B.TECH | MECHANICAL ENGINEERING

Academic Regulations, Course Structure and Detailed Syllabus

(Applicable for the batches Admitted 2018-19 Onwards)

ANURAG
Engineering Engineers

R18

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)
Ananthagiri (V&M), Kodad, Suryapet (Dist),
Telangana, INDIA. Pin : 508 206.

MECHANICAL ENGINEERING

ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

FOR
B.TECH FOUR YEAR DEGREE COURSE
(Applicable for the batches admitted from 2018-2019)

Regulation: R18

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B.Tech R18 Regulations

DEFINITIONS OF KEY WORDS:

Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses (elective or minor or soft skill courses).

Course: Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weightage. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/ laboratory work/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars/ term papers/ assignments/ presentations/ self-study etc. or a combination of some of these.

Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/ field work per week.

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

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

Letter Grade: It is an index of the performance of students in a said course.
Grades are denoted by letters O, A+, A, B+, B, P and F.

Semester Grade Point Average (SGPA): It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

Cumulative Grade Point Average (CGPA): It is a measure of overall cumulative performance of a student over all 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.

Programme: An educational programme leading to award of a Degree, diploma or certificate.

Semester: Each semester shall consist of 16 weeks of instruction. The odd semester may be scheduled from June to November and even semester from December to May.

Transcript or Grade Card or Certificate: Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

Types of Courses: The Courses in a programme may be of three kinds: Core, Elective and Foundation.

Core Course:-

This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study, called as "Professional Core".

Elective Course:-

Elective course is a course which can be chosen from a pool of papers. 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 "Generic Elective" focusing on those courses which add generic proficiency to the students. An elective may be "Discipline centric" called "Professional Elective" or may be chosen from an unrelated discipline, called as an "Open Elective."

Foundation Course:-

The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. "Compulsory Foundation" courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at man-making education.

ACADEMIC REGULATIONS FOR B. TECH. (REGULAR)

Applicable for the students of B. Tech. (Regular) from the Academic Year 2018-19 onwards

1. Title and Duration of the Programme

1.1 The course shall be called the degree programme in Bachelor of Technology, abbreviated as B.Tech.

1.2 The programme shall be of four academic years duration divided into eight semesters, each semester having duration of minimum 16 weeks of instruction.

1.3 The calendar of events in respect of the programme shall be fixed by the Institute from time to time.

1.4 The external examination in all the subjects shall be conducted at the end of each semester for all the eight semesters.

1.5 Students joining the B.Tech. Programme shall have to complete the programme within a stipulated time frame of 8 years from the year of joining and Students joining the B.Tech. Programme in the third semester directly through Lateral Entry Scheme (LES) shall have to complete the programme within a stipulated time frame of 6 years from the year of joining. Otherwise they shall forfeit their seat in B.Tech Programme and their admission shall stand cancelled.

2. Admission Procedure

2.1 Admissions shall be done as per the norms prescribed by the Government of Telangana State.

2.2 The Government orders in vogue shall prevail.

2.3 The candidate should have passed the prescribed qualifying examination on the date of admission.

3. Award of B. Tech. Degree

A student shall declared eligible for the award of B. Tech. Degree if he fulfills the following academic requirements:

3.1 The candidate shall pursue a course of study for not less than four academic years and not more than eight academic years.

3.2 The candidate shall register for 160 credits and secure all the 160 credits by securing a minimum CGPA of 5.0.

3.3 The students, who fail to fulfill the academic requirements for the award of the degree within eight academic years from the year of admission, shall forfeit their admission in B.Tech. Course.

4. Programmes Offered

The following B. Tech. Programmes are offered at present:

Branch	Branch Code
Civil Engineering	01
Electrical and Electronics Engineering	02
Mechanical Engineering	03
Electronics and Communication Engineering	04
Computer Science and Engineering	05

and any other course as approved by the Authorities from time to time.

5. Credits Distribution

Semester		
	Contact Periods / week	**Credits**
Theory	04	04
	03	03
	02	02
Practical	03 02	1.5 01
Drawing	00+04 02+02 00+06	02 03 03
Mini Project	--	02
Seminar	4	02
Project	20 (08+12)	10 (04+06)

6. Distribution and Weight age of Marks

6.1 The performance of a student in a semester shall be evaluated subject-wise for a maximum of 100 marks each for a theory and practical subject. In addition, industry-oriented Mini-project / Summer Internship, Seminar, Project Work Stage I and Project Work Stage II shall be evaluated for 100 marks each.

6.2 For theory subjects, the distribution shall be 25 marks for Continuous Internal Evaluation (CIE) and 75 marks for the Semester End Examination (SEE).

6.3 For theory courses, during the semester there shall be two midterm examinations as part of CIE. Each midterm examination consists of Part-A (Short Answers) for 5 marks and Part-B (Long Answers) for 15 marks with duration of 90 minutes and an assignment carrying 5 marks.

Part-A contains 5 questions. Each question carries 1 mark. Part-B shall contain 3 questions with internal choice, each carries 5 marks. First midterm examination shall be conducted for 2.5 units of syllabus and second midterm examination shall be conducted for remaining 2.5 units. The Assignment should be completed a week prior to the conduct of the midterm examinations.

The total marks secured by the student in each midterm examination for 25 marks are considered and the average of the two midterm examinations shall be taken as the final marks secured by each student. If a student is absent for any midterm examination / assignment, he/she is awarded zero marks for that midterm examination / assignment.

6.4 The Semester End Examination will be conducted for 75 marks which consist of two parts viz. i). Part-A for 25 marks, ii). Part –B for 50 marks.

6.5 Part-A is compulsory, which consists of ten questions (numbered from 1 to 10) two from each unit i.e., one question carrying 2 marks and the other question carrying 3 marks.

6.6 Part-B consists of five questions (numbered from 11 to 15) carrying 10 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an “either” “or” choice (that means there will be two questions from each unit and the student should answer any one question).

6.7 For practical courses, during the semester there shall be two practical midterm examinations for CIE. CIE carries 25 marks. Out of the 25 marks for CIE, day-to-day work in the laboratory shall be evaluated for 15 marks and internal practical examination shall be evaluated for 10 marks conducted by the laboratory teacher concerned. The 15 marks for day-to-day work shall be considered only if the student attends the practical examination when conducted. The total marks secured by the student in each practical midterm examination for 25 marks are considered and the average of the two practical midterm examinations shall be taken as the final marks secured by each student.

6.8 Practical SEE is conducted for 75 marks. The practical SEE shall be conducted with an external examiner along with the internal examiner. The external examiner shall be appointed by the Principal from the panel of examiners recommended by Chairman, Board of Studies / HoD of the respective branch.

6.9 For the subjects having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 25 marks for internal evaluation (15 marks for day-to-day work and 10 marks for internal tests) and 75 marks for end examination. There shall be two midterm examinations in a semester and the average of the two shall be considered for the award of marks for midterm examinations. The 15 marks for day-to-day work shall be considered only if the student attends the midterm examination when conducted.

6.10 For subjects like Engineering Graphics/Engineering Drawing, the SEE shall consist of five questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions. There shall be no Part – A, and Part – B system.

6.11 For subjects like Machine Drawing Practice/Machine Drawing, the SEE shall be conducted for 75 marks consisting of two parts viz. (i) Part – A for 30 marks. 2 out of 4 questions must be answered, (ii) Part – B for 45 marks. Part – B is compulsory.

6.12 There shall be an Industry-Oriented Mini-Project / Summer Internship, to be taken up during the vacation after III year II Semester examination. However, the Industry-Oriented Mini-Project / Summer Internship and its report shall be evaluated in IV year I Semester. The Industry-Oriented Mini-Project / Summer Internship shall be submitted in the report form and should be presented before the committee, which shall be evaluated for 75 marks. The committee consists of an external examiner, head of the department and the supervisor of Industry-Oriented Mini-Project / Summer. There shall be 25 marks for internal assessment of Industry-Oriented Mini-Project / Summer Internship. The Supervisor awards the internal marks based on the periodical evaluation during the Industry-Oriented Mini-Project / Summer Internship.

6.13 There shall be a seminar presentation in IV year II Semester. For the seminar, the student shall collect the information on a specialized topic in the respective discipline and prepare a technical report, showing his understanding of the topic, and submit it to the department. It shall be evaluated by the departmental committee consisting of Head of the Department, Seminar Supervisor and a senior faculty member. The seminar report shall be evaluated for 100 marks. Out of 100 marks, 25 marks should be awarded by the Supervisor and 75 marks should be awarded by the Departmental Committee. There shall be no external examination for the seminar.

6.14 B.Tech Project Work shall be carried out in two stages: Project Stage – I during IV Year I Semester, Project Stage – II during IV Year II Semester. Each stage will be evaluated for 100 marks. Student has to submit project work report at the end of each semester. First report includes project work carried out in IV Year I semester and second report includes project work carried out in IV Year I & II Semesters. SEE for both project stages shall be completed before the commencement of SEE Theory examinations.

6.15 For Project Stage – I, the departmental committee consisting of Head of the Department, project supervisor and a senior faculty member shall evaluate the project work for 75 marks and project supervisor shall evaluate for 25 marks. The student is deemed to have failed, if he (i) does not submit a report on Project Stage - I or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) secures less than 40% marks in the sum total of the CIE and SEE taken together. A student who has failed may reappear once for the above evaluation, when it is scheduled again; if he fails in such 'one reappearance' evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

6.16 For Project Stage – II, the external examiner shall evaluate the project work for 75 marks and the project supervisor shall evaluate it for 25 marks.

The topics for Industrial Oriented Mini-Project, Seminar and Project Stage – I shall be different from one another. The student is deemed to have failed, if he (i) does not submit a report on Project Stage - II, or does not make a presentation of the same before the external examiner as per schedule, or (ii) secures less than 40% marks in the sum total of the CIE and SEE taken together. For conducting viva-voce of project stage – II, Principal selects an external examiner from the Panel of Experts submitted by Chairman, BoS / HoD of the respective branch.

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if student fails in such 'one reappearance' evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

6.17 For mandatory courses of, Gender Sensitization, Human Values and Professional Ethics, Constitution of India and Intellectual Property Rights, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the Continuous Internal Evaluation for passing the subject/course. These marks should also be processed along with the internal marks of other subjects. There is no Semester End Examination for mandatory courses.

6.18 No marks or letter grades shall be allotted for mandatory/non-credit courses. Only Pass/Fail shall be indicated in Grade Card.

6.19 The theory / practical midterm examination marks awarded by the faculty are subject to scrutiny and scaling by the Institution whenever/wherever necessary. In such cases, theory / practical midterm examination marks awarded by the teacher will be referred to a committee consisting of Principal, Chairman, BoS / HoD, CoE and Subject Expert. The committee will arrive at a scaling factor and the marks will be scaled accordingly. The recommendations of the committee are final and binding. The laboratory records and midterm examination scripts shall be preserved as per the University rules and produced before the Committees of the University as and when asked for.

