangian descriptions, Stream line, path line, streak line and stream tube, classification and description of flows for one and three dimensions.
Fluid Dynamics: Euler's equation of motion, Bernoulli equation for flow along a stream line and applications, Measurement of flow.

MODULE-III	BOUNDARY LAYER CONCEPTS AND CLOSED CONDUIT FLOW	Classes: 09

Concept of boundary layer – Definition, characteristics along thin plate, laminar, transition and turbulent boundary layers, separation of boundary layer, measures of boundary layer thickness.

Closed conduit flow: – Darcy Weisbach equation, friction factor, Head loss in pipe flow, Moody's diagram. Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli.

MODULE-IV	FLUID MACHINES	Classes: 09

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

MODULE-V	DIMENSIONAL ANALYSIS AND PUMPS	Classes: 09

Dimensional Analysis: Need for dimensional analysis–methods of dimension analysis, Similitude, types of similitude Dimensionless parameters–application of dimensionless parameters, Model analysis.
Pumps: Theory of Roto dynamic machines , various efficiencies , velocity components at entry and exit of the rotor, velocity triangles, Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump–working principle.

Text Books:

1. Rajput, "Fluid Mechanics and Hydraulic Machines", S.Chand & Co, 6th Edition, 1998
2. H Modi, Seth, "Hydraulics, Fluid Mechanics and Hydraulic Machinery", Rajsons Publications, 20th Edition, 2013.
3. M. White, Fluid Mechanics, 8th Edition, Tata McGraw Hill, 2016.

4. V. Gupta and S. K. Gupta, Fundamentals of Fluid Mechanics, 4th Edition, New Age International 2011.
5. W. L. McCabe, J. C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill International Edition 2005.
6. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall of India, 2005.
7. R. W. Fox, P. J. Pritchard and A. T. McDonald, Introduction to Fluid Mechanics, 7th Edition, Wiley-India 2010.
8. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th Edition, 2007.

Reference Books:

1. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", Kotaria & Sons, 9th Edition 2013.
2. Dr. R K Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 9th Edition, 2015.
3. B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch, Wiley-India, 6th Edition, 2010.
4. R. L. Panton, Incompressible Flow, , Wiley-India, 3rd Edition, 2005.
5. R. B. Bird, W. E. Stewart and E. N. Lightfoot, Transport Phenomena, 2nd Edition, Wiley- India 2002.

Web Reference:

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

E-Book:

1. https://vscht.cz/uchi/ped/hydroteplo/materialy/introduction.fluid.mech.pdf

APPLIED THERMODYNAMICS - I

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB09	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Visualize the construction and working of internal combustion engines, compressors and refrigeration systems.
II. Compare the ideal and real working of thermodynamic cycles for performance evaluation.
III. Understand the subsystems of internal combustion systems.

MODULE-I	IC ENGINES	Classes: 09

Four and two stroke engine, SI and CI engines, valve and port timing diagrams, fuel injection systems for SI engines, fuel injection systems for CI engines, ignition systems, cooling and lubrication system, fuel properties and combustion, stoichiometry.

MODULE-II	COMBUSTION IN SI ENGINES AND CI ENGINES	Classes: 09

Normal combustion and abnormal combustion, importance of flame speed and effect of engine variables, type of abnormal combustion, pre-ignition and knocking, fuel requirements and fuel rating, anti-knock additives, combustion chamber, requirements, types; Combustion in CI Engines: Four stages of combustion, delay period and its importance, effect of engine variables, diesel Knock, need for air movement, open and divided combustion chambers and nozzles used, fuel requirements and fuel rating.

MODULE-III	PERFOMANCE OF ENGINES AND COMPRESSORS	Classes: 09

Parameters of performance, measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, brake power, determination of frictional losses and indicated power, performance test, heat balance sheet and chart.

Classification, of compressors, fans, blower and compressor, positive displacement and dynamic types, reciprocating and rotary types.

MODULE-IV	CENTRIFUGAL AND AXIAL COMPRESSORS	Classes: 09

Roots blower, vane sealed compressor, mechanical details and principle of working efficiency considerations; Centrifugal compressors: mechanical details and principle of operation, velocity and Pressure variation, Energy transfer, impeller blade shape-losses, slip factor, and power input factor, pressure coefficient and adiabatic coefficient, velocity diagrams, power; Axial flow compressors: Mechanical details and principle of operation, velocity triangles and energy transfer per stage degree of reaction, work done factor, isentropic efficiency, pressure rise calculations, poly-tropic efficiency.

MODULE-V	REFRIGERATION	Classes: 09

Mechanical refrigeration and types, units of refrigeration, air refrigeration system, details and principle of operation, applications of air refrigeration, vapor compression refrigeration systems, calculation of COP, effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants, vapor absorption system, mechanical details, working principle, use of p-h charts for calculations.

Text Books:

1. V. Ganesan, "I.C. Engines", Tata McGraw Hill, 3rd Edition, 2011.
2. B. John Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill, 2nd Edition, 2011.
3. R.K. Rajput, "Thermal Engineering", Lakshmi Publications, 1st Edition, 2011.

Reference Books:

1. Mathur, Sharma, "IC Engines", Dhanpat Rai & Sons, 3rd Edition, 2008.
2. Pulkrabek, "Engineering Fundamentals of IC Engines", Pearson Education, 2nd Edition, 2008.
3. Rudramoorthy, "Thermal Engineering", Tata McGraw-Hill, 5th Edition 2003.
4. C. P. Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill Education, 3rd Edition, 2013.

Web References:

1. http://www.newworldencyclopedia.org/entry/Internal_combustion_engine
2. http://www.nptel.ac.in/courses/112106133/#
3. https://www.grc.nasa.gov/www/k-12/airplane/engopt.html

E-Text Books:

1. http://www.link.springer.com/book/10.1007%2F978-3-319-12304-22.

KINEMATICS OF MACHINES

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB10	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. To understand the mechanisms of various machines in order to find the velocity and accelerations for ideation of product development.
II. Understand the basic principles of kinematics and the related terminology of machines.
III. Discriminate mobility; enumerate links and joints in the mechanisms.
IV. Formulate the concept of analysis of different mechanisms.
V. Understand the working of various straight line mechanisms, gears, gear trains, steering gear mechanisms, cams and a Hooke's joint.
VI. Analyze a mechanism for displacement, velocity and acceleration of links in a machine.

MODULE-I	MECHANISMS	Classes: 09

Mechanisms: Elements or links, classification, rigid link, flexible and fluid link, types of kinematic pairs types of constrained motion, kinematic chain, mechanism, machine, structure, inversion of mechanism, inversions of quadric cycle chain, single and double slider crank chains, mechanical advantage, Grubler's Criterion.

MODULE -II	KINEMATICS, PLANE MOTION OF BODY, ANALYSIS OF MECHANISMS	Classes: 09

Kinematics: Velocity and acceleration, motion of link in machine, determination of velocity and acceleration, Graphical method, application of relative velocity method, plane motion of body: Instantaneous center of rotation, centroids and axodes, three centers in line theorem, graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Klein's construction, Coriolis acceleration, determination of Coriolis component of acceleration; Analysis of mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider, acceleration diagram for a given mechanism.

MODULE-III	STRAIGHT LINE MOTION MECHANISMS, STEERING GEARS, HOOKE'S JOINT	Classes: 09

Straight-line motion Mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart and Scott Russul, Grasshopper, Watt, TChebicheff and Robert mechanisms, pantograph.

Steering gears: Conditions for correct steering, Davis Steering gear, Ackerman's steering gear, Hooke's joint: Single and double Hooke's joint, velocity ratio, application, problems.

MODULE-IV	CAMS, ANALYSIS OF MOTION OF FOLLOWERS	Classes: 09

Cams: Definitions of cam and followers, their uses, types of followers and cams, terminology, types of follower motion, uniform velocity, simple harmonic motion and uniform acceleration; Maximum velocity and maximum acceleration during outward and return strokes in the above three cases; Analysis of motion of followers: Tangent cam with roller follower, circular arc cam with straight, concave and convex flanks.

MODULE –V	HIGHER PAIRS, GEAR TRAINS	Classes: 09

Higher Pairs: friction wheels and toothed gears, types, law of gearing, condition for constant velocity ratio for transmission of motion, velocity of sliding, form of teeth, cycloidal and involute profiles, phenomena of interferences, methods of interference; Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact of pinion and gear pinion and rack arrangements; Introduction to helical, bevel and worm gearing; Gear trains: Introduction, types, simple and reverted gear trains, epicyclic gear train; Methods of finding train value or velocity ratio of epicyclic gear trains, selection of gear box, differential gear for an automobile.

Text Books:

1. Mallik, A. K., Ghosh, A., & Dittrich, G. Kinematic analysis and synthesis of mechanisms: CRC Press. , 10th Edition, 2008.
2. Uicker, J. J., Pennock, G. R., & Shigley, J. E. Theory of machines and mechanisms: OUP. , 2nd Edition, 2008.
3. Norton, R. L. Design of machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines: McGrawHill, 2nd Edition, 2008.
4. Rattan.S.S. Theory of Machines: McGraw-Hill Education (India) Pvt Ltd, , 6th Edition, 2013.
5. Rao, J. S. The Theory Of Machines Through Solved Problems: New Age International, 2nd Edition, 2008.

References

1. Bevan, T. The theory of machines: A Text-Book for Engineering Students: Pearson Education, 4th Edition, 2013.
2. Vinogradov, O. G. Fundamentals of kinematics and dynamics of machines and mechanisms: CRC Press, 2nd Edition, 2014.
3. Ballaney PL, Theory of Machines and Mechanisms, Khanna Publications, 5th Edition, 2012.

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1. http://www.uobabylon.edu.iq/uobColeges/ad_downloads/4_1293_515.pdf
2. http://ebooks.library.cornell.edu/k/kmoddl/toc_hartenberg1.html

E-Text Books

1. https://drive.google.com/file/d/0B7raaoEF40D7eEJIR1VoODJodFE/edit
2. http://royalmechanicalbuzz.blogspot.in/2015/04/theory-of-machines-by-rs-khurmi-ebook-pdf.html
3. https://docs.google.com/file/d/0B5dLUIZfysmqMXBhakRyODhublU/edit
4. https://archive.org/details/theoryofmachines00mckarich

MATERIALS AND MECHANICS OF SOLIDS

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB11	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
II. Calculate the elastic deformation occurring in various simple geometries for different types of loading.

MODULE-I	FUNDAMENTALS OF MATERIAL SCIENCE	Classes: 09

Basic Crystallography- Crystal structure – BCC, FCC and HCP structure – unit cell –rystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number. Frank Reed source of dislocation Elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Bauschinger's effect, yield point phenomenon, cold/hot working, recovery, re-crystallization, and grain growth, strengthening of metals.

MODULE -II	ALLOYS AND PHASE DIAGRAMS	Classes: 09

Constitution of Alloys and Phase Diagrams- Constitution of alloys – Solid solutions - substitutional and interstitial. Phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions. Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.

MODULE-III	SIMPLE STRESSES AND STRAINS, PRINCIPAL STRESSES	Classes: 09

- Hooke's law, stress and strain- tension, compression and shear stresses elastic constants and their relations

Volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

MODULE -IV	SHEAR FORCE AND BENDING MOMENT DIAGRAMS, FLEXURAL STRESSES, SHEAR STRESSES	Classes: 09

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

MODULE -V	SLOPE & DEFLECTION	Classes: 09

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Text Books:

1. Sidney H Avner, "Introduction to Physical Metallurgy", McGraw-Hill Education, 2nd Edition, 2008.
2. Donald R Askeland, Thomson, "Essentials of Material Science and Engineering", Thomson Press, 1st Edition, 2005.
3. R. S. Kurmi, Gupta, "Strength of Materials", S Chand & Co, New Delhi, 1st Edition, 2013.
4. Egor P. Popov, "Solid Mechanics" Pearson, 2nd Edition, 2002.

5. Ryder. G.H, “Strength of Materials”, Macmillan Long Man Publications, 3rd Edition, 2002.
6. W.A. Nash, “Strength of Materials”, Tata McGraw-Hill, 4th Edition, 2007..
7. S. S Ratan, “Strength of Materials”, Tata McGraw-Hill, 2nd Edition, 2011.

References

1. Jindal, “Strength of Materials”, Pearson Education, 1st Edition, 2012.
2. Vazirani, Ratwani, “Analysis of Structures”, Khanna Publishers, 19th Edition, 2014.
3. H.J.Shah, S.B.Junnarkar, “Mechanics of Structures”, Charotar Publishing House Pvt. Ltd, 31st Edition, 2014.
4. S. Ramamrutam, R. Narayan, “Strength of Materials”, Dhanpat Rai Publishing Company, 18th Edition, 2014.
5. . K. Rajput, “Strength of Materials”, S.Chand & Co New Delhi, 4th Edition, 2007.

Web References:

1. https://www.youtube.com/watch?v=whB7IX3NQpg&list=PL49866E92803B242C
2. https://www.youtube.com/watch?v=vidZ1p82oCg
3. http://web.mit.edu/emech/dontindex-build/

E-Text Book:

1.http://royalmechanicalbuzz.blogspot.in/2015/04/strength-of-materials-book-by-r-k-bansal.html

OPTIMIZATION TECHNIQUES

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB12	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Apply the dynamic programming to solve problems of discreet and continuous variables.
II. Apply the concept of non-linear programming.
III. Complex problem analysis to be carried out to identify the sensitivity of project.
IV. Model the real world problem and simulate it.

MODULE-I	DEVELOPMENT OF O.R AND ALLOCATION	Classes: 09

Development, Definition– Characteristics and Phases**,** Types of models, Operations Research models, applications. Allocation**:** Linear Programming Problem Formulation, Graphical solution, Simplex method, Artificial variables techniques: Two–phase method, Big-M method.

MODULE-II	TRANSPORTATION AND ASSIGNMENT	Classes: 09

Transportation Problem, Formulation, Optimal solution, unbalanced transportation problem, Degeneracy. Assignment problem, Formulation, Optimal solution, Variants of Assignment Problem, Traveling Salesman problem.

MODULE-III	SEQUENCING AND REPLACEMENT	Classes: 09

Sequencing Introduction**:** Flow**,** Shop sequencing**,** n jobs through two machines**,** n jobs through three machines, Job shop sequencing, two jobs through 'm' machines.

Replacement**:** Introduction**:** Replacement of items that deteriorate with time**,** when money value is not counted and counted, Replacement of items that fail completely, Group Replacement.

MODULE-IV	THEORY OF GAMES AND INVENTORY	Classes: 09

Theory Of Games: Introduction – Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, m X 2 & 2 X n games, Graphical method.
Inventory: Introduction**,** Single item**,** Deterministic models**,** Purchase inventory models with one price break and multiple price breaks, Stochastic models, demand may be discrete variable or continuous variable, Single period model and no setup cost.

MODULE-V	WAITING LINES, DYNAMIC PROGRAMMING AND SIMULATION	Classes: 09

Waiting Lines: Introduction, Terminology, Single Channel, Poisson arrivals and exponential service times with infinite population and finite population models, Multichannel, Poisson arrivals and exponential service times with infinite population.
Dynamic Programming: Introduction, Terminology, Bellman's Principle of optimality, Applications of dynamic programming, shortest path problem, linear programming problem. Simulation: Introduction, Definition, types of simulation models, steps involved in the simulation process - Advantages and Disadvantages, Application of Simulation to queuing and inventory.

Text Books:

1. J. K. Sharma, "Operations Research", Macmillan, 5th Edition, 2012.
2. R. Pannerselvan, "Operations Research", PHI Publications, 2nd Edition, 2006.

Reference Books:

1. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 2013.
2. Maurice Saseini, Arhur Yaspan, Lawrence Friedman, "Operations Research: Methods & Problems", 1st Edition, 1959.
3. Hamdy A. Taha, "Introduction to O.R", PHI, 8th Edition, 2013.
4. Harvey M.Wagner, "Operations Research", PHI Publications, 2nd Edition, 1980.

Web References:

1. https://www.aicte-india.org/flipbook/p&ap/Vol.%20II%20UG/UG_2.html#p=8
2. https://www.britannica.com/topic/operations-research

E-Text Books:

1. http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf
2. https://www.pdfdrive.com/operations-research-books.html

FLUID MACHINERY AND IC ENGINE LABORATORY

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB13	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The **courses should enable the students to:**

I. Understand the basic principles of fluid mechanics.
II. Apply Bernoulli equation for fluid flow.
III. Determine co-efficient of discharge.
IV. Evaluate the performance of hydraulic turbines.
V. Understand the functioning and characteristic curves of pumps.

LIST OF EXPERIMENTS

Week-1 **CALIBRATION OF FLOW METERS**

Determination of coefficient of discharge (C_d) and generation of various characteristic curves for water flowing through venturimeter

Determination of coefficient of discharge (C_d) and generation of various characteristic curves for water flowing through Orifice meter.

Week-2 **DETERMINATION OF FRICTION FACTOR**

Determination of friction factor for a given pipe line.

Week-3 **BERNOULLI'S THEOREM**

Verification of Bernoulli's theorem.

Week-4 **PERFORMANCE TEST ON REACTION TURBINES**

Performance Test on Francis Turbine and generate various characteristic curves.

Performance Test on Kaplan wheel and generate various characteristic curves.

Week-5 **PERFORMANCE TEST ON IMPULSE TURBINE**

Performance test on Pelton wheel and generate various characteristic curves.

Week-6 **PERFORMANCE TEST ON POSITIVE DISPLACEMENT PUMP**

Performance Test on Reciprocating Pump and generate various characteristic curves

Week-7 **PERFORMANCE TEST ON ROTODYNAMIC PUMPS**

Performance Test on Centrifugal Pumps and generate various characteristic curves

Week-8 **IC Engines Valve/Port timing diagram**

Drawing valve and port timing diagram for 4-stroke diesel and 2-stroke petrol engine respectively.

Week-9	**IC Engine performance test for 4-stroke SI Engine**
Performance test for 4-stroke SI engine and draw performance curves	
WeeK-10	**IC Engine performance test on 4-Stroke CI engine**
Performance Test on 4-stroke CI engine and to draw the performance curves	
Week-11	**Performance Test on Air Compressor Unit**
Volumetric Efficiency of Reciprocating Air compressor unit	
Week-12	**Performance test on Variable Compression Ratio(VCR) engine**
Performance Test on CI engine when the compression ratio is changing.	
Week-13	**Examination**

Reference Books:

1. D.S. Kumar,"Fluid Mechanics and Fluid Power Engineering", Kotaria & Sons, Reprint, 2013.
2. D. Rama Durgaiah, "Fluid Mechanics and Machinery", New Age International, 1st Edition, 2002.
3. Banga, Sharma, "Hydraulic Machines", Khanna Publishers, 6th Edition, 2001.
4. Dr. R K Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 9th Edition, 2015.
5. V. Ganesan, "I.C. Engines", Tata McGraw-Hill, 3rd Edition, New Delhi, India. 2011.
6. B. John Heywood, "Internal combustion engine fundamentals", Tata McGraw Hill, 2nd Edition, New Delhi. 2011
7. R. K. Rajput , "Thermal Engineering", Lakshmi Publications, 18th Edition, 2011.

Web References:

1. https://docs.google.com/document/d/1UaDrm0pnHgd8GnN7dAcXM6EikgqAD7BU-0d52VFZz1w/edit
2. http://www.iare.ac.in
3. https://en.wikipedia.org/wiki/Internal_combustionengines.
4. https://en.wikipedia.org/wiki/Compression_Ignitionengines

MATERIAL AND MECHANICS OF SOLIDS LABORATORY

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB14	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The course will enable the students to:

I. Determination of mechanical properties of different materials.
II. Establish the constitutive relations in metals using destructive methods.
III. Understand the behavior of members during twisting and transverse loading.
IV. Familiarize with standard test specimens.
V. Prepare samples for investigating micro structure of different materials.

LIST OF EXPERIMENTS

Week-1	**MICROSTRUCTURE OF PURE METALS**

Preparation and study of the micro Structure of pure metals like iron, cu and al.

Week-2	**MICROSTRUCTURE OF STEELS**

Preparation and study of the microstructure of mild steels, low carbon steels, high–C steels.

Week-3	**MICROSTRUCTURE OF CAST IRON**

Study of the micro structures of cast irons.

Week-4	**MICROSTRUCTURE OF NON FERROUS ALLOYS**

Study of the micro structures of non-ferrous alloys.

Week-5	**MICROSTRUCTURE OF HEAT TREATED STEELS**

Study of the micro structures of heat treated steels.

Week-6	**HARDENABILITY OF STEELS**

Hardenability of steels by jominy end quench test.

Week-7	**HARDNESS OF STEELS**

To find out the hardness of various treated and untreated steels.

Week-8	**TENSION TEST**

To Find % of elongation and young's modulus of a material.

Week-9	**TORSION TEST**
To find the torsional rigidity of a material.	
Week-10	**HARDNESS TEST**
a) Brinell's hardness test. b) Rockwell hardness test.	
WeeK-11	**SPRING TEST**
Testing on compressive and elongation springs.	
Week-12	**COMPRESSION TEST**
Compression test on springs.	
Week-13	**IMPACT TEST**
a) Charpy. b) Izod test.	
Week-14	**SHEAR TEST**
Punch shear test on aluminium sheet.	

Text Books:

1. Sidney H Avner, "Introduction to Physical Metallurgy", McGraw Hill Education, 2nd Edition, 2008.
2. William, Callister, "Material Science and Engineering", Wiley, 9th Edition, 2014.
3. V Raghavan, "Elements of Material Science", PHI Learning Company Pvt Ltd, 6th Edition, 2015.
4. Er.Amandeep Singh Wadhva, "Engineering Materials and Metallurgy", Laxmi Publications, 1st Edition, 2008.
5. Traugott Fisher, "Material Science", 1st Edition, Academic Press Elsevier, 2013.

Web References:

1. http://www.iare.ac.in

OPTIMIZATION TECHNIQUES LABORATORY

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB15	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic concepts of Python programming.
II. Apply Python programming skills in solving matrix operations.
III. Apply Python concepts in solving linear programming problems.
IV. Apply optimization techniques through TORA.
V. Evaluate optimization problems using Lingo/ Excel solver.

LIST OF EXPERIMENTS

Week-1 MATRIX OPERATIONS

Write a Python program to find out when given an array of size **N**, the task is to partition the given array into two subsets such that the average of all the elements in both subsets is equal. If no such partition exists print -1. Otherwise, print the partitions. If multiple solutions exist, print the solution where the length of the first subset is minimum. If there is still a tie then print the partitions where the first subset is lexicographically smallest.

Week-2 MATRIX OPERATIONS

Write a Python program to find out when given an array of positive elements, you have to flip the sign of some of its elements such that the resultant sum of the elements of array should be minimum non-negative (as close to zero as possible). Return the minimum no. of elements whose sign needs to be flipped such that the resultant sum is minimum non-negative. Note that the sum of all the array elements will not exceed 10^4.

Week-3 MINIMUM COST PATH

Given a cost matrix cost[][] and a position (m, n) in cost[][], write a function that returns cost of minimum cost path to reach (m, n) from (0, 0). Each cell of the matrix represents a cost to traverse through that cell. Total cost of a path to reach (m, n) is sum of all the costs on that path (including both source and destination). You can only traverse down, right and diagonally lower cells from a given cell, i.e., from a given cell (i, j), cells (i+1, j), (i, j+1) and (i+1, j+1) can be traversed. You may assume that all costs are positive integers.

Week-4 FINDING MAXIMUM IN AN INTEGER ARRAY

Write a Python program to find out when given an array of non-negative integers **arr[]**, the task is to find a pair **(n, r)** such that ${}^{n}\mathbf{P}_{r}$ is maximum possible and $\mathbf{r} \leq \mathbf{n}$.

Week-5 ARRAY SORTING

Write a Python program to find out when given an array **arr[]** of **N** integers, the task is to sort the array in non-decreasing order by performing the minimum number of operations. In a single operation, an element of the array can either be incremented or decremented by **1**. Print the minimum number of operations required.

Week-6 LINEAR PROGRAMMING PROBLEM

A store sells men's and women's tennis shoes. It makes a profit of $1 per pair of men's shoes and $1.20 per pair of women's shoes. It takes two minutes of a salesperson's time and two minutes of a cashier's time to sell a pair of men's shoes. It takes three minutes of a salesperson's time and one minute of a cashier's time per pair of women's shoes. The store is open eight hours per day, during which time there are two salespersons and one cashier on duty. How many pairs of shoes of each type should the store sell in order to maximize profit each day?

Week-7 QUEUING PROBLEM

A super market has two girls ringing up sales at the counters. If the service time for each customer is exponential with mean 4 minutes, and if people arrive 3 in a poison fashion at the 10/hour.

a. What is the probability of having to wait for the service?
b. What is the expected percentage of idle time for each girl?
c. Find the average length and average number of units in the system.

Week-8 SEQUENCING PROBLEM

We have five jobs each of which must go through two machines in the order BA, processing times are given in the table below

Job No.	1	2	3	4	5
Machine A	10	2	18	6	20
Machine B	4	12	14	16	8

Determine a sequence for the five jobs that will minimize the total elapsed time. Also compute idle times for each of the machine

Week-9 GAME THEORY

Using the dominance property obtain the optimal strategy for both the players and determine the value of game. The payoff matrix for player A is given

Player - A	Player - B				
	I	II	III	IV	V
I	2	4	3	8	4
II	5	6	8	7	8
III	6	7	9	8	7
IV	4	2	8	4	3

Week-10 ASSIGNMENT PROBLEM

A Company has three plants at locations A,B and C which supply to warehouses located at D,E,F,G and H. monthly plant capacities are 800,500 and 900 respectively. Monthly warehouse requirements are 400, 500,400 and 800 units respectively. Unit transportation cost in rupees is given below.

Plant		Ware houses				
		D	E	F	G	H
	A	5	8	6	6	3
	B	4	7	7	6	5
	C	8	4	6	6	4

Determine an optimum distribution for the company in order to minimize the total transportation cost.

Week-11	DYNAMIC PROGRAMMING PROBLEM

Given an array **arr[]** of **N** integers, the task is to sort the array in non-decreasing order by performing the minimum number of operations. In a single operation, an element of the array can either be incremented or decremented by **1**. Print the minimum number of operations required.

Week-12	INVENTORY PROBLEM

A dealer supplies you the following information with regards to an product that he deals in annual demand =10,000 units, ordering cost Rs.10/order, Price Rs.20/unit. Inventory carrying cost is 20% of the value of inventory per year. The dealer is considering the possibility of allowing some back orders to occurs. He has estimated that the annual cost of back ordering will be 25% of the value of inventory.

a. What should be the optimum no of units he should buy in 1lot?
b. What qty of the product should be allowed to be backordered?
c. What would be the max qty of inventory at any time of year?