6.20 Candidates shall be permitted to apply for recounting/revaluation of SEE scripts within the stipulated period with payment of prescribed fee.

7. Attendance Requirements

7.1 A student is eligible to write the semester end examinations only if he / she acquire a minimum of 75% of attendance in aggregate of all the subjects.

7.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted on medical grounds as approved by the Academic Council.

7.3 A stipulated fee shall be payable towards condonation of shortage of attendance.

7.4 Shortage of attendance below 65% in aggregate shall not be condoned.

7.5 Students whose shortage of attendance is not condoned are not eligible to write semester end examinations of that semester. Such students are detained and their registration for examination stands cancelled.

7.6 A student detained due to shortage of attendance in a semester may seek re-admission into that semester, as and when offered, within four weeks from the date of the commencement of class work with the academic regulations of the batch into which he/she gets admitted.

7.7 A student will be promoted to the next semester if he/she satisfies the attendance requirement of the present semester and shall not be eligible for re-admission into the same semester.

7.8 For all mandatory, non-credit courses offered in a semester, a "Satisfactory Participation Certificate" shall be issued to the student from the concerned authorities, only after securing $\geq 75\%$ attendance in such a course. No marks or Letter Grade shall be allotted for these activities (Refer to 15.2)

8. MINIMUM ACADEMIC REQUIREMENTS

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in Item no.7.

8.1 A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical/design/drawing subject/project and secured not less 35% marks in semester end examination (SEE), and minimum 40% of marks in the sum total of the internal evaluation and end examination taken together.

8.2 The student has to pass the failed course by appearing the supplementary examination as per the requirement for the award of degree.

8.3 Students, who fail to earn 160 credits as indicated in the course structure within eight academic years from the year of their admission, shall forfeit their admission in B. Tech. Programme.

8.4 A student shall be promoted from I Year to II Year only if he/she fulfills the academic requirements of securing 50% of average credits (19 credits out of 38 credits) up to I year II Semester, from all the examinations, whether or not the candidate takes the examinations.

8.5 A student shall be promoted from II Year to III Year only if he/she fulfills the academic requirements of securing 50% of average credits (39 credits out of 79 credits) up to II year II semester, from all the examinations, whether or not the candidate takes the examinations.

8.6 A student shall be promoted from III year to IV year only if he/she fulfills the academic requirements of securing 50% of average credits (60 credits out of 121 credits) up to III year II semester, from all the examinations, whether or not the candidate takes the examinations.

8.7 A student shall register and put up attendance in all 160 credits and earn all 160 credits for the award of degree.

8.8 When a student is detained due to shortage of attendance in any semester, no grade allotments or SGPA/CGPA calculations will be done for that entire semester in which he got detained.

8.9 When a student is detained due to lack of credits in any year, he/she may be readmitted after fulfillment of the academic requirements, with the academic regulations of the batch into which he gets readmitted subject to 3.3.

8.10 For readmitted candidates, if there are any professional electives / open electives, the same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the set of elective subjects offered under that category.

8.11 If a student registers for some more 'extra Subjects' (in the parent department or other departments / branches of engineering) other than those listed subjects totaling to 160 credits as specified in the course structure of his department, the performances in those 'extra Subjects' (although evaluated and graded using the same procedure as that of the required 160 Credits) will not be taken into account while calculating the SGPA and CGPA. For such 'extra Subjects' registered, Letter Grade alone will be indicated in the Grade Card, as a performance measure, subject to completion of the Attendance and Academic Requirements as stated in Items 7 and 8.1 – 8.10 above.

9. Program Structure:

S. No.	Classification		Course Work - Subject Area
	AICTE	UGC	
1	HS	Foundation Courses	Humanities and Social Sciences including Management; (HS),
2	BS		Basic Sciences(BS) including Mathematics, Physics, Chemistry, Biology;
3	ES		Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/ Electronics/ Mechanical/Computer Engineering Instrumentation;
4	MC		Mandatory Courses like Gender Sensitization, Human Values and Professional Ethics, Constitution of India and Intellectual Property Rights, Environmental science etc.
5	PC	Core Courses	Professional Subjects-Core (PC), relevant to the chosen specialization/branch;
6	PW		Project Work, Seminar and/or Internship in Industry or elsewhere.
7	PE	Elective Courses	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;
8	OE		Open Subjects- Electives (OE), from other technical and/or emerging subject areas;

10. Programme pattern

10.1 The entire Programme of study is for four academic years in semester pattern.

10.2 A student eligible to appear for semester end examinations in a subject, but absent from it or failed in that examination, may write the examination in that subject during supplementary examinations.

10.3 A student eligible to appear in the Semester End Examination in any subject / course, but absent at it or failed (thereby failing to secure P Grade or above), may reappear for that subject / course at the supplementary as and when examination conducted. In such cases, his Continuous Internal Evaluation (CIE) assessed earlier for that subject/course will be carried over, and added to the marks to be obtained in the supplementary examinations, for evaluating his performance in that course.

11. Minimum Instruction

The minimum instruction for each semester shall be 16 weeks.

12. Grade Points

12.1 Marks will be awarded to indicate the performance of each student in each theory course, or Lab / Practical, or Seminar, or Project, or Industry Oriented Mini-Project, Minor Course etc., based on the % marks obtained in CIE+SEE(Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

12.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed.

Letter Grade	Grade Points	% of marks Secured (Class Intervals)
O (Out Standing)	10	90% and above (≥90%, ≤100%)
A+ (Excellent)	9	Below 90% but not less than 80% (≥80%, <90%)
A (Very Good)	8	Below 80% but not less than 70% (≥70%, < 80%)
B+ (Good)	7	Below 70% but not less than 60% (≥60%, < 70%)
B (Average)	6	Below 60% but not less than 50% (≥50%, < 60%)
P (Pass)	5	Below 50% but not less than 40% (≥40%, < 50%)
F (Fail)	0	Below 40% (< 40%)
Ab (Absent)	0	--

12.3 A student obtaining F Grade in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when conducted. In such cases; his Internal Marks (CIE Marks) in those Subject(s) will remain same as those he obtained earlier.

12.4 A Letter Grade does not imply any specific % of Marks.

12.5 In general, a student shall not be permitted to repeat any Subject/Course (s) only for the sake of 'Grade Improvement' or 'SGPA/CGPA Improvement'. However, he has to repeat all the Subjects/Courses pertaining to that Semester, when he / she is detained (as listed in items 8.10).

12.6 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits For a Course

12.7 The Student passes the Subject/ Course only when he gets GP ≥ 5 (P Grade or above).

13. Registration/Dropping

13.1 Each student has to compulsorily register for course work at the beginning of each semester as per the schedule mentioned in the Academic Calendar.

13.2 A student at the end of II year II semester either having the CGPA of ≥ 7.0 or having passed all previous courses in first attempt with a minimum CGPA ≥ 5.0 is allowed to register an additional theory course/credits. However mandatory non credit courses can be registered during the course of study with the consent of the faculty advisor.

13.3 A student would be allowed to register in an additional course only if he/she satisfies the prerequisites.

13.4 Departments will notify at the time of registration about the minimum number of students to be enrolled for a particular course to be offered.

13.5 Any student may be barred from registering for any course for specific reasons like disciplinary reasons, non- payment of fees, etc.

13.6 Dropping of Courses: Within four weeks after the commencement of the semester, the student may, in consultation with his / her faculty advisor, drop one or more courses. The dropped courses are not recorded in the Grade Card.

14. Earning of Credit

A student shall be considered to have completed a Course successfully and earned the credits if he/she secures an acceptable letter grade in the range 'O' to 'P'. Letter grade 'F' in any Course implies failure of the student in that Course and no credits earned.

15. Passing Standards:

15.1 A student shall be declared successful or 'passed' in a Semester, only when he gets a SGPA ≥ 5.00 (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire B.Tech programme, only when he/she gets a CGPA ≥ 5.00; subject to the condition that he secures a GP ≥ 5 (P Grade or above) in every registered Subject/ Course in each Semester (during the entire B.Tech programme) for the Degree Award, as required.

15.2 A Student shall be declared successful or 'passed' in any Non-Credit Subject/ Course, if he secures a 'Satisfactory Participation Certificate' for that Mandatory Course.

15.3 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade earned etc.), Credits earned, SGPA, and CGPA.

16. Vertical Progression

It shall also be necessary to lay down uniform minimum standards for SGPA and CGPA together with the minimum number of *credits* to be earned in a semester for the *vertical progression* of students. This shall be used in facilitating the mobility of students from one College to another and also in avoiding any confusion among the students. The

a) Minimum Standard for SGPA =5.0;
b) Minimum Standard for CGPA =5.0; (at the end of each semester)

However, failure to secure a minimum CGPA = 5.0 at the end of any semester for the first time, shall **attract a warning** before approval of the student to continue in the following semester.

17. Eligibility for Award of B.Tech. Degree

A student shall be eligible for award of the B.Tech degree if he/she fulfils all the following conditions;

17.1 Registered and successfully completed all the components prescribed in the Programme of study to which he/she is admitted by securing 160 credits,

17.2 Obtained CGPA greater than or equal to 5.0 (Minimum requirements for Pass),

17.3 Has no dues to the Institute, hostels, Libraries, NCC/NSS etc., and

17.4 No disciplinary action is pending against him/her.

18. Award of Class

18.1 A student who registers for all the specified subjects/ courses as listed in the course structure and secures the required number of 160 credits (with CGPA ≥ 5.0), within 8 academic years from the date of commencement of the first academic year, shall be declared to have 'qualified' for the award of the B.Tech. degree in the chosen branch of Engineering as selected at the time of admission.

18.2 A student who qualifies for the award of the degree as listed in item 18.1 shall be placed in the following classes.

18.3 Students with final CGPA (at the end of the B.Tech programme) ≥ 8.00, and fulfilling the following conditions -

i. Should have passed all the subjects/courses in 'first appearance' in regular semester examinations within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

ii. Should have secured a CGPA ≥ 8.00, at the end of each of the 8 sequential semesters, starting from I year I semester onwards.

iii. Should not have been detained or prevented from writing the end semester examinations in any semester due to shortage of attendance or any other reason, shall be placed in 'first class with distinction'.

18.4 The Students who secure CGPA ≥ 8.00 not fulfilling the above conditions (18.3) shall be awarded 'first class'.

18.5 Students with final CGPA (at the end of the B.Tech Programme) ≥ 6.50 but < 8.00, shall be placed in 'first class'.

18.6 Students with final CGPA (at the end of the B.Tech Programme) ≥ 5.50 but < 6.50, shall be placed in 'second class'.

18.7 All other students who qualify for the award of the degree (as per item 18.1), with final CGPA (at the end of the B.Tech Programme) ≥ 5.00 but < 5.50, shall be placed in 'pass class'.

18.8 A student with final CGPA (at the end of the B.Tech Programme) < 5.00 will not be eligible for the award of the degree.