Would you recommend to allow backordering? If so what would be the annual cost saving by adopting the policy of backordering.

Week-13	EXAMINATIONS

Examinations

Text Books

1. Kalavathy.S, “Operations Research using C Programmes”, Vikas Publishing House Pvt Ltd., New Delhi, 3rd Edition,2010.
2. Hamdy A. Taha, “Operations Research An Introduction”, Pearson, 10th Edition, 2017.

Reference Books

1. Eric Matthes, "Python Crash Course", 2nd Edition, 2016.
2. Paul Barry, “Head- First Python”, 2nd Edition, 2016.

Web References

1. www.tutorialspoint.com/How-to-Multiply-Two-Matrices-using-Python
2. https://www.programiz.com/python-programming/examples/multiply-matrix

MANUFACTURING TECHNOLOGY

V Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB16	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Visualize the generation of surface profiles using the relative motion between directrix and generatrix.
II. Understand the basic mechanism involved in metal cutting processes using different cutting tools.
III. Understand the measurement of different attributes of metal cutting using various measuring instruments.
IV. Analyze surface topography, establish geometrical dimensioning and tolerance.

MODULE-I	BASIC MECHANISM OF METAL CUTTING	Classes : 09

Elementary treatment of metal cutting theory, element of cutting process, geometry of single point tool and angles chip formation and types of chips, built up edge and its effects, chip breakers: Mechanics of orthogonal cutting, Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, machinability, tool materials.

MODULE-II	MACHINE TOOL-I	Classes : 09

Engine lathe, Principle, specification, types, work and tool holding devices, Automatic lathes, classification: Single spindle and multi-spindle automatic lathes and its tool layouts; Shaping, slotting and planning machines, Principles of working, specification, operations performed, Kinematic scheme.

MODULE-III	MACHINE TOOLS-II	Classes: 09

Milling machine, classifications, specifications, working principles of milling machines; Geometry of milling cutters, methods of indexing , kinematic scheme of milling machines; Drilling and boring machines, principles of working, specifications, types, operations performed, twist drill; Kinematics scheme of the drilling and boring machines.

MODULE-IV	GEOMETRICAL DIMENSIONING AND TOLERANCES	Classes: 09

Systems of Limits and Fits: Introduction, normal size, tolerance limits, deviations, allowance, fits and their types, unilateral and bilateral tolerance system, hole and shaft basis systems, Interchangeability and selective assembly.

Linear Measurement: Slip gauges, dial indicator, micrometers; Measurement of angles and tapers: Bevel protractor, angle slip gauges, spirit levels, sine bar.

MODULE-V	MEASURING INSTRUMENTS	Classes : 09

Optical measuring instruments: Tool maker's microscope and its uses, collimators, optical projector, interferometer; Screw thread measurement: Element of measurement, errors in screw threads, measurement of effective diameter, angle of thread and thread pitch, profile thread gauges; Surface roughness measurement**:** Numerical assessment of surface finish: CLA, R.M.S Values, R_z values, methods of measurement of surface finish: profilograph, talysurf - ISI symbol for indication of surface finish.

Text Books:

1. Dr. R. Kesavan, Dr. R. Kesavan, "Machine Tools"Laxmi publications, 2nd Edition, 2016.
2. N. K Mehta**,** "Metal Cutting and Design of Cutting Tools, Jigs & Fixtures"**,** McGraw-Hill Education, 1st Edition, 2014.
3. T.L. Chaudhary,"Metal Cutting and Mechanical Tool Engineering", Khanna Publishers, 5th Edition, 2001
4. R. K. Jain, "Engineering Metrology", Khanna Publishers, 21st Edition, 2013.

Reference Books:

1. B.L. Juneja, G.S. Sekhon, Nitin Seth "Fundamentals of Metal Cutting and Machine Tools ", New Age Publishers, 2nd Edition, 2014.
2. GeofreyBoothroyd, "Fundamentals of metal machining and machine tools", McGraw-Hill Education, 1st Edition, 2013.
3. S. Sirohi, H. C. Radha Krishna, "Mechanical Measurements", New Age Publishers, 3rd Edition, 2016.
4. M Mahajan "A Textbook of Metrology ", Dhanpatrai and Co ,2nd Edition, 2016.

Web References:

1. http://www.me.iitb.ac.in/~ramesh/courses/ME338/metrology1.pdf
2. http://www.mfg.mtu.edu/marc/primers/machtool/metrology.html3.
3. http://nptel.ac.in/courses/112106138.
4. https://en.wikipedia.org/wiki/Machine_tool.

E-Text Book:

1.http://www.faadooengineers.com/threads/8474-Engineering-Metrology-Measurements-ppt-ebook-pdf-Download
2. http://www.yildiz.edu.tr/~meksi/index_dosyalar/MACHINE%20_TOOLS.pdf.

DYNAMICS OF MACHINERY

V Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB17	Core	2	1	-	3	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the concept of equilibrium of a body subjected to static and dynamic forces.
II. Apply the phenomenon of friction for automobile application.
III. Analyze the significance of governors and its application in turning moment diagram.
IV. Determine the fundamental frequency of mechanical system.

MODULE-I	**PRECESION, STATIC AND DYNAMIC FORCE ANALYSIS OF PLANAR MECHANISMS**	**Classes : 09**

Precession: Gyroscopes, effect of processional motion on the stability of moving vehicles such as motor car, motor cycle, aero-planes and ships, static and dynamic force analysis of planar mechanisms: (Neglecting friction), Introduction to free body diagrams, conditions of equilibrium, two and three force members, inertia forces and D'Alembert's principle, planar rotation about a fixed centre.

MODULE-II	**CLUTCHES, BRAKES AND DYNAMOMETERS**	**Classes : 09**

Clutches: Friction clutches, Single disc or plate clutch, multiple disc clutches, cone clutch and centrifugal clutch; Brakes and dynamometers: Simple block brakes, internal expanding brake, band brake of vehicle; Dynamometers absorption and transmission types, general description and method of operation.

MODULE-III	**TURNING MOMENT AND GOVERNORS**	**Classes: 09**

Turning moment diagrams and flywheels: turning moment: Inertia torque, angular velocity and acceleration of connecting rod, crank effort and torque diagrams, fluctuation of energy; Design of flywheels.

Governors: Watt, Porter and Proell governors, spring loaded governors, Hartnell and Hartung with auxiliary springs, sensitiveness, isochronism and hunting.

MODULE-IV	**BALANCING OF ROTATORY AND RECIPROCATING MASSES**	**Classes: 09**

Balancing: Balancing of rotating masses, single and multiple-single and different planes-balancing of reciprocating masses, primary and secondary balancing-analytical and graphical methods; unbalanced forces and couples: Balancing of V-engines, multi cylinder, inline and radial engines for primary, secondary balancing and locomotive balancing.

MODULE-V	**MECHANICAL VIBRATIONS**	**Classes : 09**

Vibrations: Free vibration of mass attached to a vertical spring, simple problems on forced damped vibration; Vibration isolation and transmissibility, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems.

Text Books:

1. Thomas Bevan, "Theory of Machines", Pearson Education, 3rd Edition, 2009.
2. S.S Ratan, "Theory of Machines", Tata McGraw-Hill, 4th Edition, 2014.
3. R. L. Norton, "Kinematics and Dynamics of Machinery", McGraw-Hill, 1st Edition, 2009.
4. P.L. Balleny, "Theory of Machines and Mechanisms", Khanna publishers, 49th Edition, 2013.

Reference Books:

1. J. S. Rao, R.V. Dukkipati, “Mechanism and Machine Theory”, New Age Publication, 1st Edition, 2013.
2. Uiker, Penock, Shigley, “Theory of Machines and Mechanisms”, Oxford University Press, 4th Edition, 2013.
3. R.S. Khurmi, Gupta, “Theory of Machines”, S.Chand & Co, New Delhi, 14th Edition, 2013.

Web References:

1. http://www.uobabylon.edu.iq/uobcolleges/ad_downloads/4_1293_515.pdf
2. http://ebooks.library.cornell.edu/k/kmoddl/toc_hartenberg1.html

E-Text Book:

1. https://drive.google.com/file/d/ob7raaoEF40D7eEJIR1voODJodFE/edit
2. http://royalmechanicalbuzz.blogspot.in/2015/04/theory-of-machines-by-rs-khurmi-ebook-pdf.html
3. http://archive.org/details/theoryofmachinesOOmckarich

APPLIED THERMODYNAMICS - II

V Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB18	Core	2	1	-	3	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Apply the concepts of basic thermodynamics to analyses the performance parameters of steam Gas power cycles.

II. Contrast between various steam generator operating principles to evaluate best possible devices for specific application.

III. Analyze various thermal systems to create futuristic designs.

MODULE-I	BASIC CONCEPTS OF RANKINE CYCLE and FUELS & COMBUSTION	Classes : 09

Rankine cycle schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance, regeneration and reheating. Combustion: fuels and combustion, adiabatic flame temperature, stoichiometry, exhaust gas analysis.

MODULE-II	BOILERS AND STEAM NOZZLES	Classes : 09

Boilers: Classification, working principles with sketches, boilers mountings and accessories, working principles.; Basics of compressible flow, Isentropic flow of a perfect gas through nozzle, subsonic, supersonic and choked flow- normal shocks-ideal gas tables for isentropic and normal shock flow, flow of steam and refrigerant through nozzles, thermodynamic analysis of nozzle.

MODULE-III	STEAM TURBINES AND CONDENSERS	Classes: 09

Steam Turbines: Classification, Impulse turbine-velocity diagrams, pressure and velocity compounding. Reaction turbine-principle of operation, thermodynamic analysis of a stage, degree of reaction, velocity diagrams.

Steam Condensers: Requirements of steam condensing plant, classification of condensers, working principle of different types.

MODULE-IV	GAS TURBINES	Classes: 09

Gas turbines: Simple gas turbine plant, ideal cycle, essential components, parameters of performance, actual cycle, regeneration, inter cooling and reheating, closed and Semi-closed cycles, merits and demerits, brief concepts of combustion chambers of gas turbine plant..

MODULE-V	JET POPULSION AND ROCKETS	Classes : 09

Jet propulsion: Principle of operation, classification of jet propulsive engines, working Principles with schematic diagrams and representation on T-S diagram, thrust, thrust power and propulsion efficiency, turbo jet engines, needs and demands met by turbo jet, schematic diagram, thermodynamic cycle, performance evaluation; Rockets: Application, working Principle, classification, propellant type, thrust, propulsive efficiency, specific impulse, solid and liquid propellant rocket engines.

Text Books:
1. R. K. Rajput, “Thermal Engineering”, Lakshmi Publications, 8th Edition, 2015. 2. V.Ganeshan “Gas turbines”, Tata McGraw-Hill, 3rd Edition, 2010
Reference Books:
1. P. Khajuria, S. P Dubey, “Gas Turbines and Propulsive systems”, Dhanpat Rai Publishers., 1st Edition, 2012. 2. Ballaney, “Thermal Engineering”, Khanna Publishers, 1st Edition, 2012. 3. R. Yadav, “Thermodynamics and Heat Engines”, Central Book Depot, 1st Edition, 2002. 4. P.K Nag, “Engineering Thermodynamics”, Tata McGraw-Hill publishing Co. Ltd.
Web References:
1. http://www.newworldencyclopedia.org/entry/Internal_combustion_engine 2. http://www.livescience.com/50776-thermalengineering.html
E-Text Book:
1. http://www.ebookdownloadz.net/2014/08/ Thermal engineering -by-R.K Rajput.html

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

III Semester: CSE / IT | V Semester: EEE / CE / MECH | VI Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB14	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the market dynamics namely demand elasticity of demand and pricing in different market structures.
II. Analyze how capital budgeting decisions are carried out for selecting the best investment proposal.
III. Learn how organizations make important investment and financing decisions.
IV. Analyze a company's financial statements and come to a reasoned conclusion about the financial situation of the company.
V. Acquire the basics of how to analyze and interpret the financial statements through ratio analysis.

MODULE – I	**INTRODUCTION AND DEMAND ANALYSIS**	**Classes: 07**

Definition, nature and scope of business 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.

MODULE – II	**PRODUCTION AND COST ANALYSIS**	**Classes: 10**

Production function; Isoquants and isocosts, MRTS, least cost combination of inputs, Cobb-Dougles production function, internal and external economies of scale, cost analysis; Cost concepts: Break even analysis (BEA), determination of break-even point (simple problems), managerial significance.

MODULE – III	**MARKETS AND NEW ECONOMIC ENVIRONMENT**	**Classes: 08**

Types of competition and markets, features of perfect competition, monopoly and monopolistic competition, price-output determination in case of perfect competition and monopoly business.

Features and evaluation of different forms of business organizations: Sole proprietorship, partnership, joint stock company, public enterprises and their types.

MODULE – IV	**CAPITAL BUDGETING**	**Classes: 10**

Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising capital, capital budgeting: features of capital budgeting proposals; Methods of capital budgeting: Payback period, accounting rate of return(ARR), net present value method and internal rate of return method (simple problems).

MODULE – V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**	**Classes : 10**

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.

Text Books:

1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4th Edition, 2012.
2. M. Kasi Reddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 2nd Edition, 2012.
3. Varshney, Maheswari, "Managerial Economics", Sultan Chand Publications, 11th Edition, 2009.

Reference Books:

1. S. A. Siddiqual, A. S. Siddiqual, "Managerial Economics and Financial Analysis", New Age International Publishers, Hyderabad, Revised 1st Edition, 2013.
2. S. N. Maheswari, S. K. Maheswari, "Financial Accounting", Vikas publications, 3rd Edition, 2012.
3. J. V. Prabhakar Rao, P. V. Rao, "Managerial Economics and Financial Analysis", Maruthi Publishers, Reprinted Edition, 2011.
4. Vijay Kumar, Appa Rao, "Managerial Economics and Financial Analysis", Cengage Publications, 1st Edition, Paperback, 2011.

Web References:

1. https:// www.slideshare.net/glory1988/managerial-economics-and- financial analysis
2. https:// thenthata.web4kurd.net/mypdf/managerial-economics-and- financial analysis
3. https:// bookshallcold.link/pdfread/managerial-economics-and-financial analysis
4. https:// www.gvpce.ac.in/syllabi/Managerial Economics and financial analysis

E-Text Book:

1. https:// books.google.co.in/books/about/Managerial economics and financial analysis
2. http://www. ebooktake.in/pdf/title/managerial-economics-and-financial analysis
3. http://all4ryou.blogspot.in/2012/06/mefa-managerial-economics and financial analysis
4. http://books.google.com/books/about/Managerial economics and financial analysis
5. http://www.scribd.com/doc/37684926

MANUFACTURING TECHNOLOGY LABORATORY

V Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB19	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The courses should enable the students to:

I. Hands on experience on lathe machine to perform turning, facing, threading operations.
II. Practical exposure on flat surface machining, milling and grinding operations.
III. Skill development in drilling and threading operations.
IV. Linear and angular measurements exposure.
V. Create awareness on various mechanical measuring instruments.

LIST OF EXPERIMENTS

Week-1	**Lathe Machine**
Step turning, taper turning, Thread cutting and knurling using lathe machine	
Week-2	**Screw Thread Measurement**
Screw thread measurement by Three wire method	
Week-3	**Drilling and step boring**
Drilling, tapping and step boring using drilling machine.	
Week-4	**Surface Roughness Measurement**
Surface roughness measurement by Talysurf	
Week-6	**Shaping**
Shaping of V groove using shaper.	
Week-7	**Slotting**
Slotting of a keyway using slotter machine	
Week-8	**Milling and Surface Grinding**
Milling of gear and Surface Grinding	
Week-9	**Vernier Calipers and Micrometer**
Length, Depth, Diameter measuring using vernier calipers and micrometer.	
Week-10	**Bore Gauge**
Bore measurement using bore gauge	
Week-11	**Gear Teeth Caliper**
Use of gear teeth caliper for checking the chordal addendum and chordal height of spur gear.	
WeeK-12	**Angle And Taper Measurements**
Angle and taper measurements using Bevel protractor, Sine bar and slip gauges.	
Week-13	**Review**
Spare session for additional repetitions and review.	
Week-14	**Examinations**

Text Books:

1. B. S. Raghu Vamshi, Workshop Technology, Vol - II, , Dhanpat Rai Publishers, New Delhi, India, 9th Edition . 2010.

2. H.M.T. (Hindustan Machine Tools), Production Technology, , Tata McGraw Hill Education (P) Ltd, New Delhi, India, 2nd Edition 1980.
3. Jain R.K., "Engineering Metrology", Khanna Publishers, 21st Edition, 2005
4. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 6th Edition, 2006.

Web References:

1. https://ocw.mit.edu/courses/mechanical-engineering/
2. nptel.ac.in/courses/112106138/
3. www.nptel.ac.in/courses/112106139/
4. nptel.ac.in/courses/112105126/

THEORY OF MACHINES LABORATORY

V Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB20	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic principles of kinematics and the related terminology of machines.
II. Discriminate mobility; enumerate links and joints in the mechanisms.
III. Formulate the concept of analysis of different mechanisms.

LIST OF EXPERIMENTS

Week-1	**GOVERNORS**
1. Governor apparatus	
Week-2	**GYROSCOPE**
2. Gyroscope apparatus	
Week-3	**STATIC FORCE ANALYSIS**
3. Static Force analysis	
Week-4	**DYNAMIC FORCE ANALYSIS**
4. Dynamic Force analysis	
Week-5	**BALANCING**
5. Balancing of reciprocating masses	
Week-6	**BEARINGS**
6. Journal bearing apparatus	
Week-7	**VIBRATIONS**
7. Universal vibration apparatus	
Week-8	**WHIRLING**
8. Whirling of shaft apparatus	
Week-9	**MECHANISMS**
9. Various commonly used mechanisms and its inversions in machines	
Week-10	**DIFFERENTIAL**
10. Demonstration of automobile differential gear box.	
Week-11	**INDEXING**
11. Geneva indexing mechanism.	
Week-12	**EXAMINATIONS**

Text Books:

1. Joseph E. Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 4th Edition, 2010.
2. Thomas Bevan, "Theory of Machines", Pearson, 3rd Edition, 2009.

HEAT TRANSFER

VI Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB21	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic forms of heat transfer like conduction, convection and radiation and build a strong foundation.
II. Understand the governing equations and solution procedures of various forms of heat transfer and solve practical problems using empirical correlations.
III. Understand the construction and working of heat exchangers.
IV. Analyze the concepts of boiling and condensation by the effect of phase change.

MODULE-I	INTRODUCTION TO HEAT TRANSFER	Classes : 09

Modes and mechanisms of heat transfer, basic laws of heat transfer, applications of heat transfer; conduction heat transfer: Fourier rate equation, general three dimensional heat conduction equations in cartesian, cylindrical and spherical coordinates; Simplification and forms of the field equation, steady and unsteady and periodic heat transfer, initial and boundary conditions.

MODULE-II	CONDUCTION HEAT TRANSFER	Classes : 09

One dimensional steady state conduction heat transfer: Homogeneous slabs, hollow cylinders and spheres, overall heat transfer coefficient, electrical analogy, Critical radius of insulation; one dimensional steady state conduction; heat transfer: with variable thermal conductivity, extended surfaces (Fins) long, short and insulated tips; significance of Biot and Fourier numbers, chart solutions of transient conduction systems.

MODULE-III	CONVECTIVE HEAT TRANSFER	Classes: 09

Buckingham Pi Theorem and method, application for developing semi, empirical non-dimensional correlation for convection heat transfer, significance of non-dimension numbers, concepts of continuity, momentum and energy equations; free convection: Development of hydrodynamic and thermal boundary layer along a vertical plate, use of empirical relations for vertical plates and pipes.

Forced convection: external flows: Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer, flat plates and cylinders; Internal flows, Concepts about Hydrodynamic and thermal entry lengths, division of internal flows based on this, use of empirical correlations for horizontal pipe flow and annulus flow.

MODULE-IV	RADIATION HEAT TRANSFER	Classes: 09

Emission characteristics, laws of black-body radiation, Irradiation, total and Monochromatic quantities, laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, heat exchange between two black bodies, concepts of shape factor, emissivity, heat exchange between grey bodies, radiation shields, electrical analogy for radiation networks.

MODULE-V	HEAT EXCHANGERS AND PHASE CHANGE	Classes : 09

Classification of heat exchangers, overall heat transfer Coefficient and fouling factor, Concepts of LMTD and NTU methods, Problems using LMTD and NTU methods. Boiling: Pool boiling-regimes Calculations on Nucleate boiling, Critical heat flux, Film boiling; Condensation: Film wise and drop wise condensation, Nusselt‘s theory of condensation on a vertical plate Film condensation on vertical and horizontal cylinders using empirical correlations.

Text Books:
1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw hill Education (P) Ltd, New Delhi, India. 4th Edition, 2012. 2. R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age, New Delhi, India, 3rd Edition, 2012.
Reference Books:
1. Holman, "Heat Transfer", Tata McGraw-Hill Education, 10th Edition, 2011. 2. P. S. Ghoshdastidar, "Heat Transfer", Oxford University Press, 2nd Edition, 2012. 3. D. S. Kumar, "Heat and Mass Transfer", S.K. Kataria & sons, 9th Edition 2015.
Web References:
1. https://nptel.ac.in/courses/112101097/
E-Text Book:
1. https://b-ok.cc/book/539558/504c7c 2. https://b-ok.cc/book/454490/e8f467

FINITE ELEMENT METHODS

VI Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB22	Core	2	1	-	3	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Select and apply numerical methods to solve engineering problems.
II. Discretize the given continuum and problem formulation using constitutive relations.
III. Apply FEM techniques to solve engineering problems (both vector and scalar) involving various fields for design, analysis and optimization.
IV. Understand to refine the approximate solution by spending more computational effort by using higher order interpolation continuities.

MODULE-I	INTRODUCTION TO FEM	Classes : 09

Introduction to FEM for solving field problems. Basic equations of elasticity, Stress–Strain and strain-displacement relations for 2D-3D elastic problems. Boundary conditions. One Dimensional problem: Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations - Quadratic shape functions.

MODULE-II	ANALYSIS OF TRUSSES AND BEAMS	Classes : 09

Analysis of Trusses Stiffness matrix for plane Truss Elements, stress calculations and problems Analysis of beams: Element stiffness matrix for two nodes, two degrees of freedom per node beam element and simple problems. Problems

MODULE-III	2-D ANALYSIS	Classes: 09

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, stresses;

Finite element modeling of Axisymmetric solids subjected to Axisymmetric loading with triangular elements. Two dimensional four nodded isoparametric elements.

MODULE-IV	STEADY STATE HEAT TRANSFER ANALYSIS	Classes: 09

Steady state Heat Transfer Analysis: 1-D Heat conduction of slab 1D fin elements, 2D heat conduction - analysis of thin plates, Analysis of a uniform shaft subjected to torsion- problems.

MODULE-V	DYNAMIC ANALYSIS	Classes : 09

Dynamic Analysis: Dynamic equations, lumped and consistent mass matrices, eigen Values and Eigen Vectors for a stepped bar, beam; Finite element, formulation to 3D problems in stress analysis, convergence requirements, mesh generation, techniques such as semi automatic AND fully automatic use of software such as ANSYS, NISA, NASTRAN.

Text Books:

1. Tirupathi K. Chandrupatla and Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Pearson, 4th Edition,2011.
2. S. Rao, "The Finite Element Methods in Engineering", Elsevier, 4th Edition 2009.
3. J. N. Reddy, "An Introduction to Finite Element Methods", McGraw Hill, 4th Edition 2009.

Reference Books:

1. O.C. Zienkowitz, "The Finite Element Method in Engineering Science", McGraw Hill. 4th Edition, 2009.
2. Robert Cook, "Concepts and Applications of Finite Element Analysis", Wiley, 4th Edition, 2010.
3. S.Md.Jalaludeen, "Introduction of Finite Element Analysis" Anuradha publications, 4th Edition, 2010.

Web References:

1. https://www.google.co.in/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=fem%20notes
2. https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwj8l5D3hqDQAhUJMI8KHVt1DDsQFggpMAI&url=http%3A%2F%2Ffaculty.ksu.edu.sa%2Frizwanbutt%2Fdocuments%2Ffem_lecture_notes.pdf&usg=AFQjCNEN0EUu9fHFOCd0vbEFwn0_sQxjsw&sig2=vrVKeosgduzEv22yxKaC3A&bvm=bv.138493631,d.c2I
3. https://www.kth.se/social/upload/5261b9c6f276543474835292/main.pdf

E-Text Book:

1. http://engineeringstudymaterial.net/tag/finite-element-analysis-books/
2. http://www.faadooengineers.com/threads/8846-FINITE-ELEMENTS-METHODS-CHANDRAPUTLA-ebook-pdf
3. https://themechangers.blogspot.in/2013/08/ebook-finite-element-method-in.html

DESIGN OF MACHINE ELEMENTS

VI Semester: ME

Course Code	Course Code	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB23	Core	2	1	-	3	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand design and analysis of load transmitting elements and selection of suitable materials and manufacture of these components.
II. Analyze the forces acting on various components and their design.
III. Apply theories of failure and select optimum design size for various machine elements.
IV. Understand the need for joints and their application for different purposes in transmission of static loads.

MODULE-I	INTRODUCTION TO THEORY OF FAILURES	Classes : 09

Introduction: General considerations in the design of engineering materials and their properties, selection, manufacturing consideration in design, tolerances and fits, BIS codes of steels; Theories of failures, factor of safety design for strength and rigidity, preferred number; Fatigue loading : Stress concentration, theoretical stress concentration factor, fatigue stress concentration factor, notch sensitivity, design for fluctuating stresses, endurance limit, estimation of endurance strength, Goodman's life, Soderberg's line.

MODULE-II	DESIGN OF FASTENERS	Classes : 09

Design of fasteners: Riveted joints, methods of failure of riveted joints, strength equations, efficiency of riveted joints, eccentrically loaded riveted joints; Welded Joints: Design of fillet welds, axial loads, circular fillet welds, bending, bolts of uniform strength.

MODULE-III	DESIGN OF KEYS AND JOINTS	Classes : 09

Keys, cotters and knuckle joints: Design of keys, stress in keys, cotter joints, spigot and socket.

Sleeve and cotter, jib and cotter joints, Knuckle joints.

MODULE-IV	DESIGN OF SHAFTS	Classes : 09

Design of Shafts: Design of solid and hollow shafts for strength and rigidity, design of shafts for complex loads, Shaft sizes, BIS code, design of shafts for gear and belt drives; Shaft couplings: Rigid couplings, muff, Split muff and flange couplings, flexible couplings, pin, bush coupling.

MODULE-V	DESIGN OF SPRINGS	Classes : 09

Mechanical Springs: Stresses and deflections of helical springs, extension compression springs, springs for static and fatigue loading, natural frequency of helical springs, energy storage capacity, helical torsion springs, co-axial springs.

Text Books:

1. P. Kannaiah, “Machine Design”, 2nd Edition, Scitech Publications India Pvt. Ltd, New Delhi, 2012.
2. V.B. Bandari, “A Text Book of Design of Machine Elements”, 3rd edition, Tata McGraw hill, 2011.

Reference Books:

1. Richard G. Budynas, J. Keith Nisbett, “Shiegly’s Mechanical Engineering Design”, 10th Edition, 2014.
2. S. Md. Jalaluddine, “Machine Design”, Anuradha Publishers, 1st Edition, 2004.
3. R.L. Norton, “Machine Design-An Integrated approach”, Person Publisher, 2nd Edition, 2006.
4. U.C. Jindal, “Machine Design”, Pearson, 1st Edition, 2010.
5. T. Krishna Rao, “Design of Machine Elements”, IK International Publishing House, 2nd Edition, 2011.
6. R.S. Khurmi, A. K. Gupta, “Machine Design”, S. Chand & Co, New Delhi, 1st Edition, 2014.
7. PSG College, “Design Data: Data Book of Engineers”, 1st Edition, 2012.

Web References:

1. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/New_index1.html
2. http://nptel.ac.in/downloads/112105125/
3. http:/alljntuworld.in/download/design-machine-members-1-dmm-1-materials-notes/
4. http:/scoopworld.in/2015/03/design-of-machine-members-dmm-mech.html

E-Text Book:

1. http://faadooengineers.com/threads/26687-Machine-design-by-shigley-ebook-download-pdf
2. http://freepdfbook.com/design-of-machine-elements-by-v-b-bhandari/
3. http:/only4engineer.com/2014/10/a-textbook-of-machine-design-by.html
4. http:/engineering108.com/Data/.../Handbooks/machine_design_databook.pdf

HEAT TRANSFER LABORATORY

VI Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB24	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The courses should enable the students to:

I. Apply the basic modes of heat transfer and determine constants for different geometrics.
II. Estimate the Performance of parallel and counter flow heat exchangers.
III. Determine Stefan Boltzmann constant-Black body radiation.
IV. Demonstration of application of heat transfer devices-heat pipes.
V. Use of heat transfer data hand book.

List of Experiments	
Week-1	**Composite slab apparatus-Overall heat transfer coefficient**
Calculating the overall heat transfer coefficient for a composite slab	
Week-2	**Heat transfer through lagged pipe**
Determination of thermal conductivity.	
Week-3	**Heat transfer through concentric sphere**
Determination of thermal conductivity.	
Week-4	**Thermal conductivity of given metal rod**
Determination of thermal conductivity.	
Week-5	**Heat transfer in Pin fin apparatus**
Calculate the effectiveness and efficiency of pin fin.	
Week-6	**Experiment on transient heat conduction**
Determination of thermal conductivity in transient mode.	
Week-7	**Heat transfer in forced convection apparatus**
Calculating convective heat transfer coefficient	
Week-8	**Heat transfer in natural convection apparatus**
Calculating convective heat transfer coefficient.	
Week-9	**Parallel an counter flow heat exchangers**
Calculate the effectiveness both experimental and theoretical method	
Week-10	**Emissivity apparatus**
Determination of emissivity of grey and blackbody.	
WeeK-11	**Stefan Botlzman apparatus**
Determination of Stefan Botlzmanconstant and compare its value.	
Week-12	**Critical heat flux apparatus**
Evaluate the critical heat flux value by studying different zones of boiling.	
Week-13	**Study of heat pipe**
Demonstration of heat pipe	

Week-14	Film and drop wise condensation apparatus
Understanding different methods of condensation	
Text Books:	
1. Yunus A. Cengel,"Heat Transfer a Practical Approach", Tata McGraw hill education (P) Ltd, New Delhi, 4th Edition, 2012. 2. R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age, New Delhi, India, 3rd Edition, 2012.	
Web References:	
1. https://en.wikipedia.org/wiki/Heat_Transfer 2. https://en.wikipedia.org/wiki/Heat and Mass Transfer	

FLUID THERMAL MODELING AND SIMULATION LABORATORY

VI Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB25	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The courses should enable the students to:

I. Analyze the fluid flow through pipes.
II. Understand the external fluid flow.
III. Apply simulation techniques to heat flow problems.
IV. Evaluate the thermal stresses of real time problems.
V. Demonstrate the 3D Heat conduction for real time problems.

LIST OF EXPERIMENTS

Week-1	**Internal Pipe Fluid Flow - FEM**
Internal Pipe flow problem Using theoretical FEM	
Week-2	**Internal Pipe Fluid Flow - ANSYS**
Analyzing Flow in a System of Pipes using ANSYS	
Week-3	**Internal Pipe Fluid Flow - MATLAB**
Internal Pipe flow problem using MAT LAB	
Week-4	**External Fluid Flow**
Determination of the drag coefficient of a circular cylinder immersed in a uniform fluid stream using ANSYS/Solid Works Flow Simulation	
Week-5	**Flow Through Ball Valve**
Flow of water through a ball valve assembly using ANSYS/Solid Works Flow Simulation	
Week-6	**Heat Conduction**
Heat Conduction within a Solid using ANSYS	
Week-7	**Temperature Distribution**
Temperature distribution in a fin cooled electronic component using ANSYS	
Week-8	**3D Heat Conduction**
3D Heat Conduction within a Solid-Cell Phone using ANSYS	
Week-9	**Counter Flow Heat Exchanger**
Calculation of the efficiency of the counter flow heat exchanger using ANSYS/Solid Works Flow Simulation	
Week-10	**Conjugate Heat Transfer**
Conjugate heat transfer problem using ANSYS/Solid Works Flow Simulation	
WeeK-11	**3D Thermal Analysis**
3D Thermal Analysis, Finned Pipe using ANSYS	
Week-12	**Thermal Stress Analysis**
Thermal stress analysis of piston	
Week-13	**Review of Fluid Problems**

Week-14	Review of Thermal Problems

Text Books:

1. Janna, W.S., "Design of Fluid Thermal Systems", Cengage Learning, 3rd Edition, 2011
2. Jaluria, Y., "Design and Optimization of Thermal Systems", McGraw-Hill, 2nd Edition, 2007.
3. McDonald, A. G., and Magande, H. L., "Thermo-Fluids Systems Design", John Wiley, 2012.
4. Suryanarayana, N. V. and Arici, Ö., "Design and Simulation of Thermal Systems", McGraw-Hill, 2003.

Web References:

1.https://docs.google.com/document/d/1UaDrm0pnHgd8GnN7dAcXM6EikgqAD7BU-0d52VFZz1w/edit
2. http://www.iare.ac.in

CAD/CAM

VII Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB26	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the concept of implementation automation and PLMS in industries practicing CIM.
II. Recognize the need of computer graphics in seamless manufacturing environment.
III. Summarize the historical development of CAD/CAM software and CNC Technology.
IV. Categorize the creation of group technology of part families and end-end utility.

MODULE-I	FUNDAMENTAL CONCEPTS IN CAD	Classes : 09

Fundamentals of CAD/CAM, Design process, Application of computers for design, Product cycle-CAD/CAM approach, Benefits of CAD, computer peripherals, Graphics terminal CAD software, Definition of system software and application software, Functions of Graphics package, Graphics packages in present industry, CAD database and structure.

MODULE-II	GEOMETRICAL MODELLING AND DRAFTING SYSTEMS	Classes : 09

Wire frame modeling- wire frame entities and their definitions, interpolation andapproximation of curves, concepts of parametric and non-parametric representation, curve fitting techniques, Characteristics of Bezier and B-spline curves, NURBS.

Surface modeling**:** Surface modeling entities,Blending functions,Parameterization of surface patch, sub dividing. Applications of Surface Modeling.

Solid modeling:Solid modeling entities-Boolean operations, sweep representation,Constructive Solid geometry, Boundary representation, Hybrid Modeling. Applications of Solid Modeling

MODULE-III	COMPUTER AIDED MANUFACTURING	Classes: 09

Numerical control: NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of machining center, turning center;

CNC part programming: fundamentals, manual part programming methods, computer aided part programming.

MODULE-IV	GROUP TECHNOLOGY, CAPP AND CAQC	Classes: 09

Group technology: Part family, coding and classification, production flow analysis, advantages and limitations, computer Aided Processes Planning, Retrieval type and generative type, terminology in quality control, the computer in QC, contact inspection methods, noncontact inspection methods-optical, noncontact inspection methods-non-optical, computer aided testing, integration of CAQC with CAD/CAM.

MODULE-V	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	Classes: 09

Flexible Manufacturing System: FMS Equipment, FMS layouts Benefits of FMS, Computer Aided Quality Control: Automated inspection, Contact and non-contact Inspection methods, co-ordinate measuring machines, machine vision, Computer Integrated Manufacturing: CIM systems, Benefits of CIM.

Text Books:

1. William M Neumann and Robert F.Sproull “Principles of Computer Graphics”, McGraw Hill Book Co.

Singapore, 1989.
2. Ibrahim Zeid, “Mastering CAD/CAM”, McGraw Hill, International Edition, 2007.
3. K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, “Computer Aided Design Manufacturing”, PHI, 2008

Reference Books:

1. YoramKoren, “Computer Control of Manufacturing Systems”, McGraw Hill. 1983.
2. Groover, M. P. and Zimmers, E. W., “CAD/CAM: Computer Aided Design & Manufacturing”, Pearson Education India, 2006.

Web References:

1.http:// nptel.ac.in/courses/112102101/
2.http://nptel.ac.in/courses/112102103/
3.https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring-009/lecturenotes/

E-Text Book:

1. https:/elsevier.com/books/curves-and-surfaces-for-cagd/farin/978-1-55860-737-8
2. http:/springer.com/in/book/9789401171229

INSTRUMENTATION AND CONTROL SYSTEMS

VII Semester: ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AMEB27	**Core**	**3**	**-**	**-**	**3**	**30**	**70**	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Visualize the concepts of measurement and dynamic performance characteristics of measuring instruments.
II. Understand the measurement of typical physical quantities like displacement, temperature, pressure, discharge, and speed.
III. Comprehend for machine condition monitoring systems by using seismic instruments.
IV. Develop electronic servo and interfacing systems for analogue to digital measurement.

MODULE-I	**PRINCIPLES OF MEASUREMENT**	**Classes : 09**

Definition, basic principles of measurement, measurement systems, generalized configuration and functional descriptions of measuring instruments examples, dynamic performance characteristics, sources of error, classification and elimination of error.

MODULE-II	**MEASUREMENT OF DISPLACEMENT, TEMPERATURE, PRESSURE**	**Classes : 09**

Measurement of Displacement: Theory and construction of various transducers to measure displacement, peizo electric, inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures; Measurement of temperature: Classification ranges, various principles of measurement, expansion, electrical resistance, thermistor, thermocouple, pyrometers, temperature indicators; Measurement of pressure: MODULEs, classification, different principles used, manometers, piston, bourdon pressure gauges, bellows, diaphragm gauges. low pressure measurement, thermal conductivity gauges, ionization pressure gauges, Mcleod pressure gauge.

MODULE-III	**MEASUREMENT OF LEVEL, FLOW, SPEED, ACCELERATION AND VIBRATION**	**Classes: 09**

Measurement of Level: Direct method, indirect methods, capacitative, ultrasonic, magnetic, cryogenic fuel level indicators, bubler level indicators; Flow measurement: Rotameter, magnetic, ultrasonic, turbine flow meter, hot-wire anemometer, laser doppler anemometer (LDA);

Measurement of Speed**:** Mechanical tachometers, electrical tachometers, stroboscope, noncontact type of tachometer; Measurement of Acceleration and Vibration: Different simple instruments, principles of seismic instruments, vibrometer and accelerometer using this principle.

MODULE-IV	**MEASUREMENT OF STRESS – STRAIN, HUMIDITY, FORCE, TORQUE AND POWER**	**Classes: 09**

Stress Strain Measurements: Various types of stress and strain measurements, electrical strain gauge, gauge factor method of usage of resistance strain gauge for bending compressive and tensile strains, usage for measuring torque, strain gauge rosette; Measurement of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter; Measurement of Force, Torque and Power:Elastic force meters, load cells, torsion meters, dynamometers.

MODULE-V	ELEMENTS OF CONTROL SYSTEMS	Classes : 09
Elements of Control Systems: Introduction, importance, classification, open and closed systems, servomechanisms examples with block diagrams, temperature, speed and position control systems.		
Text Books:		
1. D. S. Kumar, "Measurement Systems: Applications & Design", Anuradha Agencies. 2. C. Nakra, K. K. Choudhary, "Instrumentation, Measurement & Analysis", TMH.		
Reference Books:		
1. Chennakesava R Alavala, "Principles of Industrial Instrumentation and Control Systems", Cengage Learning. 2. S. Bhaskar, "Instrumentation and Control systems", Anuradha Agencies. 3. Holman, "Experimental Methods for Engineers", McGraw Hill. 4. R. K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers. 5. Sirohi, Radhakrishna, "Mechanical Measurements", New Age 6. A. K. Tayal, "Instrumentation & Mech. Measurements", Galgotia Publications.		
Web References:		
1. http://nptel.ac.in/courses/112106138/		
E-Text Book:		
1. http://elearning.vtu.ac.in/newvtuelc/courses/10ME42B.html		

CAD/CAM LABORATORY

VII Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB28	Core	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand code of drawing practice as per BIS conventions for mechanical elements using CAD software's.
II. Prepare the 2-D and 3-D drawings using parametric solid software's as per industry templates.
III. Solve vector and scalar problems for structural and thermal fields using analysis software's.
IV. Summarize computer aided engineering results with real time problems.

LIST OF EXPERIMENTS

Week-1	**INTRODUCTION TO CATIA**
Familiarization and practicing of drawing and modifying commands, template creation, lettering, object snapping and sectioning.	
Week-2	**DRAFTING OF SIMPLE 2D DRAWINGS**
Prepare the 2D drawings using draw and modify commands for simple geometric assemblies, sectional views for part drawing and assemblies.	
Week-3	**SOLID MODELING**
Preparing the 2D and 3D models (wire frame, surface and solid models) by using B-REP, CSG. Introduction of Boolean operations. Generation of 2D, 3D models through protrusion, revolve, sweep.	
Week-4	**CREATING ORTHOGRAPHIC VIEWS FROM SOLID MODELS**
Development of orthographic views for assembly drawings and preparation of bill of materials(IC engine components, Machine tool accessories, Jigs & Fixtures).	
Week-5	**INTRODUCTION TO ANSYS**
Determination of deflection and stresses in bar.	
Week-6	**TRUSSES AND BEAMS**
Determination of deflection and stresses in 2D and 3D trusses and beams.	
Week-7	**SHELL STRUCTURES**
Determination of stresses in 3D and shell structures (one example in each case).	
Week-8	**HARMONIC ANALYSIS**
Estimation of natural frequencies and mode shapes, harmonic responses of 2D beams.	
Week-9	**HEAT TRANSFER ANALYSIS**
Steady state heat transfer analysis of plane and axi-symmetric components.	
Week-10	**INTRODUCTION TO COMPUTER NUMERICAL CONTROL**
Numerical control, functions of a machine tool, concept of numerical control, historical development, definition, advantages of CNC machine tools. Evolution of CNC, advantages of CNC, limitations of CNC, features of CNC, machine control MODULE (MCU) for CNC, classification of CNC machine tools; CNC machining centers: classification, features of CNC machining centers.	
Week-11	**CNC TURNING**
Fundamentals of CNC programming, Part programming and interpolation techniques, Work piece setting methods, tool setting methods	

WeeK-12	CNC MILLING
Fundamentals of CNC programming, Part programming and interpolation techniques, Machining practice on CNC milling.	
Week-13	**CAM SOFTWARE**
Generation of part programming through the CAM software package, CAM-CNC programming and execution on milling and turning machines.	
Reference Books:	
1. K.L. Narayana, P. Kannaiah, "Production Drawing", New Age publishers, 3rd Edition, 2009. 2. GouthamPohit, GouthamGhosh, "Machine Drawing with Auto CAD", Pearson, 1st Edition, 2004. 3. James D. Meadows, "Geometric dimensioning and tolerancing", CRC Press, 1st Edition, 1995.	
Web Reference:	
1.https://mech.iitm.ac.in/Production%20Drawing.pdf	

INSTRUMENTATION CONTROL SYSTEM AND PDP LABORATORY

VII Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB29	Core	-	-	3	1.5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Configure and calibrate for physical quantities like pressure, temperature, speed, displacement.
II. Experiment for condition monitoring of machine tools and IC engines by using seismic pickup (vibrometer).
III. Study the deflection by using strain gauge on cantilever beam.
IV. Draw the characteristic calibration curves.

LIST OF EXPERIMENTS

Week-1	**CALIBRATION OF CAPACTIVE TRANSDUCER**
Calibration of capacitive transducer for angular measurement.	
Week-2	**CALIBRATION OF LVDT**
Study and calibration of LVDT transducer for displacement measurement.	
Week-3	**STUDY OF RESISTANCE TEMPERATURE DETECTOR**
Calibration of thermistor, thermocouple, resistance temperature detector	
Week-4	**CALIBRATION OF PRESSURE GUAGE AND VACCUM**
Calibration of Pressure gauges ,Study and calibration of Mcleod gauge for low pressure.	
Week-5	**CALIBRATION OF STRAIN GUAGE**
Calibration of strain gauge for temperature measurement.	
Week-6	**CALIBRATION OF PHOTO AND MAGNETIC SPEED PICKUP**
Study and calibration of photo and magnetic speed pickups for the measurement of speed.	
Week-7	**CALIBRATION OF ROTAMETER**
Study and calibration of rotameter for flow measurement.	
WeeK-8	**CALIBRATION OF VIBROMETER**
Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.	

Week-9	CONVENTIONAL REPRESENTATION OF MATERIALS
Conventional representation of parts screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits, methods of indicating notes on drawings.	
Week-10	**LIMTS FITS AND TOLERANCES AND FORM AND POSITIONAL TOLERANCES**
Limits, Fits and Tolerances: Types of fits, exercises involving selection, interpretation of fits and estimation of limits from tables; Introduction and indication of form and position tolerances on drawings;	
Week-11	**SURFACE ROUHNESS AND ITS INTRODUCTION, DETAILED AND PART DRAWINGS**
Definition, types of surface roughness indication surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components.	
Week - 12	**DETAILED AND PART DRAWINGS**
Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors, Part drawings using computer aided drafting by CAD software.	

Reference Books:

1. D. S. Kumar, "Measurement Systems: Applications & Design", Anuradha Agencies, 1st Edition, 2013.
2. C. Nakra, K. K. Choudhary, "Instrumentation, Measurement & Analysis", Tata McGraw-Hill, 1st Edition, 2013.
3. K.L. Narayana, P. Kannaiah, "Production Drawing", New Age publishers, 3rd Edition, 2009.
4. GouthamPohit, Goutham Ghosh, "Machine Drawing with Auto CAD", Pearson, 1st Edition, 2004.
5. James D. Meadows, "Geometric Dimensioning and Tolerancing", CRC Press, 1st Edition, 1995

Web References:

1. www.iare.ac.in

PROJECT WORK - I

VII Semester: Common for all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB58	Core	0	0	10	5	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 150				Total Classes: 150		

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis / Modelling / Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

PROJECT WORK - II

VIII Semester: Common for all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB59	Core	0	0	12	6	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 180				Total Classes: 180		

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EEP1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis / Modelling / Simulation / Design / Problem Solving / Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

TURBOMACHINES

PE - I: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB30	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand energy transfer and losses in centrifugal compressors, axial fans and steam turbines
II. Classify turbo machines based on impulsive and reaction forces.
III. Estimate energy transfer through a turbo machines equipment.

MODULE -I	INTRODUCTION TO TURBOMACHINES	Classes : 09

Introduction to Turbo machines. Classification of Turbo machines. Second Law of Thermo dynamics - turbine/compressor work, Nozzle/diffuser work. Fluid equations - continuity, Euler's, Bernoulli's equation and its applications. Expansion and compression processes, Reheat Factor, Preheat Factor.

MODULE -II	PRINCIPLES OF TURBOMACHINERY	Classes : 09

Euler's Equation of Energy Transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor. Suction. pressure and net positive suction head. Phenomena of cavitation in pumps. Concept of specific speed, Shape number. Axial, Radial and Mixed Flow Machines. Similarity laws.

MODULE -III	FLOW THROUGH AXIAL FLOW FANS	Classes: 09

Flow through Axial flow fans. Principles of Axial fan and propeller. Application of fans forair circulation and ventilation. Stage pressure rise and work done.

Slip stream and Blade Element theory for propellers. Performance and characteristics of Axial fans.

MODULE -IV	FLOW THROUGH CENTRIFUGAL COMPRESSORS	Classes: 09

Flow through Centrifugal compressors. Stage velocity triangles, specific work. Forward, radial and backward swept vanes. Enthalpy entropy diagram, degree of reaction, slip factor, efficiency. Vane less and vaned diffuser systems, volute as spiral casing. Surge and stall in compressors.

MODULE -V	AXIAL TURBINES	Classes : 09

Axial turbine stages, stage velocity triangles, work, efficiency, blade loading, flow coefficient. Singlestage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, Radial equilibrium and Actuator disc approach for design of turbine blades. Partial admission problems in turbines. Losses in turbo machines.

Text Books:

1. S.M. Yahya, “Turbines, Compressors and Fans”, Tata Mcgraw Hill, 4th Edition, 2017.
2. Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitech Publications, Chennai, 1st Edition, 2008.

Reference Books:

1. Sheppard, “Principles of Turbomachinery”, Collier Macmillan, 1st Edition, 2013.
2. R. K. Turton, “Principles of Turbomachinery”, Springer Publishers, India, 2nd Edition, 2013.

Web References:

1. https://onlinecourses.nptel.ac.in/noc11_mg14

E-Text Book:

1.http://www.mescenter.ru/images/abook_file/Turbo machinery.pdf
2.https://www.researchgate.net/publication/318654507_Turbomachinery_Notes

REFRIGERATION AND AIR-CONDITIONING

PE - I: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB31	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Familiarize with the terminology associated with refrigeration systems and air conditioning.
II. Understand basic refrigeration processes.
III. Understand the basics of psychrometry and practice of applied psychrometrics.
IV. Acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.

MODULE -I	**INTRODUCTION TO REFRIGERATION**	**Classes: 8**

Basic concepts: MODULE of refrigeration and COP, refrigerators, heat pump, Carnot refrigerator, applications of refrigerators, ideal cycle, deviations of practical (actual cycle) from ideal cycle, construction and use of P-H chart and problems. Classification of refrigeration systems.

MODULE -II	**VAPOURCOMPRESSION AND VAPOUR ABSORPTION REFRIGERATION SYSTEMS**	**Classes: 9**

Advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics -Ozone depletion and global warming issues. Advanced absorption refrigeration systems and their components.

MODULE -III	**REFRIGERATION EQUIPMENT**	**Classes: 10**

System components: Compressors, Condensers, expansion devices and Evaporators;

Performance matching of Compressors, Condensers, expansion devices and Evaporators of refrigeration systems.

MODULE -IV	**INTRODUCTION TO AIR CONDITIONING**	**Classes: 10**

Review Psychometric Properties and Processes, sensible and latent heat loads, characterization, need for ventilation, consideration of Infiltration, load concepts of RSHF, ASHF, ESHF and ADP; concept of human comfort and effective temperature, comfort air conditioning and cooling load calculations, industrial air conditioning and requirements, Applications of AC systems - Concept of enthalpy potential.

MODULE -V	**AIRCONDITIONINGEQUIPMENT**	**Classes: 8**

Classification of equipment, Cooling Towers, Filters, Grills and Registers, Air Washers, Evaporative condensers, Cooling and dehumidifying coils.

Text Books:

1. Gosney, W.B, "Principles of Refrigeration", Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., "Refrigeration and Air conditioning", Tata McGraw Hill, 1986.
3. Arora, C.P., "Refrigeration and Air conditioning", Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., "Thermal Environmental Engineering", 3rd Edition, Prentice Hall, 1998.

Reference Books:

1. C.P. Arora, "Refrigeration and Air Conditioning" TMH, 17th Edition, 2006
2. Ananthanarayanan, "Basic Refrigeration and Air Conditioning", TMH, 2015
3. R.K.Rajput "A text of Refrigeration and Air Conditioning" S. K. Kataria& Sons, 3rd Edition, 2009
4. P. L. Ballaney, "Refrigeration and Air Conditioning" Khanna Publishers, 16th Edition, 2015.

Web References:

1. http://engineeringstudymaterial.net/tag/air-conditioning-and-refrigeration-books/
2. http://books.mcgraw-hill.com/engineering/PDFs/Miller.pdf
3. http://royalmechanicalbuzz.blogspot.in/2015/12/refrigeration-and-air-conditioning-by-cp-arora-pdf-download.html
4. https://en.wikipedia.org/wiki/Air_conditioning

E-Text Books:

1. http://www.mechanicalgeek.com/refrigeration-and-air-conditioning-by-rs-khurmi-pdf/
2. engineeringstudymaterial.net/tag/air-conditioning-and-refrigeration-books/

POWER PLANT ENGINEERING

PE - I: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB32	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the sources of energy for power generations.
II. Visualize the intricacies of establishing combustion engine power plants
III. Apply the knowledge of hydrology, non-conventional energy and nuclear power.
IV. Recognize the economics and environmental aspects.

MODULE -I	INTRODUCTION TO THE SOURCES OF ENERGY	Classes : 09

Introduction to the Sources of Energy: Resources and development of power in india; Steam power plant: Plant layout, Working of different circuits; Fuel and handling equipment, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems; Combustion process: Properties of coal overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and drought system, cyclone furnace, design and construction, dust collectors, cooling towers and heat rejection, corrosion and feed water treatment.

MODULE -II	INTERNAL COMBUSTION ENGINE PLANT, GAS TURBINE PLANT	Classes : 09

Internal combustion engine plant**:** Diesel power plant, introduction, internal combustion engines, types, construction, plant layout with auxiliaries, fuel supply system, air starting equipment, lubrication and cooling system, super charging**;** Gas turbine plant: Introduction, classification, construction, layout with auxiliaries, principles of working of closed and open cycle gas turbines, combined cycle power plants and comparison; Direct energy conversion: solar energy, fuel cells, thermo electric and thermo ionic, MHD generation.