18.9 Students fulfilling the conditions listed under item 18.3 alone will be eligible for award of 'college rank' and 'gold medal'.

18.10 The marks obtained in Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) will not be shown in the memorandum of Grade Sheet.

18.11 The CGPA can be converted to equivalent percentage of marks by using the following equation:

(CGPA - 0.5) X 10

19. Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the candidates will be issued after completion of the four years B. Tech Programme.

20. Withholding of Results

If the student has not paid the dues, if any, to the Institute or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases the matter will be referred to the academic council. The decision of the academic council is final.

21. Transitory Regulations

21.1 Discontinued, detained, or failed candidates are eligible for readmission as and when next offered as per the college admission procedure.

21.2 Students on transfer shall complete the prescribed courses of the concerned programme not covered earlier and however he/she should take the remaining programme along with others.

21.3 There shall be no branch transfers after the cut-off date of admissions in the academic year.

22. Transcripts

After successful completion of the total Programme of study, a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee.

23. Supplementary Examinations

In addition to the Regular Semester End Examinations held at the end of each semester, Supplementary Final Examinations will be conducted during the academic year. Candidates taking the Regular / Supplementary examinations as Supplementary candidates may have to take more than one End Semester 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 cannot be relaxed under any circumstances.

24. Graduation Ceremony

a. The College shall have its own annual Graduation Ceremony for the award of degree to students completing the prescribed academic requirements in each case, in consultation with the University and by following the provisions in the Statute.
b. The College shall institute Prizes and Awards to meritorious students, for being given away annually at the Graduation Ceremony.

25. Termination from the Program

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

a. The student fails to satisfy the requirements of the programme within the maximum period stipulated for that program.
b. The student fails to satisfy the norms of discipline specified by the Institute from time to time.

26. Non-Credit Courses (Mandatory Courses)

a. All the courses designated as mandatory course is a compulsory requirement for all students for the award of degree.
b. These activities carry no credits and are evaluated as Satisfactory/ Unsatisfactory.
c. Minimum attendance requirement as per the regulations is compulsory for completing the mandatory courses.

27. Amendments

a. The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already undergoing the program) as may be decided by the Academic Council.

28. General

a. Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
b. The academic regulation should be read as a whole for the purpose of any interpretation.
c. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

ACADEMIC REGULATIONS FOR B. TECH - LATERAL ENTRY SCHEME (LES)

Applicable for the students admitted into II year B. Tech. (Lateral Entry Scheme) from the Academic Year 2019-20 and onwards

1. Eligibility for award of B. Tech. Degree (LES)

1.1 The LES candidates shall pursue a course of study for not less than three academic years and not more than six academic years.

1.2 The candidate shall register for 122 credits and secure 122 credits by securing a minimum CGPA of 5.0 from II to IV year B.Tech. Program (LES) for the award of B.Tech. degree.

1.3 The students, who fail to fulfill the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their admission.

1.4 The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech.(LES) scheme.

2. **Promotion Rule**

A student shall be eligible for promotion in B.Tech programme, if he/she acquires the minimum number of credits as given below:

2.1 A student shall be promoted from II Year to III Year only if he/she fulfills the academic requirements of securing 50% of average credits (20 credits out of 41 credits) up to II year II semester, from all the examinations, whether or not the candidate takes the examinations.

2.2 A student shall be promoted from III year to IV year only if he/she fulfills the academic requirements of securing 50% of average credits (41 credits out of 83 credits) up to III year II semester, from all the examinations, whether or not the candidate takes the examinations.

2.3 A student shall register and put up attendance in all 122 credits and earn all 122 credits to be eligible for award of degree.

2.4 Students, who fail to earn 122 credits as indicated in the course structure within six academic years, shall forfeit their seat in B.Tech. programme and their admission stands cancelled.

3. All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B.Tech. (Lateral Entry Scheme).

--*

ANNEXURE – I

1 Grade Point Average

1.1 SGPA and CGPA

The *credit index* can be used further for calculating the Semester Grade Point Average *(SGPA)* and the Cumulative Grade Point Average *(CGPA),* both of which being important performance indices of the student. While *SGPA* is equal to the *credit index* for a semester divided by the total number of *credits* registered by the student in that semester, *CGPA* gives the sum total of *credit indices* of all the previous semesters divided by the total number of *credits* registered in all these semesters. Thus, the Grade Point Average (GPA) will be calculated according to the formula:

$$GPA = \frac{\sum CiGi}{\sum Ci}$$

Where C_i = number of credits for the course i,
G_i = grade points obtained by the student in the course.

1.2 Semester Grade Point Average (SGPA) is awarded to candidates considering all the courses of the semester. Zero grade points are also included in this computation. SGPA is rounded off to TWO Decimal Places.

SGPA will be computed as follows;

∑ [(Course *credits*) X (*Grade points*)] (for all Courses passed in that semester)

∑ [(Course *credits*)] (for all courses registered in that semester)

1.3 To arrive at Cumulative Grade Point Average (CGPA), the formula is used considering the student's performance in all the courses taken in all the semesters completed up to the particular point of time. CGPA is rounded off to TWO Decimal Places.

CGPA will be computed as follows:

∑ [(Course *credits*) X (*Grade points*)] (for all Courses passed upto that semester)

∑ [(Course *credits*)] (for all Courses registered until that semester)

CGPA is thus computed from the I Year First Semester onwards, at the end of each Semester, as per the above formula. However, the SGPA of I year I Semester itself may be taken as the CGPA, as there are no cumulative effects.

1.4 Illustrative Example

An illustrative example given in below Table below indicates the use of the above two equations in calculating SGPA and CGPA, both of which facilitate the declaration of academic performance of a student, at the end of a semester and at the end of successive semesters respectively . Both of them shall be normally calculated up to the second decimal position, so that the CGPA, in particular, can be made use of in rank ordering the student's performance in a class. If two students get the same CGPA, the tie should be resolved by considering the number of times a student has obtained higher SGPA; But, if it is not resolved even at this stage, the number of times a student has obtained higher grades like O, A, B etc shall be taken into account in rank ordering of the students in a class.

Year and Semester	Course No.	Credits	Grade	Grade Points	Credit Points
I year I sem	XX101	5	A	8	40
I year I sem	XX102	4	F	0	00
I year I sem	XX103	3	A+	9	27
I year I sem	XX104	4	F	0	00
I year I sem	XX105	5	P	5	25
I year I sem	XX106	5	P	5	25
Total		**26 (18*)**			**117**
SGPA = 117/26 = 4.5					**CGPA = 4.5**
I year II sem	XX107	5	B+	7	35
I year II sem	XX108	4	A	8	32
I year II sem	XX109	3	P	5	15
I year II sem	XX110	5	P	5	25
I year II sem	XX111	4	A+	9	36
I year II sem	XX112	2	F	0	00
I year II sem	XX113	2	A	8	16
Total		**25 (23*)**			**159**
SGPA = 159/25 = 6.36					**CGPA = 276/51 = 5.41**

*Total No. of credits excluding those with 'F'; this is particularly important to keep track of the number of credits earned by a student up to any semester.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course (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 course (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 course 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 course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester. The Hall Ticket of the candidate is to be cancelled.
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 courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all END examinations. The continuation of the course by the candidate is course 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all END examinations. The continuation of the Programme 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 course.
6.	Refuses to obey the orders of the Chief Controllerof Exams/Chief Superintendent / Assistant Superintendent / 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 officer-in charge 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	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the

	words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, 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 College campus 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.	police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester.

11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that semester examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the PRINCIPAL for further action to award suitable punishment.	

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)
Mechanical Engineering
COURSE STRUCTURE (R18)

I YEAR I SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	MA101BS	Mathematics-I	BS	3	1	0	4	25	75	100
2	CH102BS	Engineering Chemistry	BS	3	1	0	4	25	75	100
3	EN103HS	English	HS	2	0	0	2	25	75	100
4	CS104ES	Programming for Problem Solving-I	ES	2	0	0	2	25	75	100
5	CH105BS	Engineering Chemistry Lab	BS	0	0	3	1.5	25	75	100
6	EN106HS	English Language Communication Skills Lab-I	HS	0	0	2	1	25	75	100
7	CS107ES	Programming for Problem Solving-I Lab	ES	0	0	2	1	25	75	100
8	ME108ES	Engineering Workshop	ES	0	0	3	1.5	25	75	100
Total				**10**	**2**	**10**	**17**	**200**	**600**	**800**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

I YEAR II SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	MA201BS	Mathematics-II	BS	3	1	0	4	25	75	100
2	PH202BS	Engineering Physics	BS	3	1	0	4	25	75	100
3	ME203ES	Engineering Mechanics	ES	3	1	0	4	25	75	100
4	CS204ES	Programming for Problem Solving-II	ES	2	0	0	2	25	75	100
5	ME205ES	Engineering Graphics	ES	1	0	3	3	25	75	100
6	PH206BS	Engineering Physics I Lab	BS	0	0	3	1.5	25	75	100
7	CS207ES	Programming for Problem Solving-II Lab	ES	0	0	3	1.5	25	75	100
8	ME208HS	English Language Communication Skills Lab-II	HS	0	0	2	1	25	75	100
Total				**12**	**3**	**11**	**21**	**200**	**600**	**800**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

Mechanical Engineering
COURSE STRUCTURE (R18)

II YEAR I SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	AM301BS	Numerical Methods &Partial Differential Equations	BS	3	0	0	3	25	75	100
2	ES302BS	Environmental Sciences	BS	3	0	0	3	25	75	100
3	ME303ES	Metallurgy and Material Science	ES	3	0	0	3	25	75	100
4	EE304ES	Basic Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
5	ME305PC	Mechanics of Solids	PC	3	1	0	4	25	75	100
6	ME306PC	Thermodynamics	PC	3	0	0	3	25	75	100
7	ME307ES	Metallurgy and Mechanics of Solids Lab	ES	0	0	2	1	25	75	100
8	ME308PC	Basic CAD Lab	PC	0	0	2	1	25	75	100
9	HS309MC	Gender Sensitization	MC	0	0	2	0	100	0	100
Total				**18**	**1**	**6**	**21**	**300**	**600**	**900**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

II YEAR IISEMSESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	PS401BS	Probability and Statics	BS	3	0	0	3	25	75	100
2	ME402PC	Kinematics of Machinery	PC	3	0	0	3	25	75	100
3	ME403PC	Production Technology	PC	3	0	0	3	25	75	100
4	ME404PC	Thermal Engineering-I	PC	3	0	0	3	25	75	100
5	ME405PC	Mechanics of Fluids and Hydraulic Machines	PC	3	0	0	3	25	75	100
6	ME406PC	Machine Drawing	PC	3	0	0	3	25	75	100
7	ME407PC	Mechanics of Fluids and Hydraulic Machines Lab	PC	0	0	2	1	25	75	100
8	ME408PC	Production Technology Lab	PC	0	0	2	1	25	75	100
9	HS409MC	Human Values and Professional Ethics	MC	0	0	2	0	100	0	100
Total				**18**	**0**	**6**	**20**	**300**	**600**	**900**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