MODULE -III	HYDRO ELECTRIC POWER PLANT, HYDRO PROJECT AND PLANT	Classes:09

Hydro electric power plant: Water power, hydro logical cycle, flow measurement, drainage area characteristics, hydro graphs, storage and Poundage , classification of dams and spill ways;

Hydro Projects And Plant**:** Classification typical layouts, plant auxiliaries, plant operation pumped storage plants; Power from Non-Conventional Sources: Utilization of slk-collectors; Principle of working, wind Energy, types, HAWT, VAWT tidal energy.

MODULE -IV	NUCLEAR POWER STATION	Classes: 09

Nuclear Power Station**:** Nuclear fuel, breeding and fertile materials, nuclear reactor, reactor operation, types of reactors, pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding radioactive waste disposal.

MODULE -V	POWER PLANT ECONOMICS AND ENVIRONMENT CONSIDERATIONS	Classes : 09

Power plant economics and environmental considerations**:** Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor, related exercises, effluents from power plants and Impact on environment, pollutants and pollution standards, methods of Pollution control.

Text Books:

1. Dr. P.C. Sharma, "A Text Book of Power Plant Engineering", S.K.Kataria, 1st Edition, 2016.
2. I Arora, S. Domkundwar, "A Course in Power Plant Engineering:", DhanapatRai, 1st Edition,2014

Reference Books:

1. I. Rajput, "A Text Book of Power Plant Engineering", Laxmi Publications, 5th Edition, 2014.
2. P. K. Nag, "Power Plant Engineering", Tata McGraw-Hill, 4th Edition, 2014.
3. G. D. Rai, "An Introduction to Power Plant Technology", Khanna Publishers, 1st Edition, 2013.
4. C. Elanchezhian, L. Sravan Kumar, B. Vijay Ramnath, "Power plant Engineering, I. K. International Publishers, 1st Edition, 2013.

Web References:

1. http://www.slideshare.net/mo7amedaboubakr/solar-collector-45031961
2. https://alison.com/courses/Renewable-Energy-Sources

E-Text Book:

1. http://www.cs.kumamoto-u.ac.jp/epslab/APSF/Lecture%20Notes/lecture-1.pdf
2. http://www.vssut.ac.in/lecture_notes/lecture1428910296.pdf

AUTOMOBILE ENGINEERING

PE - I: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB33	Elective	3	-	-	3	30	70	100
Contact Classes:45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the function of various parts of automobile, features of fuel supply systems for S.I and C.I engines.
II. Distinguish the features of various types of cooling, ignition and electrical systems.
III. Identify the merits and demerits of the various transmission and suspension systems.
IV. Recognize the working of various braking and steering systems.
V. Summarize the ways and means of reducing the emissions from automobiles.

MODULE –I	INTRODUCTION	Classes: 09

Introduction to automobile engineering, chassis and body components, types of automobile engines, engine lubrication, engine servicing; Fuel system; spark ignition engine fuel supply systems, mechanical and electrical fuel pump, filters, carburetor types, air filters, petrol injection, multipoint fuel injection(MPFI) and gasoline direct injection systems; Compression ignition engines fuel supply systems, requirement of diesel injection systems, types of injection systems, direct injection systems, indirect injection (IDI) systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps, CRDI and turbocharged direct injection (TDI) systems.

MODULE -II	COOLING SYSTEM	Classes: 09

cooling requirements, air cooling, water cooling, thermo, water and forced circulation system, radiators types cooling fan, water pump, thermostat, pressure sealed cooling, antifreeze solutions, intelligent cooling; Ignition system**:** Function of an ignition system, battery ignition system constructional features of storage, battery, contact breaker points, condenser and spark plug, magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers, spark advance and retard mechanism; Electrical system**:** Charging circuit, generator, current-voltage regulator, starting system, bendix drive mechanism solenoid switch, lighting systems, automatic high beam control, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator.

MODULE -III	TRANSMISSION AND SUSPENSIONS SYSTEMS	Classes: 09

Transmission system: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid flywheel, gear box, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, auto transmission, continuous variable transmission over drive, torque converter, propeller shaft, Hotch-Kiss drive, torque tube drive, universal joint, differential, rear axles, types, wheels and tyres.

Suspension system: Objects of suspension systems, rigid axle suspension system, torsion bar, shock absorber, independent suspension system, air suspension system, Daimler-benz vehicle suspension.

MODULE -IV	BRAKING AND STEERING SYSTEMS	Classes: 09

Brakingsystem:Mechanicalbrakesystem,Hydraulicbrakessystem,Mastercylinder,wheelcylindertandem master cylinder; Requirement of brake fluid, Pneumatic and vacuum brake, anti skid braking (ABS), regenerative braking; Steering system: Steering geometry, camber, castor, king pin, rake, combined angle, toe-in, toe-out, center point steering, types of steering mechanism, power steering,Hydraulic, electronics, Ackerman steering mechanism, Davis steering mechanism, steering gears types, steering linkages, special steering columns.

MODULE -V	EMISSIONS FROM AUTOMOBILES	Classes: 09

Emissions from Automobiles, Pollution standards national and international, various pollution control techniques: Multipoint fuel injection for spark ignition engines, common rail diesel injection, variable valve timing, closed crank cake ventilisation, p[c valus, EGR value, catalytic converters, catalyst window, lambda probe, energy alternatives, solar, photo-voltaic, hydrogen, biomass, alcohols, LPG, CNG, liquid Fuels and gaseous fuels, hydrogen as a fuel for internal combustion engines, their merits and demerits, standard vehicle maintenance practice.

Text Books:

1. Willam H Crouse, Donald L. Anglin, "Automobile Engineering", McGraw-Hill, 10th Edition, 2006.
2. Manzoor, Nawazish Mehdi, Yosuf Ali, "A Text Book Automobile Engineering", Frontline Publications, 1st Edition, 2008.
3. Dr. Kirpal Singh, "Automobile Engineering", Standard Publishers", 2nd Edition, 2013.

Reference Books:

1. R.K. Rajput, "A Text Book of Automobile Engineering", Laxmi Publications, 1st Edition, 2010.
2. S. Srinivasan, "Automotive Engines", McGraw-Hill, 2nd Edition, 2003.
3. Khalil U Siddiqui, "A Text Book of Automobile Engineering", New Age International, 1stEdition, 2009.

Web References:

1.http://books.google.co.in/books/about/A_Text_Book_of_Automobile_Engineering.html?id=nBVefxD_0a

GAS DYNAMICS

PE -II: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB34	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the features of compressible isentropic flow.
II. Understand the concept of shock with in depth knowledge in normal and oblique shocks.
III. Knowledge of various types of flows and their applications.
IV. Understand the concepts of high temperature gas dynamics and their applications in hypersonic flows.

MODULE -I	COMPRESSIBLE FLOW	Classes : 09

Concept of compressible flow, speed of sound, temperature rise, Mach angle, thermodynamics of fluid flow, energy equation, entropy equation, thermal properties, the perfect gas, wave propagation, subsonic and supersonic flows

MODULE -II	SHOCKWAVE PROPAGATION	Classes : 09

Fundamental equations, stream tube area-velocity relations, De Laval nozzle, supersonic flow generation, diffusers, equation of motion for a normal shockwave, Hugoniot equation, reflected shockwave, shock tube, oblique shock relations, shock polar, Prandtl-Meyer expansions, reflection and intersection of shockwaves, Mach reflection, shock expansion theory.

MODULE -III	1D, 2D COMPRESSIBLE FLOWS	Classes: 09

Crocco's theorem, linearization of potential equation, boundary conditions, pressure coefficient, Prandtl-Glauert rule for subsonic, supersonic flows, Von Karman rule for transonic flows,

Hypersonic similarity, critical Mach number, general linear solutions for supersonic flows, flow along a wave shaped wall, two dimensional compressible flows.

MODULE -IV	FRICTION FLOW WITH HEAT TRANSFER	Classes: 09

Prandtl-Meyer expansion fan, thermodynamics considerations, reflections, flow in a constant area duct with friction, flow with heating and cooling in ducts, the concepts of characteristics, compatibility relations, theorems for two dimensional flow, design of supersonic nozzle

MODULE -V	HIGH TEMPERATURE GAS DYNAMICS	Classes : 09

Pressure, temperature, velocity and density measurement, compressible flow visualization, high speed wind tunnels, Knudsen number, slip flow, importance of high temperature flows, nature of high temperature flows.

Text Books:

1. E. Rathakrishnan, "Gas Dynamics", PHI Learning Pvt Ltd, 6th Edition, 2017.
2. S.M. Yahya, "Fundamental of Compressible Flow", New Age Publication, 3rd Edition, 2006.

Reference Books:
1. Frank H Shu, “Physics of Astrophysics II: Gas Dynamics”, 1st Edition, 1992. 2. J. D. Anderson, “Hypersonic and High Temperature Gas Dynamics”, AIAA Edu Series, 2nd Edition, 1988
Web References:
1. https://nptel.ac.in/courses/112103021/
E-Text Book:
1.https://b-ok.cc/book/449653/7ec8b0 2.https://b-ok.cc/book/449803/d9554e

COMPUTATIONAL FLUID DYNAMICS

PE -II: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB35	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the knowledge and essential Numerical background of Computational Fluid dynamics
II. Apply and solve the fundamental and applied fluid dynamics governing equations including heat transfer.
III. Learn to Implement numerical schemes and program the same for simple problems of fluid flow and heat transfer
IV. Develop the computational problem solving skills using commercial software.

MODULE -I	INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS	Classes : 09

Introduction: History and Philosophy of computational fluid dynamics, CFD as a design and research tool, Applications of CFD in engineering, Numerical Methods Programming fundamentals, simple coding techniques for numerical problems.

MODULE -II	GOVERNING EQUATIONS OF FLUID FLOW AND HEAT TRANSFER	Classes : 09

Governing Equations of Fluid Dynamics: Models of the flow, The substantial derivative, Physical meaning of the divergence of velocity, The continuity equation, The momentum equation, The energy equation, Navier-Stokes equations for viscous flow, Euler equations for inviscid flow, Physical boundary conditions.

MODULE -III	PARTIAL DIFFERENTIAL EQUATIONS AND ITS NUMERICAL BEHAVIOUR	Classes: 09

The Forms of the governing equations suited for CFD, Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching problems.

Mathematical Behavior of Partial Differential Equations: Classification of quasi-linear partial differential equations, Methods of determining the classification, General behavior of Hyperbolic, Parabolic and Elliptic equations.

MODULE -IV	DISCRETIZATION AND NUMERICAL METHODS OF PDEs	Classes: 09

Basic aspects of Discretization: Introduction to finite differences, Finite difference equations using Taylor series expansion and polynomials, Explicit and implicit approaches, uniform and unequally spaced grid points. Grids With Appropriate Transformation: General transformation of the equations, Metrics and Jacobians. Stability Analysis: Discrete Perturbation Stability analysis, von Neumann Stability analysis, Error analysis, Modified equations, Artificial dissipation and dispersion; Grid Generation: Algebraic Grid Generation, Elliptic Grid Generation, Hyperbolic Grid Generation, Parabolic Grid Generation.

MODULE -V	SOLUTION METHODS AND APPLICATIONS OF NUMERICS TO SIMPLE PROBLEMS	Classes : 09

Parabolic Partial Differential Equations: Finite difference formulations, Explicit methods – FTCS, Richardson. Implicit methods – Lasonen and Crank-Nicolson; Finite Volume Method For Structured and Unstructured Grids: Advantages, Cell Centered and Nodal point Approaches, Numerical Solution of Quasi 1D Flow equation and 2D heat conduction equation.

Text Books:
1. Anderson, J.D.(Jr), “Computational Fluid Dynamics”, McGraw-Hill Book Company, 1st Edition, 1995. 2. Hoffman, K.A., and Chiang, S.T., “Computational Fluid Dynamics”, Vol. I, II and III, Engineering Education System, Kansas, USA, 2000. 3. Anderson, D.A., Tannehill, J.C., and Pletcher, R.H., “Computational Fluid Mechanics and Heat Transfer”, McGraw Hill Book Company, 2002.
Reference Books:
1. Chung, T.J., “Computational Fluid Dynamics”, Cambridge University Press, 2003. 2. Muralidhar K and Sundararajan., “Computational Fluid Flow & Heat Transfer”, 2009.
Web References:
1. https://nptel.ac.in/courses/112105045/
E-Text Book:

GAS TURBINES AND JET PROPULSION TECHNOLOGY

PE - II: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB36	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the fundamentals of gas turbine theory and applications.
II. Ability to calculate the thermal efficiency thrust power and overall efficiency.
III. Visualize the geometry of inlets, combustors and nozzles in industrial applications.
IV. Analyze the axial flow compressor and turbines, velocity diagram and application in industrial field.

MODULE -I	FUNDAMENTALS OF GAS TURBINE THEORY	Classes : 09

Thermodynamic Cycles, open closed and semi-closed, parameters of performances, cycle modifications for improvement of performance; Jet Propulsion: Historical sketch-reaction principle, essential features of propulsion devices, thermal engines, classification of energy flow thrust, thrust power and propulsion efficiency, need for thermal jet engines and applications.

MODULE -II	TURBOPROPULSION AND TURBOJET	Classes : 09

Thermo dynamic cycles, plant layout, essential components, principles of operation, performance evaluation, thrust augmentation and thrust reversal, contrasting with piston engine propeller plant, power and efficiency calculations, turbojet, turbofan, and turboprop engines, ramjet engine, pulse-jet engine, turbo-jet engine, turboprop engine, thrust equation, ram efficiency, thermal efficiency of turbo-jet engine, propulsion efficiency, overall efficiency of a propulsive system.

MODULE -III	INLETS, COMBUSTORS, AND NOZZLES	Classes: 09

Introduction, subsonic inlets, supersonic inlets, gas turbine combustors, afterburners and ramjet. Combustors, supersonic combustion, exhaust nozzle, numerical problems.

MODULE -IV	AXIAL FLOW COMPRESSOR	Classes: 09

Euler's turbo-machinery equations, axial flow compressor analysis, cascade action, flow field, velocity diagrams, flow annulus area stage parameters, degree of reaction, cascade airfoil nomenclature and loss coefficient, diffusion factor, stage loading and flow coefficient, stage pressure ratio, Blade Mach no., repeating-stage, repeating-row, meanline design, flow path dimensions, number of blades per stage, radial variation, design process, performance.

MODULE -V	AXIAL FLOW TURBINE	Classes : 09

Axial flow turbine : Introduction to turbine analysis, mean-radius stage calculations, stage parameters, stage loading and flow coefficients, degree of reaction, stage temperature ratio and pressure ratio, blade spacing, radial variation, velocity ratio, axial flow turbine stage flow path dimension, stage analysis, multistage design steps of design, single stage and two-stage, turbine performance, blade cooling.

Text Books:

1. Bertin, J.J, "Aerodynamics for Engineers", Pearson Education, 4th Edition, 2012.
2. Anderson, Jr, "Fundamentals of Aerodynamics‖, J.D., McGraw-Hill, 3rd Edition, 2013.

3. Kuethe, A.M, Chow, C., "Foundations of Aerodynamics", Wiley, 5th Edition, 2013. 4. Karamcheti, Krishnamurthy, "Ideal fluid Aerodynamics", Kreiger Publications, 2nd Edition, 2013.
Reference Books:
1. Kuchemann, D., "The Aerodynamic Design of Aircraft", Pergamon Press, 1st Edition, 2013. 2. Shevell, R.S., Fundamentals of Flight, Pearson Education", 2nd Edition, 2013. 3. McCormick, B.W., "Aerodynamics, Aeronautics & Flight Mechanics", John Wiley, 2nd Edition, 2013
Web References:
1. https://nptel.ac.in/courses/112105045/
E-Text Book:

BOUNDARY LAYER THEORY

PE - II: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB37	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the various viscous flow equations.
II. Discuss the laminar and turbulent boundary layer theory.
III. Visualize the approximate solution to boundary layer equations.
IV. Familiarize the thermal boundary layer.

MODULE -I	**VISCOUS FLOW EQUATIONS**	**Classes : 09**

Navier-Stokes Equations, Creeping motion, Couette flow, Poiseuille flow through ducts, Ekman drift.

MODULE -II	**LAMINAR BOUNDARY LAYER**	**Classes : 09**

Development of boundary layer, estimation of boundary layer thickness, displacement thickness, momentum and energy thicknesses for two dimensional flow, two dimensional boundary layer equations, similarity solutions, Blasius solution.

MODULE -III	**TURBULENT BOUNDARY LAYER**	**Classes: 09**

Physical and mathematical description of turbulence, two-dimensional turbulent boundary layer equations;

Velocity profiles, inner, outer and overlap layers, transition from laminar to turbulent boundary layers, turbulent boundary layer on a flat plate, mixing length hypothesis

MODULE -IV	**APPROXIMATE SOLUTION TO BOUNDARY LAYER EQUATIONS**	**Classes: 09**

Approximate integral methods, digital computer solutions, Von Karman, Polhausen method.

MODULE -V	**THERMAL BOUNDARY LAYER**	**Classes : 09**

Introduction to thermal boundary layer, heat transfer in boundary layer, convective heat transfer, importance of non-dimensional numbers, Prandtl number, Nusselt number, Lewis number.

Text Books:

1. H. Schlichting, “Boundary Layer Theory”, McGraw-Hill, New York, 1979.
2. Frank White, “Viscous Fluid flow”, McGraw Hill, 1998.

Reference Books:

1. J. Reynolds, “Turbulent flows in Engineering”, John Wiley & Sons, 1980.
2. Ronald L., Panton, “Incompressible fluid flow”, John Wiley & Sons, 1984.
3. Tuncer Cebeci and Peter Bradshaw, “Momentum transfer in boundary layers”, Hemisphere Publishing Corporation, 1977.

Web References:
1. https://nptel.ac.in/courses/112105045/
E-Text Book:
1. https://link.springer.com/book/10.1007/978-3-662-52919-5

TRIBOLOGY

PE - III: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB38	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Basic knowledge about different methods of surface modification and surface treatment
II. In-depth understanding of how different material structures affects the surface properties
III. Knowledge of different physical laws and chemical reactions which affects the physical and mechanical properties of material surfaces
IV. In-depth understanding of tribological processes and knowledge of other aspects of the surface performance
V. Basic knowledge of different analytical techniques for surface analysis and characterization of their performance.

MODULE -I	SURFACE INTERACTION AND FRICTION	Classes : 09

Topography of Surfaces, surface features, properties and measurement, surface interaction, adhesive theory of sliding friction, rolling friction, friction properties of metallic and non-metallic materials, friction in extreme conditions, thermal considerations in sliding contact.

MODULE -II	WEAR AND SURFACE TREATMENT	Classes : 09

Types of wear, mechanism of various types of wear, laws of wear, theoretical wear models, wear of metals and non metals, surface treatments, surface modifications, surface coatings methods, surface topography measurements, laser methods, instrumentation, international standards in friction and wear measurements.

MODULE -III	LUBRICANTS AND LUBRICATION REGIMES	Classes: 09

Lubricants and their physical properties, viscosity and other properties of oils, additives and selection of lubricants, lubricants standards ISO, SAE, AGMA, BIS standards.

Lubrication regimes, solid lubrication, dry and marginally lubricated contacts, boundary lubrication hydrodynamic lubrication, elasto and plasto hydrodynamic, magneto hydrodynamic lubrication, hydro static lubrication, gas lubrication.

MODULE -IV	CORROSION	Classes: 09

Introduction, principle of corrosion , classification of corrosion, types of corrosion, factors influencing corrosion, testing of corrosion, in-service monitoring, simulated service, laboratory testing, evaluation of corrosion, prevention of corrosion, material selection, alteration of environment, design, cathodic and anodic protection, corrosion inhibitors.

MODULE -V	ENGINEERING MATERIALS	Classes : 09

Introduction, advanced alloys, super alloys, titanium alloys, magnesium alloys, aluminium alloys, and nickel based alloys, ceramics, polymers, biomaterials, applications, bio-tribology and nano-tribology.

Text Books:
1. G.W. Stachowiak, A.W. Batchelor, “Engineering Tribology”, Butterworth-Heinemann, UK, 2005. 2. Rabinowicz. E, “Friction and Wear of Materials”, John Willey &Sons, UK, 1995.
Reference Books:
1. J. S. K. Basu, S. N.Sengupta, B. B. Ahuja ,“Fundamentals of Tribology”, Prentice–Hall of India Pvt Ltd, New Delhi, 2005. 2. Williams J.A. “Engineering Tribology”, Oxford University Press, 1994.
Web References:
1.http://www.tribology-abc.com/ 2. https://ocw.mit.edu/courses/mechanical-engineering/2-800-tribology-fall-2004/index.htm
E-Text Book:
1. http://www.asminternational.org/documents/10192/3454476/ACFAA73.pdf/cdfc952b-62aa-477d-9bb2-3abb823a652d 2. http://as.wiley.com/WileyCDA/WileyTitle/productCd-047063927X.html

ADDITIVE MANUFACTURING PROCESSES

PE -III: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB39	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Identify suitable time compression techniques for rapid product development.
II. Interpret the concept, process details with respect to different processes.
III. Describe the significance of each process parameter of various prototyping systems.
IV. Interpret the advantages, limitations and applications of various prototyping Systems.
V. Identify the various tooling required for rapid prototyping systems and reverse engineering & augmented reality.

MODULE -I	INTRODUCTION TO RAPID PRORTOTYPING	Classes : 09

Introduction: Prototype Fundamentals, Types and Roles of Prototype, Fundamentals of Rapid Prototyping, Phases of Development Leading to Rapid Prototyping, Advantages of Rapid Prototyping and Classifications of Rapid Prototyping System, Generic RP process. Rapid Product Development: An Overview virtual prototyping and testing technology, Physical Prototyping and Rapid Manufacturing technologies and Synergic Integration Technologies.

MODULE -II	LIQUID-BASED RAPID PROTOTYPING SYSTEMS	Classes : 09

Liquid-Based Rapid Prototyping Systems: Principle, Process parameter, Process details, Advantages, Disadvantages and Applications of Stereolithography Apparatus (SLA), Solid Ground Curing (SGC), Solid Object Ultraviolet-Laser Printer (SOUP), Rapid Freeze Prototyping and Microfabrication

MODULE -III	SOLID-BASED RAPID PROTOTYPING SYSTEMS	Classes: 09

Solid-Based Rapid Prototyping Systems: Principle, Process parameter, Process details, Advantages, Disadvantages and Applications of Laminated Object Manufacturing (LOM);

Fused Deposition Modeling (FDM), Paper Lamination Technology (PLT), Multi-Jet Modeling System (MJM) and CAM-LEM.

MODULE -IV	POWDER-BASED RAPID PROTOTYPING SYSTEMS	Classes: 09

Powder-Based Rapid Prototyping Systems: Principle, Process parameter, Process details, Advantages, Disadvantages and Applications of Selective Laser Sintering (SLS), Laser Engineered Net Shaping (LENS), Multiphase Jet Solidification (MJS), Electron Beam Melting (EBM) and Three-Dimensional Printing (3DP) – Hands on Session.

MODULE -V	RAPID TOOLING	Classes : 09

Rapid Tooling: Introduction to rapid tooling (RT), Indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, and 3D Keltool process, Direct rapid tooling methods: DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

Text Books:

1. Chua C K, Leong K F, Chu S L, "Rapid Prototyping: Principles and Applications in Manufacturing", World Scientific, 3rd Edition, 2008.
2. Liou W L, Liou F W, "Rapid Prototyping and Engineering applications: A Tool Box for Prototype Development", CRC Press, 1st Edition, 2007.

Reference Books:

1. Gibson D W Rosen, Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 1st Edition, 2014.
2. Kamrani A K, Nasr E A, "Rapid Prototyping: Theory and practice", Springer, 1st Edition, 2006.
3. Rafiq I. Noorani, "Rapid Prototyping: Principles and Applications", John Wiley & Sons, 1st Edition, 2005.

Web References:

1.https://nptel.ac.in/courses/112102103/16
2.https://nptel.ac.in/courses/112107078/37

E-Text Book:

1.https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf

COMPOSITE MATERIALS

PE - III: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB40	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the role of matrix, fiber and filler in the design of polymer/metal matrix composites.
II. Elucidate linear elastic properties by rule of mixture, fabrication of composites, mechanical and tribological properties, and fracture behavior of composite materials.
III. Assortment of suitable Fabrication method for different Composite Materials
IV. Categorize alternatives involved in the design of composites.

MODULE-I	**INTRODUCTION TO COMPOSITE MATERIALS**	**Classes : 09**

Introduction to composite materials: Definition, classification, types of matrices material and reinforcements, characteristics and selection, fiber composites, laminated composites, particulate composite, pre-pegs, and sandwich construction.

MODULE-II	**MICRO MECHANICAL ANALYSIS OF LAMINA AND BIAXIAL STRENGTH THEORIES**	**Classes : 09**

Micro mechanical analysis of a lamina: Introduction, Evaluation of the four elastic moduli, rule of mixture, numerical problems; Biaxial strength theories: Maximum stress theory, maximum strain theory, Tsa Hill theory, Tsai, Wutensor theory, numerical problems.

MODULE-III	**MACRO MECHANICAL ANALYSIS OF LAMINA AND LAMINATE**	**Classes:09**

Macro mechanics of a lamina: Hooke's law for different types of materials, Number of elastic constants, derivation of nine independent constants for orthotropic material, two dimensional relationships of compliance and stiffness matrix. Hooke’s law for two-dimensional angle lamina, engineering constants, numerical problems, Invariant properties, stress strain relations for lamina of arbitrary orientation, numerical problems.

Macro mechanical analysis of laminate: Introduction, code, Kirchoff hypothesis, CLT, A, B, and D matrices (Detailed derivation) engineering constants, special cases of laminates, numerical problems.

MODULE-IV	**MANUFACTURING PROCESS OF COMPOSITES**	**Classes: 09**

Manufacturing: Layup and curing open and closed mould processing, hand layup techniques, bag moulding and filament winding, putrusion, pulforming, thermoforming, Injection moulding, cutting, machining and joining, tooling, quality assurance, introduction, material qualification, types of defects, NDT methods.

MODULE-V	**METAL MATRIX COMPOSITES AND ITS APPLICATION DEVELOPMENTS**	**Classes : 09**

Metal Matrix Composites: Reinforcement materials, types, fabrication, characteristics and selection, base metals selection, applications; Application developments: aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment, future potential of composites.

Text Books:

1. Autar K. Kaw, “Mechanics of composite materials”, CRC Press, 2nd Edition, 2005.
2. Mein Schwartz, “Composite Materials Handbook”, McGraw-Hill, 2nd Edition, 2013.

Reference Books:

1. Rober M. Joness, “Mechanics of Composite Materials”, CRC Press, 2nd Edition, 2013.
2. MichaelW, Hye “Stress Analysis of Fiber Reinforced Composite Materials”, DESTech Publications, 2013.

Web References:

1. http://manufacturing.stanford.edu/processes/Composites.pdf
2. http://nptel.ac.in/courses/112104168/

E-Text Books:

1. https://www.elsevier.com/books/analysis-of-composite-structures/decolon/978-1-903996-02-7
2. https://www.elsevier.com/books/fatigue-of-composite-materials/reifsnider/978-0-444-70507-5
3. https://www.elsevier.com/books/mechanics-of-composite-materials/aboudi/978-0-444-88452-7
4. https://www.elsevier.com/books/book-series/composite-materials-series

NANO MATERIALS

PE -III: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB41	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Recognize the importance of nano structures and technology.
II. Understand various characterization techniques and synthesis processes.
III. Identify various multi-disciplinary industrial applications.

MODULE-I	INTRODUCTION TO NANOTECHNOLOGY	Classes : 09

Introduction: History and scope, can small things make a big difference, classifications of nano-structured materials, fascinating nanostructures, applications of nano materials, nature: The best nanotechnologist, challenges and future prospects.

MODULE-II	UNIQUE PROPERTIES OF NANOMATERIALS	Classes : 09

Unique properties of nano materials: Microstructure and defects in nanocrystalline materials: dislocations, twins stacklling faults and voids, grain boundries, triple and disclinations; Effects of nano-dimension on material behavior: Elastic properties, melting point, diffusivity, grain growth characteristics, enhanced solid solubility; Magnetic properties: Soft magnetic nano crystalline alloy, permanent magnetic nanocrystalline material, giant magnetic resonance, electrical properties, optical properties, thermal properties and mechanical properties.

MODULE-III	SYNTHESIS ROUTES	Classes:09

Synthesis Routes: Bottom up approaches: Physical vapor deposition, inert gas condensation, laser ablation, chemical vapor deposition, molecular beam epitaxy, sol-gel method, self assembly.
Top down approaches: Mechanical alloying, nano-lithography; Condensation of nano powders: Shock wave consolidation, hot isostatic pressing and cold isostatic, spark plasma sintering.

MODULE-IV	TOOLS TO CHARACTERIZE NANOMATERIALS	Classes: 09

Tools to characterize nano materials: X-ray diffraction, small angle X-ray scattering(SAXS), scanning Electron microscopy(SEM), transmission electron microscopy(TEM), atomic force microscopy(AFM), scanning tunneling microscopy(STM), field ion microscopy (FEM), three dimensional atom probe(3DAP), nano indentation.

MODULE-V	APPLICATION OF NANOMATERIALS	Classes : 09

Application of nano materials: Nano-electronics, micro and nano-electromechanical systems(MEMS/NEMS), nano sensors, nano catalysts, food and agricultural industry, cosmetic and consumer goods, structure and engineering, automotive industry, water-treatment and the environment, nano-medical applications, textiles, paints, energy defence and space applications, concerns and challenges of nanotechnology.

Text Books:
1.B.S. Murthy P. Shankar, Baladev Raj, James Munday, " Text Book of Nano Science and Nano Technology", University Press-IIM, 1st Edition, 2013. 2. Charles P. Poole, Frank .J. Owens, "Introduction to Nanotechnology", Wiley, 1st Edition, 2012.
Reference Books:
1. T. Pradeep, "Nano: The Essential ", Tata McGraw Hill, 1st Edition, 2008. 2. Miachel F. Ashby, Paulo J. Ferreira, "Nano materials, Nanotechnologies and design", wiley, 1st Edition, 2013.
Web References:
1. http://nptel.ac.in/courses/112106138/
E-Text Book:
1. http://bookboon.com/en/nanotechnology

ADVANCED MACHINE DESIGN

PE -IV: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB42	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Design and analyze the power transmitting elements.
II. Apply the theories of failures and design optimization procedures using strength and stiffness criteria.
III. Select the bearings for industrial applications using design data hand book.
IV. Comprehend the principles of standardization and interchangeability.

MODULE-I	BEARINGS	Classes : 09

Bearings: Types of journal bearings, basic modes of lubrication, bearing modulus, full and partial bearings, Clearance ratio, Heat dissipation of bearings, bearing materials, Journal bearing design. Ball and roller bearing, Static load- dynamic load, equivalent radial load-design and selection of ball and roller bearings.

MODULE-II	DESIGN OF IC ENGINE PARTS	Classes : 09

Connecting rod: thrust in connecting rod-stress due to whipping action on connecting rod ends; Cranks And Crank Shafts: strength and proportions of over hung and center cranks-crank pins, crank shafts; Piston: Forces acting on piston-construction design and proportions of piston.

MODULE-III	POWER TRANSMISSION SYSTEMS, PULLEYS	Classes: 09

Power Transmission Systems, Pulleys: Transmission of power by belt and rope drives, transmission efficiencies Belts-Flat and V belts;

Ropes- Different types of ropes, Selection of ropes; Pulleys for belt and rope drives, materials- chain drives.

MODULE-IV	GEARS	Classes: 09

Spur Gear: Load concentration factor-dynamic load factor, surface compressive strength-bending strength-design analysis of spur gear, check for plastic deformation, check for dynamic and wear considerations; Helical and Bevel Gear Drives: Load concentration factor-dynamic load factor, Analysis of helical and bevel gears, check for plastic deformation, check for dynamic and wear considerations; Design of Worm gears: worm gear-properties of worm gears-selections of materials-strength and wear rating of worm gears-force analysis-friction in worm gears-thermal considerations.

MODULE-V	DESIGN OF POWER SCREWS	Classes : 09

Design of power screws: Design of screw, design of nut, compound screw, differential screw, ball screw-possible failures.

Text Books:

1. Shigley, J.E, "Mechanical Engineering Design", Tata McGraw-Hill, New Delhi, India, 9th Edition, 2011.
2. V. Bandari, "A Text Book of Design of Machine Elements", Tata McGraw Hill education (P) ltd, New Delhi, India, 3rd Edition, 2011.
3. S. M.D. Jalaludin, "Machine Design", Anuradha Publishers, Kumbakonam, Chennai, India, 3rd Edition, 2011.

Reference Books:

1. P. Kannaiah, "Machine Design", Scitech Publications India Pvt. Ltd, New Delhi, India, 2nd Edition, 2012.
2. R. L. Norton, "Machine Design (An Integrated approach)", Pearson Publishers, Chennai, India, 2nd Edition, 2006.
3. Dr Sadhu singh, "Machine design", Khanna publishers, 1st Edition, 2009.
4. P.C.Sharma & D.K. Agrawal, S.K.Kataria& Sons Publishers, 3rd Edition, 2010.
5. PSG College, "Design Data: Data Book of Engineers", 1st Edition, 2012.
6. K. Mahadevan, K. Balaveera Reddy, "Design Data Hand Book", CBS Publisher, 4th Edition, 2019.

Web References:

1. http://nptel.ac.in/courses/112106137/#
2. http://gradestack.com/gate-exam/mechanical-engineering/machine-design/
3. http://studentskey.in/design-of-machine-elements-notes/
4. http://www.mechcareer.in/study-material/machine-design/
5. https://www.studynama.com/commMODULEy/threads/308-Machine-Design-1-lecture-notes-ebook-pdf-download-for-ME-engineers

E-Text Book:

1. http://www.mechanicalgeek.com/machine-design-rs-khurmi-pdf/
2. http://www.a-zshiksha.com/ebook/engineering/me/design_of_machine_elements_by_v_b_bhandari.php
3. http://www.allexamresults.net/2015/11/Design-of-Machine-Elements-by-V-B-Bhandari-ebook-Free-Download.html
4. http://machinedesign.com/learning-resources/ebooks

MECHANICAL VIBRATIONS

PE – IV: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB43	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand basic concepts of mechanical vibrations and phenomena of transmissibility
II. Analyze mechanical systems with/ without damping for 1/ multi degrees of freedom environment.
III. Application of vibration measuring instruments and machine monitoring systems.
IV. Develop competency in analytical methods in solving problems of vibrations along with mode shapes.

MODULE-I	**SINGLE DEGREE OF FREEDOM SYSTEMS**	**Classes : 09**

Single degree of freedom systems: Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility, response to non Periodic Excitations: MODULE impulse, MODULE step and MODULE ramp functions; response to arbitrary excitations, the convolution integral; shock spectrum; System response by the laplace transformation method.

MODULE-II	**TWO DEGREE FREEDOM SYSTEMS**	**Classes : 09**

Two degree freedom systems: Principal modes, undamped and damped free and forced vibrations; undamped vibration absorbers.

MODULE-III	**MULTI DEGREE FREEDOM SYSTEMS**	**Classes:09**

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis.

Method of matrix inversion; Torsional vibrations of multi-rotor systems and geared systems; Discrete- Time systems; Vibration measuring instruments: Vibrometer, velocity meters and accelerometers.

MODULE-IV	**FREQUENCY DOMAIN VIBRATION ANALYSIS**	**Classes: 09**

Frequency domain vibration analysis: Overview, machine train monitoring parameters, data base development, vibration data acquisition, trending analysis, failure node analysis, root cause analysis.

MODULE-V	**NUMERICAL METHODS**	**Classes : 09**

Numerical methods: Raleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods

Text Books:

1. Singiresu S Rao, "Mechanical Vibration", Pearson, 4th Edition, 2013.
2. G. K. Grover, "Mechanical Vibration", Nemchand & Brothers, 8th Edition, 2009.
3. J.S. Rao and K. Gupta, "Introductory Course On Theory & Practice Of Mechanical Vibrations", New Age International (p) Ltd , 2nd Edition,2012
4. Leonard Meirovitch, "Elements of vibration analysis", Tata McGraw-Hill, 2nd Edition, 2007.
5. John S. Mitchell, "Introduction to Machinery Analysis and Monitoring", Pennwell books, 2nd Edition, 1993.

Reference Books:

1. Singh V. P, "Mechanical Vibration", DhanpatRai & Co (p) Ltd, 3rd Edition, 2012.
2. AD Dimarogonas, SA Paipetis, "Analytical Methods In Rotor Dynamics", Applied Science Publishers London, 1983.
3. J. S. Rao, "Rotor Dynamics", New Age International (p) Ltd., 3rd Edition, 2012.
4. B.C. Nakra and K. K. Chowdary, "Mechanical Measurements", Tata McGraw-Hill, New Delhi, 2nd Edition, 2004
5. Collacott, R.A., "Mechanical Fault Diagnosis and Condition Monitoring", Chapman and Hall, London, 1st Edition, 1977.

Web References:

1. http://www.math.psu.edu/tseng/class/Math251/Notes-MechV.pdf
2. https://engineering.purdue.edu/~deadams/ME563/notes_10.pdf
3. http://nptel.ac.in/courses/112103111/#
4. https://engfac.cooper.edu/pages/tzavelis/uploads/Vibration%20Theory.pdf
5. http://vdol.mae.ufl.edu/CourseNotes/EML4220/vibrations.pdf

E-Text Book:

1. http://sv.20file.org/up1/541_0.pdf
2. https://aerocastle.files.wordpress.com/2012/10/mechanical_vibrations_5th-edition_s-s-rao.pdf
3. http://freshersclub.in/mechanical-vibrations-by-v-p-singh-pdf/

TOOL DESIGN

PE – IV: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB44	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Identify different properties of materials suitable for cutting/ forming tools.
II. Illustrate principle of 3-2-1jigs and fixture to arrest the degree of freedom.
III. Design of bushing and special clamping methods for drill jigs.
IV. Gain knowledge in design and development of forming dies and punches for different materials.

MODULE-I	**TOOL MATERIAL**	**Classes : 09**

Tool materials: Properties of materials: Tools steels, Cast Iron, Mild or low carbon steels, Non metallic and nonferrous materials, Heat treating.

MODULEII	**DESIGN OF CUTTING TOOLS**	**Classes : 09**

Design of cutting tools: Point cutting tools: Milling cutters, drills, selection of carbide steels, determination of shank size for single point carbide tools, determining the insert thickness for carbide tools.

MODULE-III	**DESIGN OF JIGS AND FIXTURES**	**Classes:09**

Design of jigs and fixtures: Basic principles of location and clamping; Locating methods and devices, jigs, definition types.
General considerations in the design of drill jigs, drill bushing, methods of construction; Fixtures, vice fixtures, milling, boring lathe grinding fixtures.

MODULE-IV	**DESIGN FOR SHEET METAL FORMING - I**	**Classes: 09**

Design of sheet metal blanking and piercing dies: Fundamentals of die cutting operation, power press types, general press information, materials handling equipment, cutting action in punch and die operations, die clearance, types of die construction, die design fundamentals, banking and piercing die construction, pilots, stripper and pressure pads presswork material, strip layout, short run tooling for piercing.

MODULE-V	**DESIGN FOR SHEET METAL FORMING – II**	**Classes : 09**

Design of sheet metal bending, forming and drawing dies: Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing, determination of blank size, drawing force, single and double action draw dies.

Text Books:

1. Donaldson, "Tool Design", Tata McGraw-Hill, 1st Edition, 2013.
2. HMT, "Production Technology", Tata McGraw-Hill, 1st Edition, 2012.
3. R.K. Jain, S. C. Gupta, "Production Technology", Tata McGraw-Hill, 1st Edition, 2013.

Reference Books:
1. George F Dieter, “Mechanical Metallurgy”, Tata McGraw-Hill, 1st Edition, 2015. 2. C. Elanchezhian, M.Vijayan, “Machine Tools”, Anuradha Publications, 1st Edition, 2010.
Web References:
1. http://nptel.ac.in/courses/112106138
E-Text Book:
1. https://books.google.co.in/books/about/Tool_Design.html?id=-M_mtiYyB_EC

EXPERIMENTAL STRESS ANALYSIS

IV Group: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB45	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Study the Various Experimental Techniques Involved for Measuring Displacements, Stresses Strains in Structural Components.
II. Understand the strain analysis of measuring circuits.
III. Understand the Different types of coatings.

MODULE-I	**EXTENSOMETERS AND DISPLACEMENT SENSORS**	**Classes : 09**

Principles of Measurements, Accuracy, Sensitivity and Range of Measurements, Mechanical, Optical, Acoustical and Electrical Extensometers and Their Uses, Advantages and Disadvantages, Capacitance Gauges, Laser Displacement Sensors

MODULE-II	**ELECTRICAL RESISTANCE STRAIN GAGES**	**Classes : 09**

Principle Of Operation And Requirements, Types And Their Uses, Materials For Strain Gauges, Calibration And Temperature Compensation, Cross Sensitivity, Wheatstone Bridge And Potentiometer Circuits For Static And Dynamic Strain Measurements, Strain Indicators, Rosette Analysis, Stress Gauges, Load Cells, Data Acquisition, Six Component Balance.

MODULE-III	**PHOTOELASTICITY**	**Classes:09**

Two-Dimensional Photo Elasticity, Photo Elastic Materials, Concept Of Light, Photoelastic Effects, Stress Optic Law, Transmission Photo elasticity, Jones Calculus, Plane And Circular Polariscopes.

Interpretation Of Fringe Pattern, Calibration Of Photo elastic Materials, Compensation And Separation Techniques, Introduction To Three Dimensional Photo Elasticity.

MODULE-IV	**BRITTLE COATING AND MOIRE TECHNIQUES**	**Classes: 09**

Relation Between Stresses In Coating And Specimen, Use Of Failure Theories In Brittle Coating, Moire Method Of Strain Analysis.

MODULE-V	**NON – DESTRUCTIVE TESTING**	**Classes : 09**

Fundamentals Of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current Testing, and Fluorescent Penetrate Testing.

Text Books:

1. Dally and Riley, "Experimental Stress Analysis", McGraw-Hill, New York, 1st Edition, 1978.
2. Sadhu Singh, "Experimental Stress Analysis", Khanna Publisher, 4th Edition, 2009.
3. Srinath L.S tata , “Experimental stress Analysis”, McGraw-Hill, 3rd Edition, 2012.

Reference Books:

1. M.M.Frocht, John Wiley & sons, "Photoelasticity Vol I and Vol II”, McGraw Hill, 2nd Edition, 1969.
2. Perry and Lissner, "Strain Gauge Primer", McGraw Hill, 2nd Edition, 1969.

Web References:
1. https://nptel.ac.in/syllabus/syllabus.php?subjectId=112106068
E-Text Books:
1. www.scribd.com/doc/241582542/Experimental-Stress-Analysis-by-Dally-and-Riley-P-1554n 2. www.apm.iitm.ac.in/smlab/kramesh/book_5.htm 3. www.myopencourses.com/subject/experimental-stress-analysis

PRECISION ENGINEERING

PE – V: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB46	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the BIS code fits and tolerances for geometrical dimensioning and tolerance (GD &T).
II. Understand the principal application of different measuring instruments.
III. Summarize the application of latest manufacturing techniques (nano).

MODULE-I	ACCURACY AND ALIGNMENT TESTS	Classes : 09

Accuracy and alignment tests: General concept of accuracy, Spindle rotation accuracy, test methods, displacement accuracy, dimensional wear of cutting tools, accuracy of NC systems, clamping errors, setting errors, location of rectangular prism, cylinder, basic type of tests, measuring instruments used for testing machine tools, alignment tests, straightness, flatness, parallelism, squareness, Circularity, cylindricity.

MODULE-II	INFLUENCE OF STATIC STIFFNESS,THERMAL EFFECTS	Classes : 09

Influence of static stiffness, thermal effects: Static stiffness, nature of deformation in a machine tool, overall stiffness of a lathe, compliance of work piece, errors due to the variation of the cutting force and total compliance, accuracies due to thermal effects, methods of decreasing thermal effects-Influence of vibration on accuracy.

MODULE-III	PRECISION MACHINING	Classes:09

Top down and bottom up approach, development of Nanotechnology, precision and micro-machining, diamond turning of parts to nanometer accuracy.

Stereo microlithography, machining of micro-sized components, mirror grinding of ceramics, ultra precision block gauges.

MODULE-IV	NANO MEASURING SYSTEMS	Classes: 09

In-process measurement of position of processing point, post process and online measurement of dimensional features, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspectionsystems.

MODULE-V	LITHOGRAPHY	Classes : 09

Nano Lithography: Photolithography, nano lithography, photolithography, electron beam lithography, ion Beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.

Text Books:

1. Murthy.R.L, “Precision Engineering in Manufacturing”, New Age International, New Delhi, 1st Edition, 2005.
2. Norio Taniguchi, “Nanotechnology”, Oxford university press, Cambridge, 1st Edition, 1996.

Reference Books:

1. Lee Tong Hong, "Precision Motion control, Design and Implementation", Springer Verlag, U.K., 1st Edition, 2001.
2. Liangchi Zhang, "Precision Machining of Advanced Materials", Trans Tech Publications Ltd., Switzerland, 1st Edition, 2001.
3. HiromuNakazawa, "Principles of Precision Engineering", Oxford university press, 1st Edition, 1994.

Web References:

1. http://nptel.ac.in/courses/112106138/

E-Text Book:

1. https://accessengineeringlibrary.com/browse/precision-engineering

MECHATRONICS

PE – IV: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB47	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand basic mechatronics system, design and their structure, mechanism, ergonomic and safety.
II. Apply the theoretical and practical aspects of computer interfacing and real time data acquisition and control.
III. Understand the fundamentals of PLC.

MODULE-I	**INTRODUCTION TO MECHATRONICS**	**Classes : 09**

Mechatronics systems, elements level of mechatronics system, mechatronics design process, system, measurement system, control system, microprocessor based controller, advantages and disadvantages of mechatronics systems, sensors and transducers, types, displacement, position, proximity, velocity, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

MODULE-II	**ELECTRONIC DEVICES**	**Classes : 09**

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC, anlog signal conditioning, amplifiers, filtering, introduction to mems and typical applications.

MODULE-III	**HYDRAULIC AND PNEUMATIC ACTUATORS**	**Classes:09**

Hydraulic and pneumatic actuating systems, fluid systems, hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydropneumatic.

Electro- hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

MODULE-IV	**DIGITAL ELECTRONIC AND SYSTEMS**	**Classes: 09**

Digital electronics and systems, digital logic control, micro processor and micro controller, programming, process controller, programmable logic controller, PLC's versus computer, application of PLC's or control.

MODULEV	**SYSTEM INTERFACING AND DATA ACCQUISITION**	**Classes : 09**

System interfacing and data acquisition, DAQS, SCADA, A to D, D to A, conversion; Dynamic models and analogies, system response, design of mechatronics system and future trend.

Text Books:

1. W. Bolton, "Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering", Pearson Education Press, 3rd Edition, 2005.
2. M. D. Singh, J. G. Joshi, "Mechatronics", Prentice Hall, 1st Edition, 2013.

Reference Books:

1. C. Braga, “Mechatronics Source Book”, Delmar Learning, 1st Edition, 2013.
2. N. Shanmugam, “Mechatronics”, Anuradha Agencies, 1st Edition, 2009.
3. Devadas Shetty, Richard A. Kolk, “Mechatronics System Design”, Cengage, 1st Edition, 2013.
4. Godfrey C. Onwubolu, “Mechatronics-Principles and Applications”, Butterworth-Heinemann, 1st Edition, 2013.

Web References:

1. www.nptel.ac.in/courses/112103174
2. www.electricalengineeringschools.org/mechatronics/

E-Text Book:

1. http://www.freepdfbook.com/mechatronics-book/
2. http://www.mechatronic.me/forum/viewforum.php?f=40
3. http://www.freepdfbook.com/introduction-to-mechatronics-and-measurement-systems/

DESIGN FOR MANUFACTURING

PE – IV: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB48	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the design principles of design for manufacturing processes.
II. Understand the various factors influencing the manufacturability of components.
III. Estimates the cost of dies, molds and machined components based on die life
IV. Application of this study to various casting, welding and machining processes.

MODULE-I	INTRODUCTION	Classes : 09

Introduction: Overview of the course, Design for manufacturing, Typical Case studies, Innovative product and service designs. Material Selection: Requirements for material selection, systematic selection of processes and materials, ASHBY charts

MODULE-II	MACHINING PROCESS	Classes : 09

Machining process: Overview of various machining processes, general design rules for machining, dimensional tolerance and surface roughness, design for machining, ease, redesigning of components for machining ease with suitable examples, general design recommendations for machined parts.

MODULE-III	METAL CASTING	Classes: 09

Metal casting: appraisal of various casting processes, selection of casting process, general design considerations for casting;

Casting tolerances, use of solidification simulation in casting design, product design rules for sand casting.

MODULE-IV	METAL JOINING	Classes: 09

Metal joining: Appraisal of various welding processes, Factors in design of weldments, general design guidelines - pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints; forging, design factors for Forging, closed dies forging design, parting lines of dies drop forging die design, general design recommendations; Extrusion and sheet metal work: design guidelines for extruded sections, design principles for punching, Blanking, bending, deep drawing, Keeler Goodman Forming line diagram; component design for blanking.

MODULE-V	DESIGN FOR SHEET METAL WORKING&POWDER METAL PROCESSING	Classes : 09

Design for Sheet metal working: Press selection, press brake operations, design rules, design for powder metal processing: Powder metallurgy, tooling and presses for compaction, sintering, materials, heat treatments, design guidelines.

Text Books:

1. Geoffrey Boothroyd, Dewhurst.P, Knight.W, "Product Design for Manufacture and Assembly", CRC press, 2002.
2. George E Dieter, "Engineering Design- A Material Processing Approach", McGraw hill international, 5th Edition. 2003.

Reference Books:
1. Surender Kumar &GouthamSutradhar, “Design and Manufacturing”, Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998. 2. ASM Handbook, Design for manufacture, 2000.
Web References:
1. https://nptel.ac.in/courses/112101005/
E-Text Book:
1.http://www.mescenter.ru/images/abook_file/ManufacturingSystems.pdf 2.https://www.researchgate.net/publication/313606361_Design _For_Manufacturing_Notes

ROBOTICS

PE – IV: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMB49	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand principles of automation and robotics.
II. Comprehend motion analysis kinematics.
III. Apply robotics for different industrials applications.

MODULE-I	INTRODUCTION TO AUTOMATION AND ROBOTICS	Classes : 09

Introduction, automation and robotics, an over view of robotics, classification by coordinate system and control systems, components of the industrial robotics: Degrees of freedom, end effectors: mechanical gripper, magnetic vacuum cup and other types of grippers , general consideration on gripper selection and design, robot actuator and sensors.

MODULE-II	MOTION ANALYSIS	Classes : 09

Motion analysis: Basic rotation matrices, composite rotation matrices, equivalent angle and axis homogeneous transformation, problems; Manipulator kinematics: D-H notations, joint coordinates and world coordinates, forward and inverse kinematics, problems.

MODULE-III	DIFFERENTIONAL KINEMATICS	Classes: 09

Differential kinematics: Differential Kinematics of planar and spherical manipulators, jacobians, problems;
Differential kinematics: Differential Kinematics of planar and spherical manipulators, jacobians, problems. Robot dynamics: Lagrange, euler formulations, newton-euler formulations, problems on planar two link manipulators.

MODULE-IV	TRAJECTORY PLANNING	Classes: 09

Trajectory planning: Joint space scheme, cubic polynomial fit, avoidance of obstacles, types of motion: Slew motion, joint interpolated motion, straight line motion, problems, robot actuators and feedback components: Actuators, pneumatic.

MODULE-V	ROBOT APPLICATIONS	Classes : 09

Robot application in manufacturing: Material handling, assembly and inspection, work cell design.

Text Books:

1. M. P. Groover, “Industrial Robotics”, Pearson, 2nd Edition, 2012.
2. J.J Criag, “Introduction to Robotic Mechanics and Control”, Pearson, 3rd Edition, 2013.

Reference Books:

1. K.S Fu, “Robotics”, McGraw-Hill, 1st Edition, 2013.
2. Richard, D.Klafter, Thomas AChmielewski, MiachaelNeigen, “Robotic Engineering An Integrated Approach”, Prentice Hall, 1st Edition, 2013.
3. Asada, Slotine, “Robot Analysis and Intelligence”, Wiley, 1st Edition, 2013.
4. Mark W.Spong, M. Vidyasagar, I.John, “Robot Dynamics & Control”, John Wiley & Sons, 1st Edition, 2013.