Mechanical Engineering
COURSE STRUCTURE (R18)

III YEAR I SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	AE501HS	Managerial Economics and Financial Analysis	HS	3	0	0	3	25	75	100
2	ME502PC	Dynamics of Machinery	PC	3	1	0	4	25	75	100
3	ME503PC	Machine Tools & Metrology	PC	3	0	0	3	25	75	100
4	ME504PC	Design Of Machine Members-I	PC	3	0	0	3	25	75	100
5	ME505PC	Thermal Engineering-II	PC	3	0	0	3	25	75	100
6	ME511PE	Professional Elective-I	PE	3	0	0	3	25	75	100
7	ME506PC	Machine Tools & Metrology Lab	PC	0	0	2	1	25	75	100
8	ME507PC	Thermal Engineering Lab	PC	0	0	2	1	25	75	100
9	HS508MC	Constitution of India	MC	0	0	2	0	100	0	100
Total				**18**	**1**	**6**	**21**	**300**	**600**	**900**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

III YEAR II SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	IM601HS	Industrial Management	HS	3	0	0	3	25	75	100
2	ME602PC	Heat Transfer	PC	3	1	0	4	25	75	100
3	ME603PC	Design Of Machine Members-II	PC	3	0	0	3	25	75	100
4	ME604PC	Operations Research	PC	3	0	0	3	25	75	100
5	ME621PE	Professional Elective-II	PE	3	0	0	3	25	75	100
6	ME611OE	Open Elective-I	OE	3	0	0	3	25	75	100
7	EN605HS/ EN505HS	Advanced English Communication Skills Lab	HS	0	0	2	1	25	75	100
8	ME606PC	Heat Transfer lab	PC	0	0	2	1	25	75	100
9	HS607MC	Intellectual Property Rights	MC	0	0	2	0	100	0	100
Total				**18**	**1**	**6**	**21**	**300**	**600**	**900**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

Mechanical Engineering
COURSE STRUCTURE (R18)

IV YEAR I SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	ME701PC	CAD/CAM	PC	3	0	0	3	25	75	100
2	ME702PC	Instrumentation and Control Systems	PC	3	0	0	3	25	75	100
3	ME731PE	Professional Elective-III	PE	3	0	0	3	25	75	100
4	ME741PE	Professional Elective-IV	PE	3	0	0	3	25	75	100
5	ME721OE	Open Elective-II	OE	3	0	0	3	25	75	100
6	ME703PC	Advanced CAD/CAM Lab	PC	0	0	2	1	25	75	100
7	ME704PW	Mini Project Evaluation	PW	0	0	4	2	25	75	100
8	ME705PW	Project Stage-I	PW	0	0	8	4	100	0	100
Total				**15**	**0**	**14**	**22**	**275**	**525**	**800**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

IV YEAR II SEMESTER:

S.No	Course Code	Course Title	Cat	L	T	P	Credits	Internal Marks	External Marks	Total Marks
1	ME851PE	Professional Elective-V	PE	3	0	0	3	25	75	100
2	ME861PE	Professional Elective-VI	PE	3	0	0	3	25	75	100
3	ME831OE	Open Elective-III	OE	3	0	0	3	25	75	100
4	ME741PE	Seminar	PW	0	0	4	2	100	0	100
5	ME721OE	Project Stage-II	PW	0	0	12	6	25	75	100
Total				**9**	**0**	**16**	**17**	**200**	**300**	**500**

T-Tutorial P-Practical D-Drawing L-Lectures C-Credits

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

Mechanical Engineering

LIST OF PROFESSIONAL ELECTIVES:

S. NO	Professional Electives	Course codes	Subjects
1	Professional Elective -I	ME511PE	Automobile engineering
		ME512PE	Welding Technology
		ME513PE	Turbo Machinery
2	Professional Elective -II	ME621PE	Refrigeration & Air Conditioning
		ME622PE	Nano Technology
		ME623PE	Tribology
3	Professional Elective -III	ME731PE	Power Plant Engineering
		ME732PE	Introduction to Finite Element Methods
		ME733PE	Unconventional Machining Process
4	Professional Elective -IV	ME741PE	Automation in Manufacturing Systems
		ME742PE	Plant Layout &Material handling
		ME743PE	Computational Fluid Dynamics
5	Professional Elective -V	ME851PE	Industrial Robotics
		ME852PE	Mechatronics
		ME853PE	Composite Materials
6	Professional Elective -VI	ME861PE	Production planning and Control
		ME862PE	Mechanical vibrations
		ME863PE	Flexible Manufacturing Systems

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

Mechanical Engineering

LIST OF OPEN ELECTIVES:

OPEN ELECTIVE- I			
S.No	**Course code**	**Course**	**Offering Department**
1	CE611OE	Construction Materials	Civil Engineering
2	CE612OE	Waste Management	
3	EE611OE	Solar Photovoltaic Systems	Electrical & Electronics Engineering
4	EE612OE	Electrical Power Generation Systems	
5	ME611OE	Advanced Engineering Materials	Mechanical Engineering
6	ME612OE	Introduction to Automobile Engineering	
7	EC611OE	Principles of Communications	Electronics & Communication
8	EC612OE	Basic Electronic Circuits Simulation &	
9	CS611OE	Software Engineering	Computer Science & Engineering
10	CS612OE	Computer Networks	

OPEN ELECTIVE- II			
S.No.	**Course**	**Course**	**Offering Department**
1	CE721OE	Disaster Management.	Civil Engineering
2	CE722OE	GPS&GIS	
3	EE721OE	Maintenance of Electrical Systems	Electrical & Electronics Engineering
4	EE722OE	Renewable Energy sources	
5	ME721OE	Fundamentals of Refrigeration & Air Conditioning	Mechanical Engineering
6	ME722OE	Industrial Robotics	
7	EC721OE	Principles of Signal Processing	Electronics & Communication
8	EC722OE	Nano Materials and Technology	
9	CS721OE	Object Oriented Analysis and Design	Computer Science & Engineering
10	CS722OE	Cyber forensics	

OPEN ELECTIVE- III			
S.No	**Course**	**Course**	**Offering Department**
1	CE831OE	Project Management	Civil Engineering
2	CE832OE	Safety Engineering	
3	EE831OE	Electrical Engineering materials	Electrical & Electronics Engineering
4	EE832OE	Fuzzy Logic and Its Applications	
5	ME831OE	Power Plant Engineering	Mechanical Engineering
6	ME832OE	Nano Technology	
7	EC831OE	Fundamentals of Embedded system	Electronics & Communication Engineering
8	EC832OE	Biometrics	
9	CS831OE	Software Project Management	Computer Science & Engineering
10	CS832OE	Human Compute Interaction	

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

Mechanical Engineering

PROGRAM OUTCOMES

PO 1) An ability to apply the knowledge of mathematics, science and engineering fundamentals.

PO 2) An ability to conduct Investigations using design of experiments, analysis and interpretation of data to arrive at valid conclusions

PO 3) An ability to design mechanical engineering components and processes within economic, environmental, ethical and manufacturability constraints.

PO 4) An ability to function effectively in multidisciplinary teams.

PO 5) An ability to identify, formulates, analyze and solve Mechanical Engineering problems.

PO 6) An ability to understand professional, ethical and social responsibility.

PO 7) An ability to communicate effectively through written reports or oral presentations.

PO 8) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO 9) An ability to recognize the need and to engage in independent and life-long learning.

PO 10) A knowledge of contemporary issues

PO 11) An ability to use the appropriate techniques and modern engineering tools necessary for engineering practice

PROGRAM SPECIFIC OBJECTIVES

PSO1: Problem Solving Skills: Ability identifies, analyze and solve engineering problems relating to mechanical engineering system together with allied engineering streams.

PSO2: Professional Skills: Ability to use the software effectively in the design, analysis and manufacturing of mechanical components and systems.

PSO3: Successful Career and Entrepreneurship Skills: An ability of collaborative learning to find out cost-effective, optimal solution, sustainable growth

PROGRAM EDUCATIONAL OBJECTIVES

PEO I: To transcend in professional career by acquiring knowledge in basic sciences, mathematics and mechanical engineering.

PEO II: To exhibit problem solving skills on par with global requirements in industry and R&D

PEO III: To adopt latest technologies, evolve as entrepreneurs, solving mechanical engineering problems, dealing environmental society and ethical issues.

PEO IV: Ability to involve actively in multidisciplinary teams and lifelong learning.

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

I Year B.Tech.MECH - I Sem

L	T	P	C
3	1	0	4

(MA101BS) MATHEMATICS-I

Linear Algebra and Calculus

Prerequisites: To study and understand the MATHEMATICS-I the student must have the basic knowledge of algebra, calculus such as the matrices, solution of linear equations, determinants of matrices, solution of linear equations, limits and continuity, differentiation, integration and partial differentiation

Course Objectives: To learn

1. Concept of a rank of the matrix and investigating the solution of system of equations by applying the concept of consistency.
2. Concepts of Eigen values and Eigen vectors and the nature of quadratic form by finding Eigen values.
3. Concepts of sequence and series and identifying their nature by applying some tests.
4. Mean value theorems geometrical interpretation and their application to the mathematical problems, Evaluation of improper integrals using Beta and Gamma functions
5. Partial differentiation, Total derivative and finding maxima minima of functions of several variables.

UNIT-I: MATRICES AND LINEAR SYSTEM OF EQUATIONS:

Matrices and Linear systems of equations: Real matrices – Symmetric, skew - symmetric, orthogonal, Linear Transformation – Orthogonal Transformation. Complex matrices: Hermitian, Skew – Hermitian and Unitary. Elementary row transformations-Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods (Gauss Jordan).

UNIT-II: EIGEN VALUES AND EIGEN VECTORS:

Eigen values, Eigen vectors – properties, Cayley-Hamilton Theorem (without Proof) - Inverse and powers of a matrix by Cayley-Hamilton theorem – Diagonolization of matrix- Quadratic forms: Nature, Index, Signature.

UNIT-III: SEQUENCES & SERIES:

Basic definitions of Sequences and series, Convergence and divergence, Ratio test, Comparison test, Integral test, Cauchy's root test, Raabe's test, Absolute and conditional convergence.

UNIT-IV: BETA & GAMMA FUNCTIONS AND CALCULUS:

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (only in Cartesian coordinates). Improper Integrals and their properties, Gamma and Beta Functions-Relation between them, their properties – evaluation of improper integrals using Gamma / Beta functions. Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Generalized Mean Value theorem (all theorems without proof) – Geometrical interpretation of Mean value theorems.

UNIT-V: MULTI VARIABLE CALCULUS (PARTIAL DIFFERENTIATION AND APPLICATIONS):

Partial Differentiation and total differentiation, Functional dependence, Jacobian Determinant-Maxima and Minima of functions of two variables with constraints and without constraints, Method of Lagrange Multipliers.

Textbooks:`

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. Introduction to Linear Algebra, by Kolman.

Course Outcomes: After learning the contents of this paper the students must able to:

CO1: Write the matrix representation of system of linear equations and identify the consistency Of the system of equations.

CO2: Find the Eigen values and Eigen vectors of the matrix and discuss the nature of the quadratic form.

CO3: Analyze the convergence of sequence and series.

CO4: Discuss the applications of mean value theorems to the mathematical problems, Evaluation of improper integrals using Beta and Gamma functions.

CO5: Examine the extreme values of functions of two variables with / without constraints.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√	√		√	√			√		√
CO 2	√	√	√		√	√			√		√
CO 3	√	√			√	√			√		√
CO 4	√	√			√	√			√		√
CO 5	√	√			√	√			√		√

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I Year B.Tech. MECH - I Sem	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

(CH102BS) ENGINEERING CHEMISTRY

Prerequisites: Basic knowledge of chemistry in intermediate level.

Course Objectives:

1. To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
2. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
3. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry
4. To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways
5. To acquire the skills pertaining polymer to apply them for medical and other fields.

UNIT-I:

Molecular structure (9L): Introduction, Concept of atomic and molecular orbitals, LCAO, Molecular orbitals of diatomic molecules, Molecular orbital energy level diagrams of diatomic molecules (N2, O2 and F2). Pi-molecular orbitals of butadiene and benzene.

Crystal field theory (CFT)

Crystal field theory, Crystal field splitting patterns of transition metal ion d- orbital- tetrahedral, octahedral and square planar geometries.

UNIT-II: Water Technology (9L):

Hardness of water, expression of hardness (CaCO3 equivalent), units and types of hardness. Estimation of temporary and permanent hardness of water by EDTA method. Numerical problems based on hardness of water. Potable water: characteristics, treatment of water for domestic supply. Desalination of brackish water: reverse osmosis. Alkalinity of water and its determination. Boiler feed water: Boiler troubles (scale and sludge, priming, foaming, caustic embrittlrment and boiler corrosion) and its treatment: Internal treatment (colloidal, phosphate calgon conditioning of water). External treatment (ion –exchange process).

UNIT-III:

Electrochemistry and corrosion (12L):

Electrode, electrode potential, galvanic cell, cell reactions and cell notation, cell EMF, types of electrodes (Normal Hydrogen Electrode, calomel electrode), Determination of pH. Nernst equation, Numerical problems.

Batteries: Introduction to cell and battery, Primary (lithium cell) and secondary cells, (lead-Acid cell, and Lithium ion cells). Fuel cells – Hydrogen – Oxygen fuel cell, advantages and engineering applications of fuel cells.

Corrosion: Introduction, types of corrosion: chemical and electrochemical corrosion, factors Affecting the rate of corrosion: nature of the metal, galvanic series, purity of metal, nature of corrosion product, nature of environment: effect of temperature, effect of pH, humidity. Corrosion control methods: Cathodic protection: sacrificial anode method and impressed Current cathode method. Protective coatings : methods of applications of metallic Coatings: Galvanistion, electroplating (of copper).

UNIT -IV:

Stereochemistry, Reaction mechanism and synthesis of drug molecules (9L):

Structural isomers and stereoisomers, configurations, symmetry and chirality, enantiomers, diastereomers, optical activity. Conformational analysis of n-butane.

Introduction to reactions involving substitution (SN1 & SN2), addition (addition of HBr to propene, Markownikoff and Anti Markownikoff addition), and Elimination reactions: dehydro halogination of alkyl halides. Saytzeff rule. Oxidation (oxidation of alcohols using KMnO4 & CrO3), reduction (reduction of carbonyl compounds by LiAlH4 & NaBH4). Synthesis & uses of commonly used drug molecules: paracetamol and Asprin.

UNIT -V:

POLYMER CHEMISTRY (8L):

Introduction, classification of polymer, Types of polymerization (addition and condensation, mechanisms not required). Plastics, types of plastics -Thermoplastics and thermosetting plastics. Preparation, properties and engineering applications of PVC, Teflon and Bakelite. Fibers: Nylon 6, 6 and terelene (Dacron). Elastomers, natural rubber, structure, vulcanization. Synthetic rubbers: Buna-S, Thiokol rubber.

Biodegradable polymers:

Introduction, Preparations and properties of Polyhydroxy butyrate (PHB), Poly-Hydroxybutyrate-co-b-Hydroxy valerate (PHBV), Polyglycolic acid (PGA), Polylactic acid (PLA). Applications of biodegradable polymers.

Text Books:

1. Engineering Chemistry by Shashi chawla, Dhanpat Rai Publishing Company
2. Engineering Chemistry by P.C Jain & Monica Jain, Dhanpat Rai Publishing Company.
3. Text book of Engineering Chemistry by A. Jayashree, Wiley Publications.
4. Engineering chemistry- S.S.DARA

Reference Books:

1. Physical Chemistry, by P. W. Atkins
2. Engineering Chemistry by Shashi chawla, Dhanpat Rai Publishing Company

Course Outcomes: The course will enable the student to:

CO1: Apply the knowledge of atomic, molecular and electronic changes related to conductivity.

CO2: Analyze the troubles caused by impure water and method of purification of water.

CO3: Apply the knowledge of electrode potentials for the protection of metals from corrosion.

CO4: Explain the concept of configurationally and conformational analysis of molecules and reaction mechanism.

CO5: Apply the knowledge of polymers in everyday's life.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√				√		
CO 2	√	√	√		√	√		√	√	√	
CO 3	√	√	√		√	√			√	√	√
CO 4	√			√					√	√	
CO 5	√	√	√			√		√	√	√	

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I Year B.Tech. MECH - I Sem

L	T	P	C
2	0	0	2

(EN103HS) ENGLISH

Prerequisites: Have the Basic knowledge of vocabulary, Grammar and LSRW skills.

Course Objectives:

The course will help to

1. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Enhance the language skills of students in English with an emphasis on Reading and writing skills.
3. Create an English Environment to develop skills of the students.
4. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
5. Develop study skills and communication skills in formal and informal situations.

Prescribed Textbook:

Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press

UNIT –I

'The Raman Effect' from the prescribed textbook **'English for Engineers'** published by **Cambridge University Press**.

Vocabulary Building: The Concept of Word Formation --The use of Prefixes and Suffixes.

Grammar: Identifying Common Errors in Writing with reference to Articles and Prepositions.

Reading: Reading and its Importance- Techniques for Effective Reading.

Basic Writing Skills: Sentence Structures –Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT –II

'Ancient Architecture in India' from the prescribed textbook **'English for Engineers'** published by **Cambridge University Press.**

Vocabulary: Synonyms and Antonyms.

Grammar: Identifying Common Errors in Writing with Reference to Noun-Pronoun Agreement and Subject-Verb Agreement.

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

Writing: Format of a Formal Letter- Writing Formal Letters Eg. Letter of Complaint, Letter of Requisition.

UNIT –III

'Blue Jeans' from the prescribed textbook '**English for Engineers'** published by **Cambridge University Press.**

Vocabulary: Acquaintance with Prefixes and Suffixes from foreign languages in English to form Derivatives-Words from foreign languages and their use in English.

Grammar: Identifying Common Errors in writing with reference to Misplaced Modifiers and Tenses.

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- Defining- Describing Objects, Places and Events – Classifying- Providing Examples or Evidence

UNIT –IV

'What Should You Be Eating' from the prescribed textbook '**English for Engineers'** published by **Cambridge University Press.**

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in oral and written communication.

Reading: Intensive Reading and Extensive Reading

Writing: Writing Practices--Writing Introduction and Conclusion - Essay Writing- Précis Writing.

UNIT –V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook **'English for Engineers'** published by **Cambridge University Press**.

Vocabulary: Technical Vocabulary and its usage

Grammar: Common Errors in English

Reading: Reading Comprehension-exercises for practice

Writing: Technical Reports- Introduction – characteristics of a Report – categories of Report Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Suggested Readings:

1. Green, David. Contemporary English Grammar –Structures and Composition. MacMillan India. 2014 (Print)
2. Rizvi, M. Ashraf. Effective Technical Communication. Tata Mc Graw –Hill. 2015 (Print)
3. Raman, Meenakshi and Sharma, Sangeeta. "Technical Communication-Principles and Practice". Third Edition. New Delhi: Oxford University Press. 2015. Print.
4. Practical English Usage. Michael Swan. OUP. 1995.
5. Remedial English Grammar. F.T. Wood. Macmillan.2007
6. On Writing Well. William Zinsser. Harper Resource Book. 2001
7. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
8. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
9. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Course Outcomes:

The students will be able to

CO1: Get Inspiration and Motivation from Dr.C.V.Raman.

CO2: Understanding ancient architecture of India.

CO3: Know about Invention of Blue Jeans.

CO4: Learn what type of diet to take and maintain good health.

CO5: Understand the result of hard work and confidence.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1						√	√	√	√	√	
CO 2						√		√		√	
CO 3							√	√			
CO 4						√	√			√	
CO 5						√		√	√	√	

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I Year B.Tech. MECH - I Sem	**L**	**T**	**P**	**C**
	2	**0**	**0**	**2**

(CS104ES) PROGRAMMING FOR PROBLEM SOLVING - I

Prerequisites: Computer Fundamentals & Mathematics

COURSE OBJECTIVES:

1. To acquire problem solving skills
2. To be able to develop flowcharts
3. To learn the syntax and semantics of C programming language.

UNIT - I

Problem Solving Using Computers: Introduction, Algorithms, Flowcharts and Pseudocode.

Overview of C Language: Introduction, Salient Features of C Language, Structure of a "C" Program.

C Language Preliminaries: Keywords and Identifiers, Constants, Variables, Data Types, and Input Output Statements with suitable illustrative "C" Programs.

UNIT-II

Operators: Assignment Operators, Relational and Logical Operators, Increment and Decrement Operators, Bitwise Operators, Ternary Operator, Type Conversion, Precedence and Associativity with suitable illustrative "C" Programs.

UNIT-III

Statements in C:

Conditional/Decision Statements: if, if-else, Nested if-else, else-if ladder, and Switch-Statement with suitable illustrative "C" Programs.

Loop Control Statements: while, do-while and for with suitable illustrative "C" Programs.

UNIT-1V

Functions: Introduction to Functions, benefits of functions, types of functions, Function calls, return vsexit ( ), Parameter Passing mechanisms, Call-by-Value, Recursion, Storage Classes

UNIT-V

Arrays: Introduction to Arrays, One-Dimensional Arrays, Two-Dimensional Arrays, Arrays and Functions

Strings: Introduction to Strings, String I/O, String Operations with and without built-in functions (strlen( ), strcmp( ), strcat( ),strcpy( ), and strrev( ))

Text Books:

1. B.A.Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016
2. PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011

Reference Books:

1. Byron Gottfried, “Programming with C “, Schaum’s Outlines, 2nd Edition, TATA McGraw-Hill.
2. M.T.Somashekara, “Problem Solving Using C”, PHI, 2nd Edition 2009.
3. A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press
4. Rajaraman V., "The Fundamentals of Computers", 4th Edition, Prentice Hall of India, 2006. R S Bichker, "Programming in C", University Press, 2012

Course Outcomes: At the end of this course, the student would be able to

CO1: Design algorithms and flowcharts for real world applications

CO2: Know the usage of various operators in Program development

CO3: Design programs involving decision and iteration structures.