5. R. K. Mittal, I.J. Nagrath, “Robotics and Control”, Tata McGraw-Hill, 1st Edition, 2011.
Web References:
1. http://nptel.ac.in/courses/112101099/ 2. http://nptel.ac.in/courses/112101099/3
E-Text Book:
1. http://www.intechopen.com/books/robot-control 2. http://www.springer.com/gp/book/9781846286414
Course Home Page:

UNCONVENTIONAL MACHINING PROCESS

PE – VI: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB50	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.
II. Understand the need and importance of non-traditional machining methods and process selection.
III. Gain the knowledge to remove material by thermal evaporation, mechanical energy process.
IV. Apply the knowledge to remove material by chemical and electro chemical methods.
V. Analyze various material removal applications by unconventional machining process.

MODULE-I	INTRODUCTION TO UNCONVENTIONAL MACHINING	Classes : 09

Need for non-traditional machining methods, classifications of modern machining processes, considerations in process selection, materials application, Ultrasonic machining: Elements of the process, mechanics of metal removal, process parameters, economic considerations, application and limitations, recent developments.

MODULE-II	ABRASIVE JET MACHINING	Classes : 09

Abrasive jet machining, water jet machining and abrasive water jet machining: basic principles, equipments process variables, mechanics of metal removal, MRR, applications and limitations; Electro chemical processes: Fundamentals of electro chemical machining, electro chemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, tool design, surface finish and accuracy, economic aspect of ECM, simple problem for estimation of metal removal rate.

MODULE-III	THERMAL METAL REMOVAL PROCESSES	Classes: 09

General principle and applications of Electric discharge machining, electric discharge grinding, electric discharge wire cutting processes, power circuits in EDM, mechanism of metal removal in EDM, process parameters.

Selection of tool electrodes and dielectric fluids, surface finish and accuracy, characteristics of spark eroded surface and machine tool selection, wire EDM principle and applications.

MODULE-IV	ELECTRON BEAM MACHINING	Classes: 09

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non thermal processes, general principle and applications of laser beam machining, thermal features, cutting speed and accuracy of cut.

MODULE-V	PLASMA MACHINING	Classes : 09

Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.

Text Books:
1. V. K. Jain, "Advanced Machining Processes", Allied Publishers, 1st Edition, 2013. 2. Pandey P. C., Shah H.S., "Modern Machining Processes", Tata McGraw-Hill, 1st Edition, 2013.
Reference Books:
1. Bhattacherya A, "New Technology", The Institute for Engineers, 1st Edition, 1973. 2. C. Elanchezhian, B. VijayaRamnath, M. Vijayan, "Unconventional Machining Processes", Anuradha Publication, 1st Edition, 2005. 3. M. K. Singh, "Unconventional Machining processes", New Age International Publishers, 1st Edition, 2010.
Web References:
1. https://nptel.ac.in/courses/112105126/36
E-Text Book:
1. https://www.springer.com/in/book/9781447151784 *2.* https://easyengineering.net/unconventional-machining-processes-by-senthil-kumar

OPERATION RESEARCH

PE – VI: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB51	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Formulate the mathematical model of real time problem for optimization.
II. Establish the problem formulation by using linear, dynamic programming, game theory and queuing models.
III. Apply stochastic models for discrete and continuous variables to control inventory.
IV. Visualize the computer based manufacturing simulation models.

MODULE-I	**INTRODUCTION AND ALLOCATION**	**Classes : 09**

Development, definition, characteristics and phases, types of operation research models, applications; Allocation**:** linear programming, problem formulation, graphical solution, simplex method, artificial variables techniques, two–phase method, big-M method.

MODULE-II	**TRANSPORTATION AND ASSIGNMENT PROBLEM**	**Classes : 09**

Transportation problem: Formulation, optimal solution, unbalanced transportation problem, degeneracy; Assignment problem, formulation, optimal solution, variants of assignment problem, traveling salesman problem.

MODULE-III	**SEQUENCING AND REPLACEMENT**	**Classes:09**

Sequencing: Introduction, flow, shop sequencing, n jobs through two machines, n jobs through three machines, job shop sequencing, two jobs through ‘m’ machines.
Replacement: Introduction: Replacement of items that deteriorate with time, when money value is not counted and counted, replacement of items that fail completely, group replacement.

MODULE-IV	**THEORY OF GAMES AND INVENTORY**	**Classes: 09**

Theory Of Games: Introduction, minimax (maximin) criterion and optimal strategy, solution of games with saddle points, rectangular games without saddle points, dominance principle, mx2 and 2xn games, graphical method; Inventory**:** Introduction, single item, deterministic models, purchase inventory models with one price break and multiple price breaks, shortages are not allowed, stochastic models, demand may be discrete variable or continuous variable, instantaneous production, instantaneous demand and continuous demand and no set up cost, single period model.

MODULE-V	**WAITING LINES AND SIMULATION**	**Classes : 09**

Waiting Lines**:** Introduction, single channel, poisson arrivals , exponential service times, with infinite population and finite population models, multichannel, poisson arrivals, exponential service times with infinite population single channel Poisson arrivals**;** Simulation**:** Definition, types of simulation models, phases of simulation, applications of simulation, inventory and queuing problems, advantages and disadvantages, brief Introduction of simulation languages.

Text Books:

1. J. K. Sharma, "Operations Research", Macmillan, 5th Edition, 2012.
2. R. Pannerselvan, "Operations Research", 2nd Edition, PHI Publications, 2006.

Reference Books:

1. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 2013.
2. Maurice Saseini, ArhurYaspan, Lawrence Friedman, "Operations Research: Methods & Problems", 1st Edition, 1959.
3. Hamdy A. Taha, "Introduction to O.R", PHI, 8th Edition, 2013.
4. Harvey M.Wagner, "Operations Research", PHI Publications, 2nd Edition, 1980.

Web References:

1. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html
2. https://pe.gatech.edu/degrees/online-masters-degrees/operations-research
3. http://nptel.ac.in/courses/112106134/1

E-Text Book:

1. http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf
2 http://www.ggu.ac.in/download/Class-Note14/Operation%20Research07.04.14.pdf

PRODUCTION PLANNING AND CONTROL

PE – VI: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB52	Elective	3	1	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the PPC function in industrial manufacturing scenario.
II. Apply forecasting techniques for different types of products.
III. Knowledge in optimal inventory control and capacity planning.

MODULE-I	OVERVIEW OF PRODUCTION PLANNING CONTROL	Classes : 09

Introduction: Definition, Objectives of production planning and control, functions of production planning and control, elements of production control, types of production, organization of production planning and control department, internal organization of department.

MODULE-II	FORECASTING	Classes : 09

Forecasting: Importance of forecasting, types of forecasting, their uses, general principles of forecasting, forecasting techniques, qualitative methods and quantitive methods; Inventory management, functions of inventories relevant inventory costs ABC analysis, VED analysis, EOQ model, inventory control systems, P-Systems and Q-Systems.

MODULE-III	INTRODUCTION TO MRP	Classes:09

Introduction to MRP and ERP, LOB (Line of Balance), JIT inventory, and Japanese concepts.

Routing, definition, routing procedure Route sheets, bill of material, factors affecting routing procedure, Schedule, definition, difference with loading.

MODULE-IV	SCHEDULING	Classes: 09

Scheduling Policies, techniques, Standard scheduling methods; Line balancing, aggregate planning, chase planning, expediting, controlling aspects.

MODULE-V	DISPATCHING	Classes : 09

Dispatching: Activities of dispatcher, dispatching procedure, follow up, definition, reason for existence of functions, types of follow up, applications of computer in production planning and control.

Text Books:

1. M. Mahajan, “Production Planning and Control”, Dhanpat Rai, 1st Edition, 2010.
2. Jain, Jain, “Production planning and control”, Khanna Publications, 1stEdition, 2012.

Reference Books:

1. SK Mukhopadhyaya, “Production Planning and Control- Text & cases” PHI, 2nd Edition, 2007.
2. U R.Panneer Selvam, “Production and operations Management”, PHI, 3rd Edition, 2012.

Web References:
1. http://nptel.ac.in/courses/112107143/
E-Text Book:
1.http://ggnindia.dronacharya.info/ecedept/Downloads/QuestionBank/IIIsem/PRODUCTION%20PLANNING_CONTROL.pdf

PLANT LAYOUT AND MATERIAL HANDLING

PE – VI: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB53	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Plan Analyze and design to improve manufacturing and service facilities.
II. Apply techniques to evaluate and design material handling and storage systems.
III. Visualize plant layout and material handling in industries

MODULE-I	**INTRODUCTION TO PLANT LAYOUT**	**Classes : 09**

Introduction, classification of layout, advantages and limitations of different layouts, layout design procedures, overview of the plant layout, process layout and product layout: Selection, specification, implementation and follow up, comparison of product and process layout

MODULE-II	**HEURISTICS FOR PLANT LAYOUT**	**Classes : 09**

Heuristics for plant layout ALDEP, CORELAP, CRAFT, group layout, fixed position layout, Quadratic assignment model, branch and bound method.

MODULE-III	**MATERIAL HANDLING SYSTEMS**	**Classes: 09**

Introduction, material handling systems, material handling principles. Classification of material handling equipment, relationship of material handling to plant layout

MODULE-IV	**BASIC MATERIAL HANDLING SYSTEMS**	**Classes: 09**

Basic material handling systems: Selection, material handling method, path equipment, function oriented systems

MODULE-V	**METHODS TO MINIMIZE COST OF MATERIAL HANDLING**	**Classes : 09**

Methods to minimize cost of material handling, maintenance of material handling equipments, safety in handling ergonomics of material handling equipment, design, miscellaneous equipments.

Text Books:

1. P. B. Mahapatra, "Operations Management", PHI, 1st Edition, 2010.
2. Dr. KC Arora, Shinde, "Aspects of Material handling", Lakshmi Publications, 1st Edition, 2013.

Reference Books:

1. R. L. Francis, LF McLinnisJr, White, "Facility Layout & Location an analytical approach", PHI, 1st Edition, 2013.
2. R. Paneersevlam, "Production and Operations Management", PHI, 3rd Edition, 2012

Web References:

1. http://nptel.ac.in/courses/112106138/

E-Text Book:

1. https://link.springer.com/book/10.1007/978-1-349-01786-7

FLIGHT CONTROL THEORY

OE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB53	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Apply stability criteria to determine the stability of an aircraft and specify the aircraft time-domain and frequency-domain response specifications.
II. Understand classical control theory in the frequency domain and modern control theory in the state-space are effectively mixed to provide the student with a modern view of systems theory.
III. Design control techniques for aircraft control systems, and study some feedback control applications.
IV. Study the controllability and observability of aerospace systems, and apply the modern control techniques to design enhanced flight control systems.

MODULE-I	INTRODUCTION TO CONTROL SYSTEMS	Classes: 10

Dynamical systems-principal constituents-input, output-process (plant)-block diagram representation. Inputs- control input, noise. Function of controls regulation (hold), tracking (command)-examples. Measure of effectiveness. Sensitivity of output to control input, noise and system parameters- robustness. Deterministic and stochastic control. Control in everyday life. The pervasiveness of control in nature, engineering and societal systems. The importance of study of control system. Need for stable, effective (responsive), robust control system. Modeling of dynamical systems by differential equations-system parameters. Examples from diverse fields. First and second order systems, higher order systems, single input single output systems, and multiple-input multiple-output.

MODULE-II	MATHEMATICAL MODELLING OF DYNAMIC SYSTEMS	Classes: 10

Control system performance- time domain description- output response to control inputs-- impulse and indicial response- characteristic parameters- significance- relation to system parameters- examples- first and second order linear systems, higher order systems. Synthesis of response to arbitrary input functions from impulse and indicial response. Review of Fourier transforms and Laplace transforms- inverse transforms- significance, applications to differential equations. 's' (Laplace) domain description of input-output relations- transfer function representation- system parameters- gain, poles and zeroes. Characteristic equation- significance- examples. Frequency and damping ratio of dominant poles.
Relation of transfer functions to impulse response. Partial fraction decomposition of transfer functions-significance.

MODULE -III	STEADY STATE RESPONSE ANALYSIS	Classes: 10

System type, steady state error, error constants- overall system stability. Application of feedback in stability augmentation, control augmentation, automatic control-examples. Composition, reduction of block diagrams of complex systems-rules and conventions. Control system components - sensors, transducers, servomotors, actuators, filters-modeling, transfer functions. Single-input single-output systems. Multiple input-multiple output systems, matrix transfer functions-examples. Types of control problems- the problem of analysis, control synthesis, system synthesis- examples- static control of aircraft. Extension to dynamic control. System identification from input output measurements importance.

Experimental determination of system transfer functions by frequency response measurements. Example. Frequency domain description- frequency response- gain and phase shift- significance- representation asymptotic (Bode) plots, polar (Nyquist) plots, frequency transfer functions. Characteristic parameters

corner frequencies, resonant frequencies, peak gain, and bandwidth- significance. First and second order systems- extension to higher order systems.

MODULE-IV	AIRCRAFT RESPONSE TO CONTROLS	Classes:07

Approximations to aircraft transfer functions, control surface actuators-review. Response of aircraft to elevator input, Response of aircraft to rudder input and Response of aircraft to aileron input to atmosphere. Need for automatic control. Auto pilots Stability augmentation systems-pitch damper and yaw damper.

MODULE -V	FLYING QUALITIES OF AIRCRAFT	Classes: 08

Reversible and irreversible flight control systems. Flying qualities of aircraft-relation to airframe transfer function. Pilot's opinion ratings. Flying quality requirements- pole-zero, frequency response and time-response specifications. Displacement and rate feedback determination of gains conflict with pilot input s resolution-control augmentation systems- Full authority fly-by-wire. Auto Pilot-Normal acceleration, Turn rate, Pitch rate Commands-Applications.

Text Books:

1. Kuo, B.C., "Automatic Control Systems", Prentice Hall India, 1992.
2. Stevens, B.L. and Lewis, F.L., "Aircraft Control and Simulation", John Wiley, 1992.

Reference Books:

1. Mc Lean, D., "Automatic Flight Control Systems", Prentice Hall, 1990 J.
2. Bryson, A.E., "Control of Aircraft and Spacecraft", Princeton University Press, 1994.
3. E H J Pallett, Shawn Coyle, "Automatic Flight Control", 4th Edition, 2002.

E-Text Books:

1. https://www.e-booksdirectory.com/
2. https://www.aerospaceengineering.es/book/

AIRFRAME STRUCTURAL DESIGN

OE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB54	Elective	3	0	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the historical evolution of airplane and types of aircrafts along with exploration of space environment.
II. Discuss various aerodynamic forces acting on aircraft components and related principles.
III. Explain the performance and stability of aircraft for different mission segments of flight.
IV. Study the various types of satellite systems and subsystems with human exploration into space.

MODULE - I	HISTORY OF FLIGHT AND SPACE ENVIRONMENT	Classes: 10

Balloons and dirigibles, heavier than air aircraft, commercial air transport; Introduction of jet aircraft, helicopters, missiles; Conquest of space, commercial use of space; Different types of flight vehicles, classifications exploring solar system and beyond, a permanent presence of humans in space; Earth‘s atmosphere, the standard atmosphere; The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity; Environmental impact on spacecraft, space debris; Planetary environments.

MODULE-II	INTRODUCTION TO AERODYNAMICS	Classes: 09

Anatomy of the airplane, helicopter; Understanding engineering models; Aerodynamic forces on a wing, force coefficients; Generating lift, moment coefficients; Aerodynamic forces on aircraft – classification of NACA airfoils, aspect ratio, wing loading, mach number, centre of pressure and aerodynamic centre-aerofoil characteristics-lift, drag curves; Different types of drag.

MODULE -III	FLIGHT VEHICLE PERFORMANCE AND STABILITY	Classes: 09

Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric maneuvers, turns, sideslips, takeoff and landing.

Flight vehicle Stability, static stability, dynamic stability; Longitudinal and lateral stability; Handling qualities of the airplanes.

MODULE-IV	INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS, POWER PLANTS	Classes:08

General types of construction, monocoque, semi-monocoque; Typical wing and fuselage structure; Metallic & non-metallic materials, use of aluminum alloy, titanium, stainless steel and composite materials; Basic ideas about engines, use of propeller and jets for thrust production; Principles of operation of rocket, types of rockets.

MODULE -V	SATELLITE SYSTEMS ENGINEERING HUMAN SPACE EXPLORATION	Classes: 09
Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, the Soviet and US missions; The mercury, Gemini, Apollo (manned flight to the moon), Skylab, apollo-soyuz, space Shuttle; International space station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, flight safety; Indian effort in aviation, missile and space technology.		
Text Books:		
1. Anderson J. D, "Introduction to Flight", McGraw-Hill, 5th Edition, 1989. 2. Newman D, "Interactive Aerospace Engineering and Design", McGraw-Hill, 1st Edition, 2002.		
Reference Books:		
1. Kermode, A. C, "Flight without Formulae", McGraw Hill, 4th Edition, 1997. 2. Barnard R.H and Philpot. D.R, "Aircraft Flight", Pearson, 3rd Edition, 2004. 3. Swatton P. J, "Flight Planning", Blackwell Publisher, 6th Edition, 2002.		
Web References:		
1. https://www.aerospaceengineering.es/book/ 2. https://www.ne.nasa.gov/education/ 3. https://nptel.ac.in		
E-Text Books:		
1. https://www.e-booksdirectory.com/ 2. https://www.adl.gatech.edu/extrovert/Ebooks/ebook_Intro.pdf 3. https://www.academia.edu/7950378/Introduction_to_Flight_-_Anderson_5th_Ed.		

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MECHANICAL PROPERTIES OF MATERIALS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB54	Open	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the physical and mechanical, metallurgical engineering concepts for metals and preparation of alloys.
II. Understand the stages of design process and evolution of materials.
III. Interpret the basis for material selection in engineering design through case studies.
IV. Explore the material property plots, database and optimization techniques to identify the best performing materials for a given application.
V. Estimate the material life and their impact on industries and environment.

MODULE-I	STRUCTURE OF METALS	Classes : 09

Structure of metals: Crystallography, Miller indices, packing efficiency, density calculations, grains and grain boundaries, effect of grain size on the properties, determination of grain size by different methods, constitution of alloys, necessity of alloying, types of solid solutions, Hume-Rothery rules, intermediate alloy phases.

MODULE-II	MATERIAL SELECTION	Classes : 09

The basics, metals and metallic structure, metallic alloys, ceramics and glasses, polymers and composites for mechanical design, material properties: surface and other functional properties, the selection strategy, Attribute limits and material indices, the selection procedure, shape factor, Computer-aided selection, and the structural index Case Studies: Diaphragms for pressure actuators, Deflection limited design with brittle polymers, Nylon bearings for ship rudders.

MODULE-III	PROCESSES AND PROCESS SELECTION	Classes: 09

Introduction and synopsis, classifying processes, the processes: shaping, joining, and finishing, Systematic process selection, Ranking: process cost, Computer - aided process selection, supporting information Case studies: Forming ceramic tape valves, Forming a silicon nitride micro-beam, Fabricating a pressure vessel.

MODULE-IV	DESIGN PROCESS	Classes: 09

Material Selection using Ashby method, micro-structural shape factors, exploring and comparing structural sections, multiple Constraints and objectives in material selection, optimal selection with and without shape factor, multiple objectives, role of materials in shaping the product character.

MODULE-V	METHODS TO MINIMIZE COST OF MATERIAL HANDLING	Classes : 09

Environmental Impact: Materials and the environment, the material life cycle, material and energy consuming systems, the eco-attributes of materials, eco-selection, Case studies-Drink containers and crash barriers. materials and industrial design: Introduction and synopsis, the requirements pyramid, product character, using materials and processes to create product personality.

Text Books:
1. M. F. Ashby, “Material Selection in Mechanical Design”, Elsevier, 4th Edition, 2015. 2. M.Ashby,K.Johnson, “Materials and Design”, Lakshmi Publications, Elsevier, 3rd Edition, 2014.
Reference Books:
1. Kenneth G. Budinski, “Engineering Materials: Properties and Selection”, PHI, 1st Edition, 2013. 2. J. G. Gerdeen, H. W. Lord, R. A. L., “Engineering Design with Polymers and Composites”, CRC Press, 2nd Edition, 2011.
Web References:
1. http://nptel.ac.in/courses/112106138/
E-Text Book:
1. https://accessengineeringlibrary.com/browse/precision-engineering

AUTOMATION IN MANUFACTURING

OE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB55	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Describe the basic concepts of automation in manufacturing systems.
II. Acquire the fundamental concepts of automated flow lines and their analysis.
III. Classify automated material handling, automated storage and retrieval systems.
IV. Illustrate adaptive control systems and automated inspection methods.

MODULE-I	**INTRODUCTION AND MANUFACTURING OPERATIONS**	**Classes: 09**

Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles and Strategies Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations

MODULE-II	**INDUSTRIAL CONTROL SYSTEM**	**Classes: 09**

Basic Elements of an Automated System, Advanced Automation Functions and Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

MODULE-III	**AUTOMATED MANUFACTURING SYSTEMS**	**Classes: 09**

Components of Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells.

MODULE-IV	**GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEMS**	**Classes: 09**

Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, and Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications, benefits, FMS Planning and Implementation issues.

MODULE-V	**Manufacturing Support System**	**Classes: 09**

Process Planning, Computer Aided Process Planning, Concurrent Engineering and Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, basic concepts of lean and Agile manufacturing.

Text Books:

1. R. Thomas Wright and Michael Berkeihiser, "Manufacturing and Automation Technology", 3rd Edition,2012
2. M.P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing" / PE/PHI.

Reference Books:
1. Tien-Chien Chang, Richard A. Wysk, Hsu-Pin Wang, "Computer Aided Manufacturing"‖, Pearson 1st Edition, 2009. 2. R Thomas Wright, Michael Berkeihiser, "Manufacturing and Automation Technology", Good Heart/Willcox Publishers, 1st Edition, 2013.
Web References:
1.https://www3.nd.edu/~manufact/MPEM_pdf_files/Ch14.pdf 2. http://nptel.ac.in/courses/112102011
E-Text Book:
1. https://docs.google.com/file/d/0B7uir_9DoCLFaGduckFqQmcwUnc/edit?usp=drive 2.https://lehrerfortbilduw.de/faecher/nwt/fb/atechnik/grundlagen/en/kapitel/563060_Fundamentals_of_automation_technology.pdf

REMOTE SENSING AND GIS

OE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB50	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the Photogrammetric techniques, concepts, components of Photogrammetry
II. Introduce the students to the basic concepts and principles of various components of remote sensing.
III. Provide an exposure to GIS and its practical applications in Civil Engineering.
IV. Analyze the energy interactions in the atmosphere and earth surface features.

MODULE - I	INTRODUCTION TO PHOTOGRAMMETRY	Classes: 09

Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducially points, parallax measurement using fiducially line.

MODULE -II	REMOTE SENSING	Classes: 09

Basic concepts and foundation of remote sensing – elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology and units. Energy resources, energy interactions with earth surface features and atmosphere, resolution, sensors and satellite visual interpretation techniques, basic elements, converging evidence, interpretation for terrain evaluation, spectral properties of water bodies, introduction to digital data analysis.

MODULE - III	GEOGRAPHIC INFORMATION SYSTEM AND TYPES OF DATA REPRESENTATION	Classes: 09

Introduction, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS.

Data collection and input overview, data input and output. Keyboard entry and coordinate geometry procedure, manual digitizing and scanning, Raster GIS, Vector GIS – File management, Spatial data – Layer based GIS, Feature based GIS mapping.

MODULE - IV	GIS SPATIAL ANALYSIS	Classes: 09

Computational Analysis Methods(CAM), Visual Analysis Methods (VAM), Data storagevector data storage, attribute data storage, overview of the data manipulation and analysis. Integrated analysis of the spatial and attribute data.

MODULE - V	WATER RESOURCES APPLICATIONS	Classes: 09

Land use/Land cover in water resources, Surface water mapping and inventory, Rainfall – Runoff relations and runoff potential indices of watersheds, Flood and Drought impact assessment and monitoring, Watershed management for sustainable development and Watershed characteristics.

Text Books:
1. Remote Sensing and GIS by B.Bhatta, Oxford University Press,New Delhi. 2. Fundamentals of remote sensing by Gorge Joseph , Universities press, Hyderabad.
Reference Books:
1. LRA Narayana, “Remote Sensing and its applications”, University Press 1999. 2. S.Kumar, “Basics of Remote Sensing & GIS”, Laxmi Publications. 3. M.Anji Reddy, “Remote Sensing and GIS”, B.S. Pubiliications, New Delhi. 4. Tsung Chang, “GIS”, TMH Publications & Co.,
Web References:
1. https://nptel.ac.in/courses/105103193/ 2. https://nptel.ac.in/courses/121107009/ 3. https://nptel.ac.in/courses/105108077/
E-Text Books:
1.https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105107160/lec20.pdf

PROJECT SAFETY MANAGEMENT

OE – I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB51	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the various safety concepts and requirements applied to construction projects.
II. Study the of construction accidents, safety programmes, contractual obligations, and design for safety.
III. Understand the safety and health of persons at work in connection with the use of plant and machinery.
IV. A structured management approach to control safety risks in operations.

MODULE - I	**CONSTRUCTION ACCIDENTS**	**Classes: 09**

Accidents and their Causes – Human Factors in Construction Safety – Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications -The introduction of OH&S management system.

MODULE -II	**SAFETY PROGRAMMES**	**Classes: 09**

Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives.

MODULE - III	**CONTRACTUAL OBLIGATIONS**	**Classes: 09**

Safety in Construction Contracts – Substance Abuse – Safety Record Keeping

Comparison of Actions and Laws – Agreements, Subject Matter, Violation, Appointment of Arbitrators, Conditions of Arbitration – Powers and Duties of Arbitrator.

MODULE - IV	**DESIGNING FOR SAFETY**	**Classes: 09**

Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices, Company Activities and Safety – Safety Personnel – Sub contractual Obligation – Project Coordination and Safety Procedures – Workers Compensation.

MODULE - V	**OWNERS' AND DESIGNERS' OUTLOOK**	**Classes: 09**

Owner's responsibility for safely – Owner preparedness – Role of designer in ensuring safety – Safety clause in design document.

Text Books:

1. Raymond Elliot Levitt and Nancy Morsesamelson "Construction Safety Management" copyright materials, Wiley; 2nd Edition, 1993.
2. Charles D. Reese, "occupational health and safety", CRC Press, 2003.

Reference Books:
1. Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 1997. 2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Tamilnadu Factory Act, Department of Inspectorate of factories, Tamilnadu. Health Management, Prentice Hall Inc., 2001.
Web References:
1. https://nptel.ac.in/content/storage2/courses/114106039/Tutorial%2012%20key.pdf 2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/114106039/lec36.pdf
E-Text Books:
1. https://safetyrisk.net/free-safety-ebooks/ 2. https://boilersinfo.com/fire-safety-management-handbook-3rd-edition/

COMPUTER ARCHITECTURE

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB32	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

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.

MODULE - I	INTRODUCTION TO COMPUTER ORGANIZATION	Classes: 09

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, a simple instruction set architecture.

MODULE -II	ORGANIZATION OF A COMPUTER	Classes: 09

Register transfer: Register transfer language, register transfer, bus and memory transfers, arithmetic micro operations, logic micro operations, shift micro operations; Control memory.

MODULE -III	CPU AND COMPUTER ARITHMETIC	Classes: 09

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	Classes: 09

Input or output organization: Input or output Interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access.

MODULE -V	MEMORY ORGANIZATION	Classes: 09

Memory organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory; Pipeline: Parallel processing, Instruction pipeline;

Text Books:

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

Reference Books:

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

Web References:

1. https://www.tutorialspoint.com/computer_logical_organization/
2. https://www.courseera.org/learn/comparch
3. https://www.cssimplified.com/.../computer-organization-and-assembly-language-programming

E-Text Books:

1. https://www.groupes.polymtl.ca/inf2610/.../ComputerSystemBook.pdf
2. https://www.cse.hcmut.edu.vn/~vtphuong/KTMT/Slides/TextBookFull.pdf

ANALYSIS OF ALGORITHMS AND DESIGN

OE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB33	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
II. Solve problems using data structures such as binary search trees, and graphs.
III. Choose the appropriate data structure and algorithm design method for a specified application.
IV. Solve problems using algorithm design methods such as the divide and conquer, greedy method, dynamic programming, branch and bound, backtracking,

MODULE -I	INTRODUCTION	Classes: 09

Algorithm: Pseudo code for expressing algorithms; Performance analysis: Space complexity, time complexity; Amortized Complexity, Asymptotic notations: Big O notation, omega notation, theta notation and little o notation.

MODULE -II	DIVIDE AND CONQUER	Classes: 09

Divide and Conquer: General method, applications: Binary search, quick sort, merge sort, Strassen‘s matrix multiplication.

MODULE -III	TRAVERSAL TECHNIQUES AND GREEDY METHOD	Classes: 09

Efficient non recursive binary tree traversal algorithms, spanning trees; Graph traversals: Breadth first search, depth first search, connected components, biconnected components.

Greedy method: The general method, job sequencing with deadlines, knapsack problem, single source shortest paths.

MODULE -IV	DYNAMIC PROGRAMMING	Classes: 09

Dynamic programming: The general method, matrix chain multiplication, optimal binary search trees, 0/1 knapsack problem, all pairs shortest paths problem.

MODULE -V	BRANCH AND BOUND, BACKTRACKING	Classes: 09

Branch and bound: The general method, travelling salesperson problem; Backtracking: The general method, the 8 queens problem, graph coloring.

Text Books:

1. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekharan, “Fundamentals of Computer Algorithms, Universities Press, 2nd Edition, 2015.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D, “The Design And Analysis Of Computer Algorithms, Pearson India, 1st Edition, 2013.

Reference Books:

1. Levitin A, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 3rd Edition, 2012.
2. Goodrich, M. T. R Tamassia, "Algorithm Design Foundations Analysis and Internet Examples", John Wiley and Sons, 1st Edition, 2001.
3. Base Sara Allen Vangelder, "Computer Algorithms Introduction to Design and Analysis", Pearson, 3rd Edition, 1999.

Web References:

1. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. http://www.facweb.iitkgp.ernet.in/~sourav/daa.html

E-Text Books:

1.http://ebook/com/item/introduction_to_the_design_and_analysis_of_algorithms_3rd_editionananylevitin/
2. https://drive.google.com/file/d/0B_Y1VbyboEDBTDVxVXpVbnk4TVE/edit?pref=2&pli=1
3. http://www.amazon.com/Computer-Algorithms-Introduction-Design-Analysis/dp/0201612445

RELATIONAL DATABASE MANAGEMENT SYSTEMS

OE – II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACSB34	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the role of database management system in an organization and learn the database concepts.
II. Design databases using data modeling and Logical database design techniques.
III. Construct database queries using relational algebra and calculus and SQL.
IV. Understand the concept of a database transaction and related concurrent, recovery facilities.
V. Learn how to evaluate a set of queries in query processing.

MODULE -I	CONCEPTUAL MODELING INTRODUCTION	Classes: 09

Introduction to Databases and Database Management System - Database system Applications Advantages of DBMS over File System - Data Models – Instances and schema - View of Data - Database Languages - DDL-DML - Database Users and Administrator - Database System Structure.

MODULE -II	RELATIONAL APPROACH	Classes: 09

Database Design and ER diagrams – Attributes and Entity Sets – Relationships and Relationship Sets – Constraints - Keys - Design Issues - Entity-Relationship Diagram- Weak Entity Sets - Extended E-R Features- Database Design with ER model - Database Design for Banking Enterprise.

MODULE -III	SQL QUERY - BASICS , RDBMS - NORMALIZATION	Classes: 09

Introduction to the Relational Model – Structure of RDBMS - Integrity Constraints over Relations – Enforcing Integrity Constraints – Querying Relational Data - Relational Algebra and Calculus.

Introduction to SQL- Data Definition commands, Data Manipulation Commands, Basic Structure, Set operations Aggregate Operations - Join operations - Sub queries and correlated queries, SQL functions, views ,Triggers, Embedded SQL

MODULE -IV	TRANSACTION MANAGEMENT	Classes: 09

Functional Dependencies– Introduction , Basic Definitions, Trivial and Non trivial dependencies, closure of a set of dependencies, closure of attributes, irreducible set of dependencies- Schema Refinement in Database Design- Problems Caused by Redundancy Decompositions – Problem Related to Decomposition –- Lossless Join Decomposition – Dependency Preserving Decomposition - FIRST, SECOND, THIRD Normal Forms – BCNF –Multi valued Dependencies – Fourth Normal Form.

MODULE -V	DATA STORAGE AND QUERY PROCESSING	Classes: 09

Transaction concept- Transaction state- Implementation of atomicity and Durability- Concurrent executions – Serializability, Recoverability; File Organization – Organization of records in file - Data Dictionary Storage – Indexing and Hashing – Basic Concepts , Ordered Indices,B^{+}Tree Index files, B- tree index files

Text Books:

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

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 6th Edition, 2014.
2. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill Publishing Company, 3rd Edition, 2007.
3. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000.
4. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.

Web References:

1. https://www.youtube.com/results?search_query=DBMS+onluine+classes
2. http://www.w3schools.in/dbms/
3. http://beginnersbook.com/2015/04/dbms-tutorial/

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re
3. https://docs.google.com/file/d/0B9aJA_iV4kHYM2dieHZhMHhyRVE/edit

MOOC Course

1. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/

ADVANCED DATA STRUCTURES

OE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AITB30	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic data structures and techniques of algorithm analysis.
II. Understand dictionaries, hashing mechanisms and skip lists for faster data retrieval.
III. Comprehension of heaps, priority queues and its operations.
IV. Understand balanced trees and their operations.
V. Illustration of tries and pattern matching algorithms.

MODULE -I	OVERVIEW OF DATA STRUCTURES	Classes: 09

Algorithms; Performance analysis: Time complexity and Space complexity, Asymptotic notation. Review of basic data structures - The list ADT, Stack ADT, Queue ADT, Linked list – Single linked list, Double linked list, Circular linked list.

MODULE –II	DICTIONARIES, HASH TABLES	Classes: 09

Dictionaries: Linear list representation, Skip list representation, operations - insertion, deletion and searching, Hash table representation, hash functions, collision resolution - separate chaining, open addressing - linear probing, quadratic probing, double hashing, rehashing, extendible hashing, comparison of hashing and skip lists.

MODULE -III	PRIORITY QUEUES	Classes: 09

Priority Queues – Definition, ADT, Realizing a Priority Queue using Heaps, Insertion, Deletion, Application- Heap Sort, External Sorting- Model for external sorting, Multiway merge, Polyphase merge.

MODULE -IV	SEARCH TREES	Classes: 09

Binary Search Trees - Definition, ADT, Operations - Searching, Insertion, Deletion, AVL Trees - Definition, ADT, Balance factor, Operations – Insertion, Deletion, Searching, Introduction to Red – Black and Splay Trees, B-Trees, B-Tree operations - insertion, deletion, searching, Comparison of Search Trees.

MODULE -V	PATTERN MATCHING AND TRIES	Classes: 09

Pattern matching algorithms - the Boyer - Moore algorithm, the Knuth – Morris - Pratt algorithm. Tries – Definition, concepts of digital search tree, Binary trie, Patricia, Multi-way trie.

Text Books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press Private Limited, India, 2nd Edition, 2008.
2. G.A. V.Pai, "Data Structures and Algorithms", Tata McGraw Hill, New Delhi, 1st Edition, 2008.
3. Richard F Gilberg, Behrouz A Forouzan, "Data Structures - A Pseudocode Approach with C", Cengage Learning, Thomson Press (India) Ltd, 2nd Edition, 2006.

Reference Books:

1. D. Samanta, "Classic Data Structures", Prentice Hall of India Private Limited, 2nd Edition, 2003.
2. Aho, Hop craft, Ullman, "Design and Analysis of Computer Algorithms", Pearson Education India, 1st Edition, 1998.
3. Goodman, Hedetniemi, "Introduction to Design and Analysis of Algorithms", Tata McGraw Hill, New Delhi, India, 1st Edition, 2002.
4. Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Course Technology, 3rd Edition, 2005.
5. M. T. Goodrich, R. Tomassia, "Data structures and Algorithms in Java", Wiley India, 3rd Edition, 2011.

Web References:

5. https://www.tutorialspoint.com/data_structures_algorithms/data_structures_basics.htm
6. https://www.geeksforgeeks.org/data-structures/
7. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

E-Text Books:

1. https://pdfs.semanticscholar.org/19ec/55ed703eb24e1d98a4abd1a15387281cc0f8.pdf
2. https://www.academia.edu/35961658/Data.Structures.A.Pseudocode.Approach.with.C.2nd.edition_1_.pdf
3. https://sonucgn.files.wordpress.com/2018/01/data-structures-by-d-samantha.pdf

MOOC Course

1. https://nptel.ac.in/courses/106103069/
2. https://www.coursera.org/learn/data-structures
3. https://www.edureka.co/blog/data-structures-algorithms-in-java/
4. https://www.edx.org/micromasters/ucsandiegox-algorithms-and-data-structures

DATA COMMUNICATIONS AND NETWORKS

OE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AITB31	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes:45		

OBJECTIVES:

The course should enable the students to:

I. Develop an understanding of modern network architectures from a design and performance perspective.
II. Understand the basics and challenges of network communication.
III. Provide an opportunity to do network programming using TCP/IP.
IV. Understand the operation of the protocols that are used inside the Internet.

MODULE - I	**DATA COMMUNICATIONS**	**Classes: 09**

Components, Direction of Data flow, Networks, Components and Categories, Types of Connections, Topologies, Protocols and Standards, ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN.

MODULE – II	**THE PHYSICAL LAYER**	**Classes: 09**

Transmission modes, Switching, Circuit Switched Networks, Transmission Media, Datagram Networks, Virtual Circuit Networks.

MODULE – III	**THE DATALINK LAYER**	**Classes: 09**

Introduction, Framing, and Error – Detection and Correction – Parity – LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols.

MODULE – IV	**THE NETWORK LAYER**	**Classes: 09**

Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols

MODULE – V	**THE TRANSPORT AND APPLICATION LAYER**	**Classes: 09**

Introduction, client server programming, WWW (World Wide Web) and HTTP (Hyper Text Transfer Protocol), FTP (File Transfer Protocol), E-MAIL, TELNET, SECURE SHELL, DNS(Domain Naming System), SNMP (Simple Network Management Protocol). Introduction to Application Layer: HTTP (Hyper Text Transfer Protocol), DNS(Domain Naming System).

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 5th Edition, 2012.
2. Andrew S. Tanenbaum, David.j.Wetherall, "Computer Networks", Prentice-Hall, 5th Edition, 2010.

Reference Books:

1. Douglas E. Comer "Internetworking with TCP/IP ", Prentice-Hall, 5th Edition, 2011.
2. Peterson, Davie, Elsevier "Computer Networks", 5th Edition, 2011
3. Comer, "Computer Networks and Internets with Internet Applications", 4th Edition, 2004.
4. Chawan- Hwa Wu, Irwin, "Introduction to Computer Networks and Cyber Security", CRC publications, 2014.

Web References:

1. http://computer.howstuffworks.com/computer-networking-channel.htm
2. http://www.ietf.org
3. http://www.rfc-editor.org/
4. https://technet.microsoft.com/en-us/network/default.aspx

E-Text Books:

1. http://www.freebookcentre.net/networking-books-download/Lecture-Notes-on-Computer-Networks.html
2. http://www.freebookcentre.net/networking-books-download/Introduction-to-Computer-Networks.html

MOOC Course

1. https://www.mooc-list.com/course/networking-introduction-computer-networking-stanford-university
2. https://lagunita.stanford.edu/courses/Engineering/Networking/Winter2014/about.

NETWORK SECURITY

OE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AITB32	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn the basic categories of threats to computers and networks.
II. Understand various cryptographic algorithms and be familiar with public-key cryptography.
III. Apply authentication functions for providing effective security.
IV. Analyze the application protocols to provide web security.
V. Discuss the place of ethics in the information security area.

MODULE-I	ATTACKS ON COMPUTERS AND COMPUTER SECURITY	Classes: 09

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.

MODULE-II	SYMMETRIC AND ASYMMETRIC KEY CIPHERS	Classes: 09

Symmetric key ciphers: Block cipher principles and algorithms (DES,AES), block cipher modes of operation, stream ciphers, and placement of encryption function, key distribution; Asymmetric key ciphers: Principles of public key cryptosystems, algorithms (RSA Diffie-Hellman).

MODULE-III	MESSAGE AUTHENTICATION ALGORITHM AND HASH FUNCTIONS	Classes: 09

Message authentication algorithm and hash functions: Authentication requirements, functions, message, authentication codes.

Hash functions: Hash functions, secure hash algorithm, digital signatures. Authentication application: Kerberos, X.509 authentication service.

MODULE-IV	E-MAIL SECURITY	Classes: 09

E-mail Security: Pretty Good Privacy; S/MIME
IP Security: IP security overview, IP security architecture, authentication header, encapsulating security payload, combining security associations, key management.

MODULE-V	WEB SECURITY	Classes: 09

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.

Text Books

1. William Stallings, "Cryptography and Network Security", Pearson Education, 4th Edition, 2005.
2. Atul Kahate, "Cryptography and Network Security", McGraw-Hill, 2nd Edition, 2009.

Reference Books
1. C K Shymala, N Harini, Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India, 1st Edition, 2016. 2. Behrouz A. Forouzan Debdeep Mukhopadhyay, “Cryptography and Network Security”, McGraw- Hill, 2nd Edition, 2010.
Web References
1. http://bookboon.com/en/search?q=INFORMATION+SECURITY 2. https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0E7QC 3. https://books.google.co.in/books/about/Information_Security.html?id=Bh45pU0_E_4C
E-Text Books
1. https://books.google.co.in/books/about/Information_Security.html 2. http://www.amazon.in/Cryptography-Network-Security-Behrouz-Forouzan/dp/007070208X

SOFT SKILLS AND INTERPERSONAL COMMUNICATION

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB18	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Communicate in a comprehensible English accent and pronunciation.
II. Use the four language skills i.e., Listening, Speaking, Reading and Writing effectively.
III. Develop the art of interpersonal communication skills to avail the global opportunities
IV. Enhances the understanding of soft skills resulting in an overall grooming of the skills

MODULE-I	SOFT SKILLS	Classes: 09

Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Application of Soft Skills, Discovering the Self; Setting Goals; Positivity and Motivation: Developing Positive Thinking and Attitude

MODULE -II	EFFECTIVENESS OF SOFT SKILLS	Classes: 09

Developing interpersonal relationships through effective soft skills; Define Listening, Speaking, Reading and Writng skills; Barriers to Listening, Speaking, Reading and Writing; Essential formal writing skills; Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking.

MODULE-III	ORAL AND AURAL SKILLS	Classes: 09

Vocabulary:
Sounds of English vowels sounds and constant sounds, Word Accent and connected speech- contractions, questions tags, Listening for information, Taking notes while listening to lectures (use of Dictionary).

Group Discussion: Importance, Planning, Elements, Skills, Effectively disagreeing, Initiating.

MODULE-IV	VERBAL AND NON-VERBAL COMMUNICATION	Classes: 09

Interpersonal communication-verbal and nonverbal etiquette; Body language, grapevine, Postures, Gestures, Facial expressions, Proximity; Conversation skills, Critical thinking, Teamwork, Group Discussion, Impact of Stress; Measurement and Management of Stress

MODULE-V	INTERPERSONAL COMMUNICATION	Classes: 09

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.

Text Books:

Handbook of English for Communication (Prepared by Faculty of English, IARE)

Reference Books:

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman & Molly Hamaker. "The Hard Truth about Soft Skills", London: HarperCollins E-books, 2007.
4. Stein, Steven J. & Howard E. Book. "The EQ Edge: Emotional Intelligence and Your Success" Canada: Wiley & Sons, 2006
5. Suresh Kumar. English for Success. Cambridge University Press IndiaPvt.Ltd.2010.
6. Dorling Kindersley. Communication Skills & Soft Skills - An Integrated Approach. India Pvt. Ltd. 2013.

Web References:

1. www.edufind.com
2. www.myenglishpages.com
3. http://grammar.ccc.comment.edu
4. http://owl.english.prudue.edu

E-Text Books:

1. http://bookboon.com/en/communication-ebooks-zip
2. http://www.bloomsbury-international.com/images/ezone/ebook/writing-skills-pdf.pdf
3. https://americanenglish.state.gov/files/ae/resource_files/developing_writing.pdf
4. http://learningenglishvocabularygrammar.com/files/idiomsandphraseswithmeaningsandexamplespdf.pdf
5. http://www.robinwood.com/Democracy/General Essays/CriticalThinking.pdf

CYBER LAW AND ETHICS

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB19	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand key terms and concepts in cyber society, cyber ethics.
II. Analyze fundamentals of Cyber Law
III. Learn the importance of nine P's in ethics.
IV. Understand artificial intelligence and Blockchain ethics.

MODULE-I	CYBER SOCIETY	Classes: 09

Definitions, Specificities of the Cyberspace, Dimensions of Cyber Ethics in Cyber Society, Fourth Industrial Revolution, Users' Motivations in Cyber-Space, Core Values and Virtues, Old Values or Eschatological Vision?, Cyber Ethics by Norms, Laws and Relations Artificial Intelligence Ethics: "AI for Good", Cyber-Capitalism: Cyber-Ethics as Business Ethics.

MODULE-II	CYBER LAW AND CYBER ETHICS	Classes: 09

Cyber Law and Cyber Ethics

The Importance of Cyber Law, The Significance of Cyber Ethics, Cyber Crime is Unethical and Illegal, Ethics Education has Positive Impact, The Need for Cyber Regulation Based on Cyber Ethics, Very Dangerous Times.

MODULE-III	ETHICS IN THE INFORMATION SOCIETY, THE NINE P'S	Classes: 09

Principles: Ethical Values, Participation: Access to Knowledge for All, People: Community, Identity, Gender, Generation, Education, Profession: Ethics of Information Professions, Privacy: Dignity, Data Mining, Security.

Piracy: Intellectual Property, Cybercrime, Protection: Children and Young People,
Power: Economic Power of Technology, Media and Consumers, Policy: Ethics of Regulation and Freedom.

MODULE-IV	DISRUPTIVE CYBER TECHNOLOGIES AND AI ETHICS	Classes: 09

Disruptive Cyber Technologies and Ethics -I

Artificial: Negative Moral Judgment?, Artificial: Ethically Positive Innovation?, Intelligence: Action-oriented Ability, Creation Story: Human Beings Responsibility, The Commandment to Love and Artificial Intelligence; **Artificial Intelligence Ethics:**Top Nine Ethical Issues in Artificial Intelligence, Five Core Principles to Keep AI Ethical, Ethics Should Inform AI – But Which Ethics?

MODULE-V	DISRUPTIVE CYBER TECHNOLOGIES AND ETHICS -II	Classes: 09

Disruptive Cyber Technologies and Ethics -II

BLOCKCHAIN ETHICS:

Blockchain Definition and Description, Blockchain Anonymity and Privacy: Ethical, No Possibility to Be Forgotten, Blockchain for Voting, Blockchain for Transparent Trade Tracing, Blockchain Energy: Environmental Impact, Decentralised or Majority-Owned, Ethically More Benefits or Dangers, future jobs in cyber society.

Text Books:
1. Christoph Stuckelberger, Pavan Duggal, “Cyber Ethics 4.0 Serving humanity with values”, Globethics.net Global Series, 2018.
Reference Books:
1. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency- Faridabad. 2. J.P. Sharma, SunainaKanojia, Cyber Laws 3. Harish Chander , Cyber Laws and IT Protection
E-Reference:
1. https://www.globethics.net/documents/4289936/13403236/Ge_Global_17_web_isbn9782889312641.pdf/

ECONOMIC POILICIES IN INDIA

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB20	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Introduce the economic development elements and its measures
II. Provide inside knowledge on monetary policy and its importance in economic development
III. Communicate the importance of fiscal policies in promoting the economy
IV. Explore the policies and practices in resource base infrastructure
V. Discuss the industrial and exit policies related to the industries

MODULE-I	INTRODUCTION ECONOMIC DEVELOPMENT AND ITS DETERMINANTS	CLASSES: 09

Approaches to economic development and its measurement – sustainable development; Role of State, market and other institutions; Indicators of development – PQLI, Human Development Index (HDI), gender development indices.

MODULE-II	MONEY, BANKING AND PRICES	CLASSES: 09

Analysis of price behavior in India; Financial sector reforms; Interest rate policy; Review of monetary policy of RBI; Money and capital markets; Working of SEBI in India

MODULE-III	FISCAL POLICY AND PUBLIC FINANCES	CLASSES: 09

Fiscal federalism – Centre-State financial relations; Finances of central government; Finances of state governments; Parallel economy; Problems relating to fiscal policy; Fiscal sector reforms in India.

MODULE-IV	RESOURCE BASE AND INFRASTRUCTURE	CLASSES: 09

Energy; social infrastructure – education and health; Environment; Regional imbalance; Issues and policies in financing infrastructure development. Policies and Performance in Industry Growth; productivity; diversification; small scale industries; public sector; competition policy; foreign investment.

MODULE-V	THE INDUSTRIAL AND EXIT POLICIES	CLASSES: 09

Industrial policy; Public Sector enterprises and their performance; Problem of sick units in India; Privatization and disinvestment debate; Growth and pattern of industrialization; Small-scale sector; Productivity in industrial sector; Exit policy – issues in labour market reforms; approaches for employment generation

Text Books:

1. The Wealth of Nations-Adam Smith, introduction by Alan B Krueger.
2. The Strength of Economic Development by Albert Hirschman.
3. Money, Banking and Public Finance by Dr. V.C.Sinha
4. Government of India, Economic Survey (Annual), Ministry of Finance, New Delhi.
5. Jain, a. K. (1986), Economic Planning in India, Ashish Publishing House, New Delhi.

Reference Books:

1. Ahluwalia, I. J. and I. M. D Little (Eds.) (1999), India's Economic Reforms and Development (Essays in honour of Manmohan Singh), Oxford University Press, New Delhi.
2. Bardhan, P. K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.
3. Bawa, R. s. and P. S. Raikhy (Ed.) (1997), Structural Changes in Indian Economy, Guru Nanak Dev University Press, Amritsar.
4. Brahmananda, P. R. and V. R. Panchmukhi (Eds.) (2001), Development Experience in the Indian Economy: Inter-State Perspectives, Book well, Delhi.
5. Chakravarty, S. (1987), Development Planning: The Indian Experience, Oxford University Press, New Delhi.
6. Dantwala, M. L. (1996), Dilemmas of Growth: The Indian Experience, Sage Publications, New Delhi.
7. Datt, R. (Ed.) (2001), Second Generation Economic Reforms in India, Deep & Deep Publications, New Delhi.

Web References:

1. Parikh, K. S. (1999), India Development Report – 1999-2000, Oxford University Press, New Delhi8.
2. Reserve Bank of India, Report on Currency and Finance, (Annual).
3. Sandesara, J. c. (1992), Industrial Policy and Planning, 1947-19919 : Tendencies, Interpretations and Issues, Sage Publications, New Delhi.

GLOBAL WARMING AND CLIMATE CHANGE

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB21	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the importance of Ozone layer in the atmosphere.
II. Comprehend composition of atmosphere.
III. Understand impacts of climate change on ecosystem.
IV. Understand initiatives taken by different countries to reduce emission of greenhouse gases.

MODULE - I	EARTH'S CLIMATE SYSTEM	Classes: 09

Role of ozone in environment, Ozone layer – Ozone depleting gases, Green House Effect – Radioactive effects of Greenhouse gases, The Hydrological cycle, Green House Gases and Global Warming, Carbon Cycle.

MODULE -II	ATMOSPHERE AND ITS COMPONENTS	Classes: 09

Importance of Atmosphere – Physical and chemical characteristics of Atmosphere, Vertical structure of the atmosphere, Composition of the atmosphere,Atmospheric stability, Temperature profile of the atmosphere,Lapse rates, Temperature inversion, Effects of inversion on pollution dispersion.

MODULE - III	IMPACTS OF CLIMATE CHANGE	Classes: 09

Causes of Climate change: Changes of Temperature in the environment, Melting of ice pole, sea level rise, Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem, Water Resources, Human Health, Industry, Settlement and Society.

Methods and Scenarios, Projected Impacts for different regions, Uncertainties in the projected impacts of Climate Change, Risk of Irreversible Changes.

MODULE - IV	OBSERVED CHANGES AND ITS CAUSES	Classes: 09

Climate change and Carbon credits, CDM – Initiatives in India-Kyoto Protocol, Paris Convention - Intergovernmental Panel on Climate change, Climate Sensitivity and Feedbacks. The Montreal Protocol – UNFCCC – IPCC – Global Climate Models (GCM) - Evidences of Changes in Climate and Environment- on a Global scale and in India.