CO4: Apply the concepts code reusability using Functions

CO5: Analyze the concepts of Arrays and Strings for real world problems.

Co-Po’s mapping:

PO’S / CO’S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√										
CO 3	√										
CO 4	√										
CO 5	√										

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I Year B.Tech. MECH - I Sem

L	T	P	C
0	0	3	1.5

(CH105ES) ENGINEERING CHEMISTRY LAB

Prerequisite: Basic Principles of Volumetric analysis and preparations in intermediate level.

Course Objectives: The student will learn:

1. Estimation of hardness of water to check its suitability for drinking purpose.
2. To determine the rate constant of reactions from concentrations as an function of time.
3. The measurement of physical properties like viscosity and surface tension.
4. To synthesize the drug molecules.

Choice of 10-12 experiments from the following:

1. Estimation of hardness of water by EDTA method
2. Determination of alkalinity of water
3. Determination of strength of HCl by conductometry
4. Determination of strength of CH3COOH by conductometry.
5. Potentiometry - determination of Fe^{+2} by using KMnO4.
6. Determination of surface tension
7. Determination of viscosity of a lubricant
8. Determination of the rate constant of acid catalysed hydrolysis of methyl acetate
9. Synthesis of a polymer(urea-formaldehyde and phenol –formaldehyde resin)
10. Estimation of copper by colorimetry
11. Adsorption of acetic acid by charcoal
12. Synthesis of Aspirin and Paracetamol
13. Saponification/acid value of an oil

TEXT BOOKS:

1. Text book of engineering chemistry. Dr.A.Jaya Shree. Wiley publications, New Delhi 2018.

2. Vogel's Textbook of Quantitative Chemical Analysis

3. Essentials of experimental engineering chemistry, Shashi Chawla, Dhanpat Rai & Co.

4. Senior practical physical chemistry, B.D.Khosla, A.Gulati and V.Garg

REFERENCE BOOKS:

1. Text Book of engineering chemistry by R. N. Goyal and Harrmendra Goel.

2. A text book on experiments and calculations. S.S. Dara.

Course Outcomes: The experiments will make the student gain skills on:

CO1: Determination of parameters like hardness and alkalinity of water.

CO2: Estimation of rate constant of a reaction from concentration – time relationships.

CO3: Determination of physical properties like surface tension and viscosity.

CO4: Calculation of strength of compound using instrumentation techniques.

CO5: The impart Fundamental knowledge in handling the equipment/glassware and chemicals in chemical laboratory.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√	√		√			√	√	√	
CO 2	√				√				√		√
CO 3	√	√		√		√	√		√	√	
CO 4	√	√	√	√			√	√	√		
CO 5	√	√				√		√	√		

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I Year B.Tech. MECH - I Sem **L T P C**
0 0 2 1

(EN106HS) ENGLISH LANGUAGE COMMUNICATION SKILLS LAB-I

Prerequisite: Have the Basic knowledge of LSRW skills.

Course Objectives: The students will be able to

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. Sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
3. Bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
4. Improve the fluency of students in spoken English and neutralize their mother tongue influence.
5. Train the students to use language appropriately for public speaking, group discussions and interviews.

Syllabus: English Language Communication Skills Lab (ELCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab**
- **Interactive Communication Skills (ICS) Lab**

Exercise-I

CALL Lab:

Introduction to Phonetics - Speech Sounds

Vowels and Consonants-Listening Comprehension

ICS Lab:

Ice-Breaking activity and JAM session

Exercise-II

CALL Lab:

Pronunciation, Common Errors in Pronunciation, Neutralization of Mother Tongue Influence

ICS Lab:

Common Everyday Situations: Conversations and Dialogues

Exercise-III

CALL Lab:

Syllables -Consonant Clusters

ICS Lab:

Communication at Workplace, Social and Professional Etiquette

Exercise-IV

CALL Lab:

Intonation, Stress and Rhythm

ICS Lab:

Formal Presentations, Visual Aids in Presentations

Exercise-V

CALL Lab:

Word accent and Stress Shifts

ICS Lab:

Interview Skills

Minimum Requirement of infra structural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Aided Language Lab for 30 students with 30 systems, one master console, LAN facility and English language software for self- study by learners.

System Requirement (Hardware component):

Computer network with LAN with minimum 30 multimedia systems with the following specifications:

i) P -IV Processor

a) Speed – 2.8 GHZ

b) RAM – 512 MB Minimum

c) Hard Disk – 80 GB

ii) Headphones of High quality

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A spacious room with movable chairs and audio-visual aids with a Public Address System

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

1. Suresh Kumar, E. & Sreehari, P. 2009. A Handbook for English Language Laboratories. New Delhi: Foundation
2. Speaking English Effectively 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
3. Sasi Kumar, V & Dhamija, P.V. How to Prepare for Group Discussion and Interviews. Tata McGraw Hill
4. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad.
5. A textbook of English Phonetics for Indian Students by T.Balasubramanian (Macmillan)
6. **Lab Manual:** A Manual entitled "**English Language Communication Skills (ELCS) Lab**

Course Outcomes: The students will be able to

CO1: Understand the importance of speech sounds and Listening Comprehension.

CO2: Understand syllables and Consonant Clusters.

CO3: Speak with appropriate Word Accent and Intonation.

CO4: Learn to communicate effectively at work place with a special focus on social and professional etiquette.

CO5: Learn Task Based Language Learning (TBLL) through various language activities effectively.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO 4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO 11
CO 1							√		√	√	
CO 2							√		√	√	
CO 3						√	√		√	√	
CO 4							√		√	√	
CO 5						√	√		√	√	

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I Year B.Tech. MECH - II Sem	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

(CS107ES) PROGRAMMING FOR PROBLEM SOLVING LAB – I

Prerequisites: Computer Fundamentals & Mathematics

COURSE OBJECTIVES:

1. To be able to understand the fundamentals of program+ming in C Language
2. To be able to write, compile and debug programs in C
3. To be able to formulate problems and implement in C.

WEEK 1

1. DOS commands: Changing the default Drive, VER,VOL,DATE,TIME,PROMPT,CLS,DIR,MD or MKDIR,CHDIR or CD,COPY CON,TYPE,MOVE,REN,COPY,EXIT.

WEEK 2

2. LINUX Commands: PWD,CAL,DATE,ECHO,LS,CD,MKDIR, CAT,HEAD,TAIL, MV,CP,WC,VI Editor.

WEEK 3

3. Designing of flowcharts using **raptor tool**
   a) Areas of Polygons
   b) Calculation of Simple and Compound Interest
   c) Swapping of Two numbers with and without temporary variable
4. a) Checking whether a number is even or odd
   b) Sum of 'n' natural numbers
   c) Checking a number whether it is divisible by any given number

WEEK 4

5. a)Write a program using control strings %d %c %s %f %e %o %x %i %g %u
   b) Write a program to print 3 student details S.No, Student name, SSC percent, Inter percent, Address using backslash constants
   c) Write a program to swap two variables without using third variable
6. a) Write a program to find displacement $s=ut+1/2\ at^2$.
   b) Write a program to read P,T,R and find Simple Interest(SI) and Compound Interest(CI)
   c) Write a program to find area and circumference of a Circle.

WEEK 5

7. a) Write a program using all relational and logical operators
   b) Write a program using increment operator (pre and post) and decrement operator (pre and post)

8. a) Write a program using bitwise operators
   b) Write a program to find largest among three numbers using conditional operator
   c) Write a program to illustrate the use of size of () operator.

WEEK 6

9. a) Write a program to accept a number and print if it is an odd or even number. b) Write a program to find roots of quadratic equation $ax^2+bx+c=0$

10. a) Write a program to accept two integers for a coordinate point and determine its quadrant.
    b) Write a program to accept three integers and print the largest among them.

WEEK 7

11. a) Write a program to accept the year,find whether it is a leap year or not.
    b) Write a program using arithmetic operators (+,-,*,/) using else if.
12. a) Write a program that declares Class awarded for a given percentage of marks, where percentage of marks<40%=Failed,40% to <60%=second class,60% to <70%=First Class,>=70%=Distinction. Read percentage from standard input.
    b) Write a program to find area of different geometrical figures such as a Circle, a Square, a triangle, and a Rectangle using Switch statement.

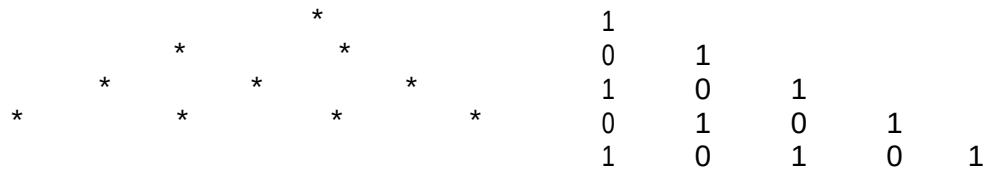
I INTERNALS

WEEK 8

13. a) Write a program to find the sum of 'n' natural numbers.
    b) Write a program to find the sum of individual digits of a given number where number is a +ve integer.
14. a) Write a program to accept a number and reverse it.
    b) Write a program to generate the first 'n' terms of Fibonacci series.

WEEK 9

15. a) Write a program to generate all prime numbers between 1 and n, where 'n' is a value supplied by user.
    b) Write a program to print sum of all odd numbers between 1 and 50 using do while statement.
16. a) Write a program to print the following patterns



b) Write a program to read two numbers x and n and compute the sum of this geometric progression: 1+x+x^2+x^3+…….+x^n.

WEEK 10

17. a) Write a program to find x power n using functions
    b) Write a program to check whether a number is perfect number or not using functions

18. a) Write a program to find the factorial of a given number using functions
    b) Write a program to find strong numbers between two given numbers using functions

WEEK 11

19. a) Write a program to check whether the given number is armstrong or not using functions
    b) Write a program to swap two values using functions
20. a) Write a program to calculate factorial of a given number using recursion
    b) Write a program to find G.C.D using recursion

WEEK 12

21. a) Write a program to find addition of two matrices using functions
    b) Write a program to find the sum of elements of 3*3 matrix using functions.

WEEK 13

22. Write a program to accept rows and columns of two matrices and check whether multiplication is possible or not, if possible accept two matrices and find multiplication of two matrices using functions.

WEEK 14

23. Write a program to check whether the given string is palindrome or not
24. Write a program to find the length of a string and copy to another string variable.

II INTERNALS

Course Outcomes: At the end of this course, the student would be able to

CO1: Formulate the algorithms and flowcharts for simple problems
CO2: Apply fundamental programming concepts, to solve simple problems
CO3: Enhance debugging skills
CO4: Exercise conditional and iterative statements to Write C programs
CO5: Modularize the code with functions so that they can be reused
CO6: Represent and manipulate data with arrays and strings

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√										
CO 3	√	√									
CO 4	√	√			√						
CO 5	√				√						
CO 6	√				√						

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I Year B.Tech. MECH - I Sem	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

(ME108ES) ENGINEERING WORKSHOP

Pre-requisites: Practical skill

Course Objectives:

1. To Study of different hand operated power tools, uses and their demonstration.
2. To provide hands on experience about use of different engineering materials, tools, Equipments and processes those are common in the engineering field.
3. It explains the construction, function, use and application of different working tools, equipment and machines.
4. To study commonly used carpentry joints.
5. To have practical exposure to various welding and joining processes.

1. TRADES FOR EXERCISES: At least two exercises from each trade:

I. Carpentry – (T-Lap Joint, Dovetail Joint, Mortise & Tenon Joint).
II. Fitting – (V-Fit, Dovetail Fit & Semi-circular fit).
III. Tin-Smithy – (Square Tin, Rectangular Tray & Conical Funnel).
IV. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern).
V. Welding Practice – (Arc Welding & Gas Welding).
VI. House-wiring – (Parallel & Series, Two-way Switch and Tube Light).
VII. Black Smithy – (Round to Square, Fan Hook and S-Hook).

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Machine Shop, Power tools used in Construction and Wood Working and Plastic Molding.

Suggested Text/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. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

3) Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.

4) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

5) P.N.Rao "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Practice on manufacturing of components using workshop trades including Carpentry, Fitting, Tin-Smithy, Foundry, Welding Practice, House wiring and Black Smithy.

CO2: Apply basic electrical engineering knowledge for house wiring practice.

CO3: Identify and apply suitable tools for different trades of engineering processes Including Material removing, measuring and Chiseling.

CO4: Study and practice on Plumbing, Machine tools, Power tools, Wood working, Plastic Molding and their operations

CO5: Learn how to analyze products and be able to improve their manufacture Ability and make the cost effectively.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√										√
CO 2	√										√
CO 3	√		√								√
CO 4	√										√
CO 5	√		√	√							

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

I Year B.Tech. MECH - II Sem

L	T	P	C
3	1	0	4

(MA201BS) MATHEMATICS – II

ODE and Vector Calculus

Pre-requisites: To study and understand the MATHEMATICS-II the student must have the basic knowledge of calculus and vector calculus differentiation, integration and partial differentiation, scalar and vector pointfunctions,2D and 3D geometry, length, area and volume etc.

Course Objectives: To learn

1. Methods of solving the differential equations of first order.
2. Methods of solving the differential equations of higher order.
3. Multiple integrals and their applications.
4. The basic properties of vector valued functions.
5. The applications to line, surface and volume integrals.

UNIT-I: Differential Equations of first order and their Applications

Formation of a Differential equations, Differential equations of first order and first degree: exact, linear and Bernoulli, Applications to Newton's law of cooling, law of natural growth and decay, orthogonal trajectories.

UNIT-II: Higher Order Linear Differential Equations

Linear differential equations of second and higher order with constant coefficients, RHS term of the type $f(X) = e^{ax}$, $\sin ax$, $\cos ax$ and e^{kx}, $V(x)$, $V(x)$. Method of variation of parameters.

UNIT-III: Multiple Integrals

Multiple integrals - double and triple integrals – change of order of integration (Only Cartesian form)- change of variables (Cartesian to Polar for double integral, Cartesian to Spherical for triple integral). Applications of Double integrals and Triple integrals.

UNIT-IV: Vector Differentiation

Vector point function and scalar point function. Gradient- Divergence- Curl and their related properties – Directional derivatives. Vector Identities, Scalar potential function, Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration

Line integral, work done, Surface and Volume integrals. Vector integrals theorems: Green's, Stoke's and Gauss Divergence Theorems (Only Statements & their Verifications).

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010 Erwin Kreyszig,
2. Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006

References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. Dennis G Zill and Michael R Cullen, Advanced Engineering Mathematics 3rd Edition, Jones & Bartlett Learning, 2006 - Technology & Engineering.

Course Outcomes: After learning the contents of this paper the students must be able to:

CO1: Classify the various types of differential equations of first order and first degree and apply the concepts of differential equations to the real world problems.

CO2: Solve higher order differential equations and apply the concepts of differential equations to the real world problems.

CO3: Evaluate the multiple integrals.

CO4: Identify the vector differential operators physically in engineering problems.

CO5: Evaluate the line, surface and volume integrals and converting them from one to another by using vector integral theorems.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√	√					√
CO 2	√	√			√	√					√
CO 3	√	√			√	√					√
CO 4	√	√			√	√					√
CO 5	√	√			√	√					√

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I Year B.Tech. MECH - II Sem

L	T	P	C
3	1	0	4

(PH202BS) ENGINEERING PHYSICS

Prerequisites:

Basic knowledge of secondary school level physics is preferred.

Higher secondary school level physics, chemistry and mathematics are preferred.

Course Objective:

1. Students will be able to demonstrate competency and understanding of the concepts found in Oscillations and waves
2. Student would understand about the phenomenon of diffraction, interference and polarization by studying the Wave Optics.
3. To have the Knowledge of Laser technology and Fiber optics technology to know about working and various applications of engineering fields.
4. Student would be able to understand the fundamentals of crystallography, X-ray diffraction by crystal planes and their applications in various fields.

UNIT-I: Oscillations and Waves (9 hours + 3 T)

Simple harmonic motion, Equation of simple harmonic motion, Simple pendulum, Torsional pendulum, Damped harmonic oscillations, Wave equation for damped harmonic motion-heavy, Critical and light damping, Energy decay in a damped harmonic oscillator, Power dissipation, Quality factor, Forced oscillations, Equation of motion of forced vibration, Resonance, Electrical analogy for a simple harmonic oscillator.

Waves; Equation of motion of transverse wave, Reflection and transmission at a boundary, Stationary waves.

UNIT-II: Wave Optics (9 hours + 3 T)

Huygens's principle, Superposition of waves, Coherence and methods to produce coherent sources, Young's double slit experiment, Interference in thin films by reflection, Newton's rings, Diffraction: Introduction, Farunhofer diffraction at single slit, Plane diffraction Gratings and their resolving power.

Polarization: Introduction, Polarization by reflection, Polarization by double refraction, Nicol's prism

UNIT-III: Fiber Optics and Lasers (9 hours + 3 T)

Fiber Optics: Introduction, Total internal reflection, Acceptance angle and numerical aperture, Losses associated with optical fibers, Step and graded index fibers, Applications of optical fibers.

Lasers: Introduction to interaction of radiation with matter: stimulated absorption, spontaneous emission and stimulated emission, Characteristics of a laser, Einstein's coefficients, Important components of a laser: active medium, pumping source, optical resonator; Population inversion, Ruby laser, He-Ne laser, Semiconductor laser, Applications of lasers.

UNIT-IV: Crystal Structures, Crystal Planes and X-RD (8 hours + 2 T)

Space lattice, Unit cell, Lattice parameter, Crystal systems, Bravais lattices, Co-ordination number, Atomic packing fraction, Structures and Packing fractions of Simple Cubic, Body Centered Cubic, Face Centered Cubic crystals.

Miller Indices for Crystal planes, Inter planar spacing of orthogonal crystal systems, Diffraction of X-rays by crystal planes: Bragg's law, Powder method, Applications of X-ray diffraction.

UNIT-V: Dielectric and Magnetic Properties of Materials (11 hours + 3 T)

Magnetic Properties: Basic definitions, Origin of magnetic moment, Bohr magneton, Classification of Dia, Para and Ferro magnetic materials, Domain theory of ferromagnetism, Hysteresis curve, Soft and Hard magnetic materials, Properties of Anti Ferro and Ferri magnetic materials, Applications.

Dielectric Properties: Dielectric polarization, Permeability and dielectric constant, Polar and non-polar dielectrics, Eletronic, Ionic and Orientation Polarizations and calculation of Polarizabilities, Internal fields, Clausius – Mossotti equation, Basic concepts of Piezo and Ferro electricity, Applications of dielectrics.

Text books:

1. M N Avadhanulu, P G Kshirsagar ,A Text book of Engineering Physics, S Chand.
2. B K Pandey and S Chaturvedi Engineering Physics, CENGAGE Learning.
3. D K Bhattacharya and Poonam Tandon Engineering Physics, OXFORD University Press.

Reference books:

1. Ian G. Main, Oscillations and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. A. Ghatak, Optics
4. O. Svelto, Principles of Lasers
5. P K palanisamy ,Engineering Physics Scietech publication
6. Charles Kittel ,Introduction to Solid State Physics, John Wiley & Sons
7. M Armugam, Solid State Physics Anuradha Publications

Course Outcomes:

At the end of the course, the student will be able to:

CO-1: Solve engineering problems using the concepts of wave and oscillations.

CO-2: Analyze the intensity variation of light due to interference, diffraction and polarization. Understand their applications in the field of engineering.

CO-3: Use the fundamental knowledge of crystallography to identify the crystal structure and defects in crystal.

CO-4: Understand the propagation of light through fiber optics in various communication fields and use of lasers as light sources for low and high energy applications.

CO-5: Classify magnetic and dielectric behavior of solids and test these materials for various Applications.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√		√				√		
CO 2	√								√		
CO 3	√	√		√					√		
CO 4	√	√	√	√			√	√	√		√
CO 5	√	√							√		√

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I Year B.Tech. MECH - II Sem	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

(ME203ES) ENGINEERING MECHANICS

Pre-requisites: Engineering Physics.

Course Objectives:

1. To apply the knowledge of mechanics for engineering problems and To develop an understanding of the principles of statics bodies with equilibrium conditions
2. To analyse the bodies with applications of friction.
3. To develop the geometric shapes for composite sections.
4. To develop the moment of inertia of the geometric shapes for composite sections
5. To develop the work-energy equation for translations.

UNIT-I:

Introduction to Engineering Mechanics - Basic concepts.

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, Lame's Theorem.

UNIT-II:

Friction: Basic concepts. Types of friction, Laws of Friction, Static and Dynamic Friction, Motion of Bodies, wedge friction, ladder friction, screw jack, applications.

UNIT-III:

Centroid: centroid of simple figures (from basic principles) centroid of composite figures. **Centre of Gravity** -Centre of Gravity simple bodies (from basic principles), Centre of Gravity of composite bodies, Theorem of Pappus

UNIT-IV:

Area moment of inertia- Definition, Polar Moment of inertia, Transfer Theorem, Moment of inertia of standard sections(I, T,L and C) and composite Figures Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem

Mass Moment of Inertia: Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT-V:

Work Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion. Connected System- Fixed Axis Rotation and Plane motion. Impulse momentum method.