MODULE - V	CLIMATE CHANGE AND MITIGATION MEASURES	Classes: 09

Clean Development Mechanism, Carbon Trading – Examples of future clean technology, Biodiesel – Natural Compost, Eco-friendly plastic, Alternate Energy –Hydrogen, Bio-fules, Solar Energy, Wind and Hydroelectric Power. Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices – Energy Supply, Transport, Buildings, Industry, Agriculture, Forestry – Carbon sequestration, Carbon capture and storage (CCS), Waste (MSW & Bio-waste, Biomedical, Industrial waste) – International and Regional cooperation.

Text Books:

1. Dr. Sushil Kumar Dash, "Climate Change: An Indian Perspective (Environment and Development)", Cambridge University Press India Pvt Ltd, 2007.
2. Adaptation and mitigation of climate change – Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006.

Reference Books:
1. Atmospheric Science, J.M. Wallace and P.V Hobbs, Elsevier/ Academic Press, 2006. 2. "Climate Change and Climate Variability on Hydrological Regimes", Jan C. Van Dam, Cambridge University Press, 2003.
E-Text Books:
1. https://www.worldcat.org/title/encyclopedia-of-global-warming-climate-change/oclc/805580328 2. https://libguides.nus.edu.sg/c.php?g=433566&p=2955835

INTELLECTUAL PROPERTY RIGHTS

OE: III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB22	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Gain knowledge in world trade organization and agreements between nations.
II. Safeguard the intellectual property with international trade agreements.
III. Understand types of intellectual property rights.
IV. Apply different laws in protection of intellectual property rights and its implementation.

MODULE- I	INTRODUCTION	Classes: 10

General agreement on tariffs and trade (GATT) eight rounds: Uruguay round, world trade organization: structure, technology transfer, dispute resolution mechanism, Doha declaration world trade organization agreements including trade related intellectual properties rights and trade related investment measures.

MODULE- I	WORLD INTELLECTUAL PROPERTY ORGANIZATION	Classes: 08

Paris convention, Bern convention, Budapest treaty, Madrid agreement, huge agreement.

MODULE- I	PATENTS	Classes: 09

Historical background of intellectual property rights, introduction, definition and classification of intellectual property, patents, patentable and non-patentable inventions. Legal requirements for patents, types of patent applications, patent document: specification and claims, important procedural aspects, management of intellectual property rights assets and intellectual property portfolio, commercial exploitation of intellectual property.

MODULE- I	DESIGNS AND GEOGRAPHICAL INDICATIONS	Classes: 10

Designs: basic requirements, procedure, convention application term, date, geographical indication: definition, what can be registered, who can apply, rights, term, restrictions.

MODULE- I	TRADEMARK AND COPYRIGHTS	Classes: 08

Definition, classification of trademarks, classifications of goods and services, Vienna classification, trademarks procedure, trademarks enforcement: infringement and passing off, remedies, copyrights, term of copyrights, and procedure of copyright assignment of copyright, copyright infringement remedies.

Text Books:

1. P. K. Vasudeva,World Trade Organization: Implications on Indian Economy, Pearson Education,2015.
2. P.KrishnaRao, WTO, Text and cases, Excel Books, 2015.
3. Carlos M.Correa- Intellectual property rights, The WTO and Developing countries-Zed books.

Reference Books:

1. Caves, Frankel, Jones, World Trade and Payments-An Introduction, Pearson4. Education, 2015.
2. Carlos M.Correa- Intellectual property rights, The WTO and Developing countries-Zed books.
3. Peter-Tobias stoll, Jan busche, Katrianarend- WTO- Trade –related aspects of IPR- Library of Congress.

Web References:
1. http://www.ebooks directory.com 2. http://Campus guides.lib.utah.edu
E-Text Books:
1. http://www.bookboon.com 2. http://www.freemagagement.com 3. http://www.emeraldinsight.com

ENTREPRENEURSHIP

OE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB23	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand the Entrepreneurial process and also inspire them to be Entrepreneurs.
II. Adopting of the key steps in the elaboration of business idea.
III. Understand the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

MODULE-I	**UNDERSTANDING ENTREPRENEURIAL MINDSET**	**Classes: 09**

The revolution impact of entrepreneurship- The evolution of entrepreneurship - Functions of Entrepreneurs – types of entrepreneurs -Approaches to entrepreneurship- Process approach- Role of entrepreneurship in economic development- Twenty first century trends in entrepreneurship.

MODULE-II	**INDIVIDUAL ENTREPRENEURIAL MIND-SET AND PERSONALITY**	**Classes: 09**

The entrepreneurial journey Stress and the entrepreneur - the entrepreneurial ego - Entrepreneurial motivations- Motivational cycle – Entrepreneurial motivational behavior – Entrepreneurial competencies. Corporate Entrepreneurial Mindset, the nature of corporate entrepreneur- conceptualization of corporate entrepreneurship Strategy-sustaining corporate entrepreneurship.

MODULE-III	**LAUNCHING ENTREPRENEURIAL VENTURES**	**Classes: 09**

Opportunities identification- Finding gaps in the market place – techniques for generating ideas-entrepreneurial Imagination and Creativity- the nature of the creativity process - Innovation and entrepreneurship.

Methods to initiate Ventures- Creating new ventures-Acquiring an Established entrepreneurial venture-Franchising- advantage and disadvantages of Franchising.

MODULE-IV	**LEGAL CHALLENGES OF ENTREPRENEURSHIP**	**Classes: 09**

Intellectual property protection - Patents, Copyrights - Trademarks and Trade secrets - Avoiding trademark pitfalls. Feasibility Analysis - Industry and competitor analysis - Formulation of the entrepreneurial Plan- The challenges of new venture start-ups, developing an effective business model – Sources of finance - Critical factors for new venture development - The Evaluation process

MODULE-V	**STRATEGIC PERSPECTIVES IN ENTREPRENEURSHIP -**	**Classes: 09**

Strategic planning - Strategic actions strategic positioning- Business stabilization - Building the adaptive firms - Understanding the growth stage – Internal growth strategies and external growth strategies, Unique managerial concern of growing ventures. Initiatives by the Government of India to promote entrepreneurship, Social and women entrepreneurship.

Text Books:

1. D F Kuratko and T V Rao, "Entrepreneurship- A South-Asian Perspective", Cengage Learning, 2012.
2. Bruce R. Barringer/ R.Duane Ireland, "Entrepreneurship Successfully Launching New Ventures", Pearson, 4th Edition, 2015.
3. S.S.Khanka, Entrepreneurship Development, S. Chand Publications, 2015.

Reference Books:

1. Stuart Read, Effectual Entrepreneurship, Routledge, 2013.
2. Rajeev Roy, Entrepreneurship, Oxford publications, 2nd Edition, 2012.
3. Nandan .H, Fundamentals of Entrepreneurship, PHI, 2013.

MICRO PROCESSORS AND INTERFACING

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB55	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the architecture of 8085 and 8086 microprocessors.
II. Analyze and develop the programming and interfacing techniques of 8086 microprocessor.
III. Understand the architecture of advanced microprocessors and microcontrollers.
IV. Analyze the basic concepts and programming of 8051 microcontroller.

MODULE -I	INTRODUCTION TO 8 BIT AND 16 BIT MICROPROCESSOR	Classes: 08

An over view of 8085, Architecture of 8086 Microprocessor, register organization of 8086, 8086 flag register. Addressing modes of 8086, Instruction set of 8086. Assembler directives, procedures, and macros. Assembly language programs involving logical, Branch & Call instructions, sorting, evaluation of arithmetic expressions, string manipulation.

MODULE -II	OPERATION OF 8086 AND INTERRUPTS.	Classes: 09

Pin diagram of 8086-Minimum mode and maximum mode of operation with Timing diagrams. Interrupt structure of 8086: Vector interrupt table, Interrupt service routines. Introduction to DOS and BIOS interrupts.

MODULE -III	INTERFACING WITH 8086.	Classes: 09

Memory interfacing to 8086 (Static RAM & EPROM). Need for DMA, DMA data transfer Method, Interfacing with 8237/8257. 8259 PIC Architecture and interfacing cascading of interrupt controller and its importance.

Serial data transfer schemes: Asynchronous and Synchronous data transfer schemes. 8251 USART architecture and interfacing. TTL to RS 232C and RS232C to TTL conversion.

MODULE -IV	ADVANCED MICRO PROCESSORS	Classes: 09

Introduction to 80286, Salient Features of 80386, Real and Protected Mode Segmentation & Paging, Salient Features of Pentium, Branch Prediction, and Overview of RISC Processors.

MODULE -V	8051 MICROCONTROLLER ARCHITECTURE	Classes: 10

8051 Microcontroller Architecture, Register set of 8051, Modes of timer operation, Serial port operation, Interrupt structure of 8051, Memory and I/O interfacing with 8051.

Text Books:

1. A.K.Ray and K.M.Bhurchandi, “Advanced Microprocessor and Peripherals”, TMH, 2000.
2. Deshmukh, “Micro Controllers”, Tata McGraw Hill Edition, TMH, 2000.

Reference Books:

1. Douglas U, “Micro Processors & Interfacing”, Hall, 2007.

2. By Liu, GA Gibson, "Micro Computer System 8086/8088 Family Architecture, Programming and Design", PHI, 2nd Edition, 2007.
Web References:
1. http://www.nptel.ac.in/downloads/106108100/ 2. http://www.the8051microcontroller.com/web-references 3. http://www.iare.ac.in
E-Text Books:
1. https://books.google.co.in/books 2. http://www.www.jntubook.com 3. http://www.ebooklibrary.org/articles/mpmc

PRINCIPLES OF COMMUNICATION

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB56	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Determine the performance of analog modulation schemes in time and frequency domains
II. Determine the performance of analog communication systems
III. Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems.

MODULE -I	**AMPLITUDE MODULATION**	**Classes: 08**

Introduction, Amplitude Modulation: Time & Frequency – Domain description, Switching modulator, Envelop detector.

MODULE -II	**DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION**	**Classes: 09**

Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

MODULE -III	**SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION**	**Classes: 09**

SSB Modulation, VSB Modulation, Frequency Translation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television.

MODULE -IV	**ANGLE MODULATION**	**Classes: 09**

Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Super heterodyne Receiver

MODULE -V	**DIGITAL REPRESENTATION OF ANALOG SIGNALS**	**Classes: 10**

Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing

Text Books:

1. Communication Systems, Simon Haykins & Moher, 5th Edition, John Willey, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, Oxford University Press., 4th edition.
2. An Introduction to Analog and Digital Communication, Simon Haykins, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.

3. Principles of Communication Systems, H.Taub & D.L.Schilling, TMH, 2011.
4. Communication Systems, Harold P.E, Stern Samy and A.Mahmond, Pearson Edition, 2004.
5. Communication Systems: Analog and Digital, R.P.Singh and S.Sapre: TMH 2nd Edition, 2005.

Web References:

1. http://www.web.eecs.utk.edu
2. https://everythingvtu.wordpress.com
3. http://nptel.ac.in/
4. http://www.iare.ac.in

E-Text Books:

1. http://www.bookboon.com/
2. http://www.jntubook.com
3. http://www.smartzworld.com
4. http://www.archive.org

IMAGE PROCESSING

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB57	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the image fundamentals and mathematical transforms necessary for image processing.
II. Describe the image enhancement techniques.
III. Analyze the image compression procedures.
IV. Design the image segmentation and representation techniques.

MODULE -I	**DIGITAL IMAGE FUNDAMENTALS**	**Classes: 10**

Digital Image through scanner, digital camera. Concept of gray levels. Gray level to binary image conversion. Sampling and quantization. Relationship between pixels. Imaging Geometry.

MODULE -II	**IMAGE TRANSFORMS**	**Classes: 09**

2-D FFT , Properties. Walsh transform, Hadamard Transform, Discrete cosine Transform, Haar transform, Slant transform, Hotelling transform.

MODULE -III	**IMAGE ENHANCEMENT**	**Classes: 08**

Point processing. Histogram processing. Spatial filtering. Enhancement in frequency domain, Image smoothing, Image sharpening.

MODULE -IV	**IMAGE SEGMENTATION**	**Classes: 08**

Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region oriented segmentation.

MODULE -V	**IMAGE COMPRESSION**	**Classes: 10**

Redundancies and their removal methods, Fidelity criteria, Image compression models, Source encoder and decoder, Error free compression, Lossy compression.

Text Books:

1. R.C. Gonzalez & R.E. Woods, "Digital Image Processing", Addison Wesley/ Pearson education, 2nd Education, 2002.

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 MAT LAB" L. Edition, PEA, 2004.
3. William K. Pratt, John, "Digital Image Processing", Wilely , 3rd Edition, 2004.

Web References:
1. https://imagingbook.com/ 2. https://en.wikipedia.org/wiki/Digital_image_processing 3. http://www.tutorialspoint.com/dip/ 4. http://www.imageprocessingplace.com/
E-Text Books:
1. http://www.sci.utah.edu/~gerig/CS6640-F2010/dip3e_chapter_02.pdf 2. http://www.faadooengineers.com/threads/350-Digital-Image-Processing 3. http://newwayofengineering.blogspot.in/2013/08/anil-k-jain-fundamentals-of-digital.html

ELECTRICAL ENGINEERING MATERIALS

OC – IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB55	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn the basics of materials used in electrical engineering.
II. Realize the dielectric properties of insulators in static and alternating fields.
III. Explain the importance of magnetic properties and superconductivity.
IV. Explain the behavior of conductivity of metals and classifications of semiconductor materials.

MODULE-I	ELEMENTARY MATERIALS SCIENCE CONCEPTS	Classes: 06

Bonding and types of solids, crystalline state and their defects, classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, hall effect.

MODULE-II	DIELECTRIC PROPERTIES OF INSULATORS IN STATIC AND ALTERNATING FIELD	Classes: 06

Dielectric constant of mono-atomic gases, poly-atomic molecules and solids, internal field in solids and liquids, properties of Ferro-Electric materials, polarization, piezoelectricity, frequency dependence of electronic and Ionic polarizability, complex dielectric constant of non-dipolar solids, dielectric losses.

MODULE-III	MAGNETIC PROPERTIES AND SUPER CONDUCTIVITY	Classes: 07

Magnetization of matter, magnetic material classification, ferromagnetic origin, curie-weiss law, soft and hard magnetic materials:

Superconductivity and its origin, zero resistance and Meissner effect, critical current density.

MODULE-IV	CONDUCTIVITY OF MATERIALS	Classes: 08

Ohm's law and relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.

MODULE-V	SEMICONDUCTOR MATERIALS	Classes: 08

Classification of semiconductors, semiconductor conductivity, temperature dependence, carrier density and energy gap, trends in materials used in electrical equipment.

Text Books:

1. J Dekker, "Electrical Engineering Materials Adrianus", Phi Learning Publishers, 2nd Edition, 1996.
2. Solymar, L, "Electrical Properties of Materials", Oxford University Press-New Delhi 8th Edition, 2009.

Reference Books:
1. Indulkar C, “Introduction to Electrical Engineering Materials”, S Chand &Company Ltd-New Delhi 4th Edition, 2004. 2. SK Bhattacharya, “Electrical and Electronic Engineering Materials”, Khanna Publishers, New Delhi, 2nd Edition, 1998.
Web References:
1. https://www.electrical4u.com/electrical-engineering-materials/ 2. https://lecturenotes.in/subject/219/electrical-engineering-materials-eem
E-Text Books:
1. https://www.books.google.co.in/books/about/A_Textbook_of_Electrical_Engineering_Mat.html?id=Ee8ruUXkJeMC. 2. https://www.amazon.in/Introduction-Electrical-Engineering-Materials-ebook/dp/B00QUYKXTI

NON CONVENTIONAL ENERGY SOURCES

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB56	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the various types of renewable energy sources.
II. Analyze the principle and operation of direct energy conversion.
III. Understand and analyze the hybrid energy systems.
IV. Understand the renewable energy sources to real world electrical and electronics problems.

MODULE-I	PRINCIPLES OF SOLAR RADIATION	Classes: 08

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

MODULE - II	SOLAR ENERGY COLLECTION AND SOLAR ENERGY STORAGE AND APPLICATIONS	Classes: 10

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and
drying, photovoltaic energy conversion

MODULE - III	WIND ENERGY AND BIO-MASS	Classes: 09

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects

MODULE - IV	GEOTHERMAL ENERGY AND OCEAN ENERGY	Classes: 10

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India
Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

MODULE - V	DIRECT ENERGY CONVERSION	Classes: 08

Need for DEC, Carnot cycle, limitations, principles of DEC.

Text Books:

1. G.D. Rai, "Non-Conventional Energy Sources", TMH, 3rd Edition 2009.
2. Twidell & Weir, "Renewable Energy Sources", CRC Press, 1st Edition, 2008.

Reference Books:

1. Renewable Energy resources /Tiwari and Ghosal/Narosa
2. Renewable Energy Technologies /Ramesh & Kumar /Narosa
3. Non-Conventional Energy Systems / K Mittal /Wheeler
4. Renewable Energy sources and emerging technologies by D.P. Kothari, K.C. Singhal, P.H.I

NANO TECHNOLOGY

OE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB57	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Impart the basic knowledge in Nano Science and Technology.
II. Give insight into many aspects of Nano science, technology and their applications in the prospective of materials science.
III. Develop new devices and technologies for applications in a wide range of industrial sectors including information technology, medicine, manufacturing, high-performance materials

UNIT-I INTRODUCTION

History and scope, can small things make a big difference, classification of nanostructured materials, fascinating nanostructures, applications of nanomaterials, Nature: The best of nanotechnologist, challenges, and future prospects.

UNIT-II UNIQUE PROPERTIES OF NANOMATERIALS

Microstructure and Defects in Nanocrystalline Materials: Dislocations, twins, stacking faults and voids, grain boundaries, triple, and disclinations, effect of Nano-dimensions on materials behavior: Elastic properties, melting point, diffusivity, grain growth characteristics, enhanced solid solubility; Magnetic Properties: Soft magnetic Nanocrystalline alloy, permanent magnetic Nanocrystalline materials, giant magnetic resonance, electrical properties, optical properties, thermal properties, and mechanical properties.

UNIT-III SYNTHESIS ROUTES

Bottom up approaches: Physical vapor deposition, inert gas condensation, laser ablation, chemical vapor deposition, molecular beam Epitaxy, solgel method, self assembly.

Top down approaches: Mechanical alloying, Nano-lithography, consolidation of Nano powders: Shock wave consolidation, hot isostatic pressing and cold isostatic pressing spark plasma sintering.

UNIT-IV TOOLS TO CHARACTERIZE NANOMATERIALS

X-Ray Diffraction (XRD), small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

UNIT-V APPLICATIONS OF NANOMATERIALS

Nano-electronics, micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, food and agricultural industry, cosmetic and consumer goods, structure and engineering, automotive industry, water treatment and the environment, Nano-medical applications, textiles, paints, energy, defence and space applications, concerns and challenges of Nanotechnology.

Text Books:

1. B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, “Text Book of Nano Science and Nano Technology”, University Press-IIM.
2. Charles P. Poole, Jr., and Frank J. Owens, “Introduction to Nanotechnology”, Wiley India Edition, 2012.

Reference Books

1. T. Pradeep, “Nano: The Essentials”, McGraw- Hill Education.
2. David Ferry, “Transport in Nano structures”, Cambridge University Press, 2000.
3. Challa S., S. R. Kumar, J. H. Carola, “Nanofabrication towards Biomedical Application: Techniques, tools”, Application and impact Edition.
4. Michael J. O’Connell. “Carbon Nanotubes: Properties and Applications”, Cambridge University Press.
5. S. Dutta, “Electron Transport in Mesoscopic Systems”, Cambridge University Press.

Web References:

1.https://www.dummies.com/education/.../useful-nanotechnology-information-websites/
2.https://www.ncbi.nlm.nih.gov/books/NBK21031/
3.https://libguides.northwestern.edu › LibGuides

E-Text Book:

1. https://www.accessengineeringlibrary.com/.../textbook-of-nanoscience-and-nanotechn
2. https://www.azonano.com/book-reviews-index.aspx
3. https://en.wikibooks.org/wiki/Nanotechnology/Print_version

ENVIRONMENTAL SCIENCES

IV Semester: AE / CSE / IT / ECE / EEE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB07	Mandatory	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

COURSE OBJECTIVES:

The course should enable the students to:

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

MODULE-I	ENVIRONMENT AND ECOSYSTEMS

Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles; Biomagnifications

MODULE-II	NATURAL RESOURCES

Natural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

MODULE-III	BIODIVERSITY AND BIOTIC RESOURCES

Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation; Hot spots of biodiversity

Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National biodiversity act.

MODULE-IV	ENVIRONMENTAL POLLUTION, POLLUTION CONTROL TECHNOLOGIES AND GLOBAL ENVIRONMENTAL PROBLEMS

Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary; Concepts of bioremediation; Global environmental problems and global efforts: Climate change, ozone depletion, ozone depleting substances, deforestation and desertification

MODULE-V	ENVIRONMENTAL LEGISLATIONS AND SUSTAINABLE DEVELOPMENT

Environmental legislations: Environmental protection act, air act1981, water act, forest act, wild life act, municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rules, Environmental impact assessment(EIA); Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building

Text Books:

1. Benny Joseph, “Environmental Studies”, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2005.
2. Erach Bharucha, “Textbook of Environmental Studies for Undergraduate Courses”, Universities Press. 2005.

Reference Books:

1. Anji Reddy .M, “Textbook of Environmental Sciences and Technology”, BS Publications, 2007.
2. Anjaneyulu, “Introduction to Environmental Sciences”, BS Publications, 2004.
3. Anubha Kaushik, Perspectives in Environmental Science, New age international. 3rd Edition, 2006.
4. Tyler Miller, Scott Spoolman, “Environmental Science”, Cengage Learning, 14th Edition, 2012.

Web References:

1. https://www.tndte.com
2. https://www.nptel.ac.in/downloads
3. https://www.scribd.com
4. https://www.cuiet.info
5. https://www.sbtebihar.gov.in
6. https://www.ritchennai.org

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

VII Semester: AE / CSE / IT / ECE / EEE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB17	Mandatory	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

COURSE OBJECTIVES:

The course should enable the students to:

I. Understand the concept of Traditional knowledge and its importance
II. Know the need and importance of protecting traditional knowledge.
III. Know the various enactments related to the protection of traditional knowledge.
IV. Understand the concepts of Intellectual property to protect the traditional knowledge

MODULE-I	INTRODUCTION TO TRADITIONAL KNOWLEDGE

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

MODULE-II	PROTECTION OF TRADITIONAL KNOWLEDGE

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

MODULE-III	LEGAL FRAME WORK AND TK

A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act);

B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

MODULE-IV	TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

MODULE-V	TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS:

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK. 139.

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh Pratibha Prakashan 2012.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2

VISION AND MISSION OF THE INSTITUTE

VISION

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

B.TECH - PROGRAM OUTCOMES (POS)

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**).

PO-2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).**

PO-3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).**

PO-4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).**

PO-5: 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 **(Modern Tool Usage).**

PO-6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).**

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).**

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).**

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).**

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).**

PO-11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments **(Project management and finance).**

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(Life-long learning).**

OBJECTIVES OF THE DEPARTMENT

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

A graduate of the Mechanical Engineering Program should:

PEO – I: To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems.

PEO – II: To prepare students for successful careers in industry that meet the needs of local, Indian and multinational companies.

PEO – III: To develop the ability among students to synthesize data and technical concepts for application to product design and prepares students to work as part of teams on multidisciplinary projects.

PEO – IV: To promote student awareness for life-long learning and to introduce them to codes of professional practice, ethics and prepare them for higher studies.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO – I: To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.

PSO – II: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.

PSO – III: To build the nation, by imparting technological inputs and managerial skills to become Technocrats.

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University

In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its own powers to grant autonomy directly to Govt. and Govt. aided Colleges.

2 Shall IARE award its own Degrees?

No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3 What is the difference between a Deemed University and an Autonomy College?

A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4 How will the Foreign Universities or other stake – holders know that we are an Autonomous College?

Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5 What is the change of Status for Students and Teachers if we become Autonomous?

An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6 Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?

There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Program Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7 Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?

No. IARE has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8 Can IARE have its own Convocation?

No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9 Can IARE give a provisional degree certificate?

Since the examinations are conducted by IARE and the results are also declared by IARE, the college sends a list of successful candidates with their final Grades and Grade Point Averages including CGPA to the University. Therefore with the prior permission of the University the college will be

entitled to give the provisional certificate.

10 Will Academic Autonomy make a positive impact on the Placements or Employability?

Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11 What is the proportion of Internal and External Assessment as an Autonomous College?

Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12 Is it possible to have complete Internal Assessment for Theory or Practicals?

Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13 Why Credit based Grade System?

The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14 What exactly is a Credit based Grade System?

The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15 What are the norms for the number of Credits per Semester and total number of Credits for UG/PG program?

These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16 What is a Semester Grade Point Average (SGPA)?

The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and i represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17 What is a Cumulative Grade Point Average (CGPA)?

An up-to-date assessment of overall performance of a student from the time of his first registration is

obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{m} \left(C_j S_j \right) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester. CGPA is rounded to two decimal places.

18 Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19 Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20 Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21 How fast Syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22 Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23 What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in every body is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24 Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Boared of Studies level are to be ratified at the Academic Council and Governing Body.

25 What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations spot valuations, tabulations preparation of Grade Sheet etc fall within the duties of the Examination Committee.

26 Is there any mechanism for Grievance Redressal?

The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27 How many attempts are permitted for obtaining a Degree?

All such matters are defined in Rules & Regulation

28 Who declares the result?

The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29 Who will keep the Student Academic Records, University or IARE?

It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30 What is our relationship with the JNT University?

We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31 Shall we require University approval if we want to start any New Courses?

Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32 Shall we get autonomy for PG and Doctoral Programs also?

Yes, presently our PG programs also enjoying autonomous status.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	**Nature of Malpractices/Improper conduct**	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculator, cell phone, pager, palm computer or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Controller of Examinations.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the COE or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the COE or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the Institute premises or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

UNDERTAKING BY STUDENT / PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr. / Ms. ---------- joining I Semester / III Semester for the academic year 2018-2019 / 2019-2020 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/laboratory/project) and secure attendance of not less than 75% in every course as stipulated by Institute. I am fully aware that an attendance of less than 65% in more than 60% of theory courses in a semester will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus/Hostel/Residence and attend all the tests to secure more than the minimum prescribed Class/Sessional Marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the HOD concerned/ Principal.
11. I hereby acknowledge that I have received a copy of IARE - R18 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number