Text books:

1. Engineering Mechanics by S.S Bhavikatti, J.G Rajasekharappa.
2. K Vijay Kumar Reddy and J. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics & Dynamics
3. Engineering Mechanics by K. L Kumar- Tata McGraw Hill

Reference books:

1. Timoshenko S.P and Young D.H., “Engineering Mechanics”, McGraw Hill International Edition, 1983.
2. Tayal A.K., “Engineering Mechanics – Statics & Dynamics”, Umesh Publications, 2011.
3. Basudev Bhattacharyya, “Engineering Mechanics”, Oxford University Press, 2008.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Solve the resultant of forces which are acting on the systems and also the Systems and able to apply the equilibrium conditions on a body.

CO2: Solve the problems based on friction.

CO3: Calculate the centroid and centre of gravity of composite sections.

CO4: Solve the area and mass moment of inertia of simple and composite sections.

CO5: Calculate the distance travelled and time required for the practice in case of Connected systems

Co-Po’s mapping:

PO’S / CO’S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√		√			√	√		√
CO 2	√		√		√			√	√		√
CO 3	√		√		√			√	√		√
CO 4	√		√		√			√	√		√
CO 5	√				√			√	√		√

ANURAG ENGINEERING COLLEGE

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I Year B.Tech. MECH - II Sem

L	T	P	C
2	0	0	2

(CS204ES) PROGRAMMING FOR PROBLEM SOLVING - II

Prerequisites: Basics of C Language

Course Objectives:

1. Develop skills for analyzing solutions.
2. To introduce various techniques for representation of the data in the real world.
3. Analyze a problem and determine the appropriate data structure for the problem.

UNIT -I

Structures: Definition and Initialization of Structures, Accessing structure members, Nested Structures, Array of Structures, Structures and Functions, Unions, typedef, Enumerated Data types.

UNIT-II

Pointers: Introduction to Pointers, Pointer Arithmetic, Pointers and Arrays, Pointers to Structures, Pointers and Strings, Function - Call by Reference, Pointers to Pointers, Dynamic Memory Allocation.

UNIT III:

Files : Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binaryfiles,State of a file, Opening and Closing files, file input / output functions(standard library input / output functions for files), file status functions (error handling),Positioning functions, command –line arguments, C program examples.

UNIT-IV:

Introduction to Data Structures: Lists and Operations, Linear and Non linear Data structures **Stacks-**Introduction to Stacks, Operations , Implementation of Stack using Arrays **Queues-** Introduction to Queues, Operations, Implementation of Queues using Arrays

UNIT-V

Linked Lists: Introduction to Linked List, Operations on Single Linked List(search, Insertion &Deletion)Searching and Sorting: Linear Search, Binary Search, Bubble Sort, Insertion Sort and Quick sort.

Text Books:

1. 1.B.A.Forouzon and R.F. Gilberg, “COMPUTER SCIENCE: A Structured Programming Approach Using C”, Third edition, CENGAGE Learning, 2016
2. PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.

Reference Books:

1. Byron Gottfried, “Programming with C “, Schaum’s Outlines, 2nd Edition, TATA McGraw-Hill.
2. M.T.Somashekara, “Problem Solving Using C”, PHI, 2nd Edition 2009.
3. A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press

4. Rajaraman V., "The Fundamentals of Computers", 4th Edition, Prentice Hall of India, 2006.
5. R S Bichker, "Programming in C", University Press, 2012.

Course Outcomes: At the end of this course, the student would be able to

CO1: Develop programs with user defined data types.

CO2: Use dynamic memory allocation functions with pointers.

CO3: Apply various file handling techniques for better data management

CO4: Distinguish between stacks and queues.

CO5: Analyze various dynamic data structures.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√	√									
CO 3	√	√									
CO 4	√	√			√						
CO 5	√	√			√						

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I Year B.Tech. MECH - II Sem

L	T	P	D	C
1	0	0	3	3

(ME205ES) ENGINEERING GRAPHICS

Prerequisites: NIL

Course objectives:

1. To provide basic concepts in engineering drawing.
2. To impart knowledge about standard principles of orthographic projection of objects.
3. To draw sectional views and development of surfaces of solids.
4. To draw Isometric views and its projections.
5. To prepare you to use the techniques, skills, and modern engineering tools like Auto Cad software necessary for engineering practice

UNIT-1 Introduction to Engineering Drawing-Principles of Engineering Graphics and their significance, usage of Drawing instruments, Conic sections including the Rectangular Hyperbola-General method only, Cycloid, Epicycloids and Hypocycloid.

UNIT-2 Orthographic Projections-Principles of Orthographic Projections-Conventions-Projections of Points and projections of lines (Midpoint problems and Traces are not included).Projections of planes (regular geometry figures).

UNIT-3 Projections of Regular Solids- prism, cylinder, pyramid, cone, sectional views of Right Regular solids- prism, cylinder, pyramid, cone.

UNIT-4 Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Intersections of prism vs. prism and Cylinder vs. cylinder.

UNIT-5 Isometric Projections-Principles of Isometric Projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of Lines, Plane of figures, Simple and Compound Solids. Conversion of Isometric Views to Orthographic Views and Vice-versa.

Introduction to CAD (For Internal Evaluation Weightage Only)

Introduction to Auto Cad software package commands, drawing 2D and 3D sketches for simple objects by using Auto Cad software package.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing,-Charotar Publishing House
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics-TMH Publication
3. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing-Scitech Publishers
4. Computer Aided Engineering Drawing – k Balaveera Reddy- CBS Publishers.

Reference Books:

1. Engineering Drawing by K. Venugopal, V Prabhu Raja,-New age publications.

2. Corresponding set of CAD Software Theory and User Manuals

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Understand engineering drawing and its place in society.

CO2: Visualize the different aspects of Points, Lines and Planes.

CO3: Acquire knowledge on projections of solids.

CO4: Draw sections of solids and plan the drawing for development of surfaces.

CO5: Understand the isometric views and projections. Exposure to computer-aided geometric design and creating working drawings.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√		√						
CO 2	√		√		√						√
CO 3	√		√		√						√
CO 4	√		√		√						
CO 5	√						√				√

ANURAG ENGINEERING COLLEGE

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I B Tech MECH II- Semester

L	T	P	C
0	0	3	1.5

(PH206BS) ENGINEERING PHYSICS LAB

Prerequisites:

Basic knowledge of higher secondary school level experimental physics, electronics and mathematics are preferred.

Course Objective:

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Develop the skills needed to set up the equipment required to test models or theory developed in the lecture course
4. Apply the analytical techniques and graphical analysis to the experimental data.
5. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

List of Experiments:

1. Determination of Rigidity Modulus of a Material – Torsional Pendulum
2. Study of Resonance in LCR – Series circuit
3. Determination of Time Constant of RC Circuit
4. Determination of frequency of vibrating tuning fork - Melde's Experiment
5. Dispersive Power of the Material of a Prism – Spectrometer
6. Newton's Rings – Determination of Radius of Curvature of Lens
7. Diffraction Grating – Determination of Wavelength of a Monochromatic Source
8. Single Slit Diffraction using Lasers – Determination of Slit Width
9. Evaluation of Numerical Aperture & Bending losses of an Optical Fiber
10. Stewart & Gees Method – Magnetic field along the axis of a Coil

Note: Any 8 experiments are to be performed.

Reference books:

1. Laboratory Manual of Engineering Physics by Dr.Y.Aparna & Dr.K.Venkateswara Rao (V.G.S Publishers)
2. Fundamentals of physics – D Halliday, R Resnick& John wiley.
3. Optics – A Ghatak Tata McGraw-Hill.
4. Practical Physics – G.L Squires.

Course Outcomes:
At the end of the course the student able to:

CO1: Apply the various procedures and techniques for the experiments.

CO2: Use the different measuring devices and meters to record the data with precision.

CO3: Test optical components using principles of interference and diffraction of light.

CO4: Apply the mathematical concepts/equations to obtain quantitative results.

CO5: Develop the basic communication through working in the groups and performing the Laboratory experiments and by interpreting the results.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√	√		√				√		√
CO 2	√	√			√						√
CO 3	√	√	√						√		√
CO 4	√	√			√				√		
CO 5	√	√		√	√		√				

ANURAG ENGINEERING COLLEGE

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I B Tech MECH II- Semester **L T P C**

0 0 3 1.5

(CS207ES) PROGRAMMING FOR PROBLEM SOLVING LAB – II

Prerequisites: Basics of C Language

Course objectives:

1. Identify appropriate data structures to use in order to solve a problem.
2. To be able to effectively choose programming components to solve computing problems in real-world.

Note: All the Programs should be implemented using functions.

Week 1 & Week 2:

Write a 'C' program to implement a List using Arrays and Functions [Insertion, Deletion]

Week 3:

a) Define a structure Student with members Hall Ticket Number (htno), name (sname), program studying (program), current year (cyear) and semester (csem). Write a 'C' program to read a student details using user defined function read student () and display the student details using print student.

b) Define a structure Date with members' day, month and year. Define a structure Employee with members' employee number (empno), employee name (empname), date of birth (dob) (Use the Structure Date), department number (deptno), salary (sal). Define the user-defined functions read employee () to read employee details and print employee to print the employee details. Structure Date should be used as a Nested Structure in the Structure Employee. Write a 'C' program to read and display details of an employee using user-defined functions read employee and print employee.

Week 4:

a) Define a structure Point with members x-coordinate and y-coordinate. Compute distance and slope between two given points using array of structures and functions.

b) Define a union Student with members Hall Ticket Number (htno), name(sname), program studying (program), current year (cyear) and semester (csem). Write a 'C' program to read a student details using user defined function read student () and display the student details using print student.

Week 5 & Week 6:

a) Write a 'C' program to compute length of a string using user –defined function string length. Pointer expression, Pointer Arithmetic and Pointer addressing should be used for computing string length.

b) Write a 'C' program to read and print 3 x 3 matrix and also sum of elements of the matrix suing pointer-to-pointer

Week 7:

Write a 'C' program to implementation of List of size n using Arrays. [Insertion and Deletion]

Week 8:

Write a C Program to perform the operations of Stacks using Arrays

Week 9:

Write a C Program to perform the operations of Queues using Arrays

Week 10:

Write a C Program to perform the operations of Single Linked List Programs [Insertion, Deletion, Searching and traversing].

Week 11:

a) Write a C Program for Linear Search

b) Write a C Program for Binary Search

Week 12:

Write a C Program to Sort N numbers in either Ascending order or Descending order using Bubble Sort.

Week 13:

Write a C Program to Sort N numbers in either Ascending order or Descending Order using Insertion Sort.

Week 14:

Write a C Program to Sort N numbers in either Ascending Order or Descending order using Quick sort.

Week 15:

a) Write a C Program to count the number of Characters, Lines, Vowels and Consonants in a given text file

b) Write a C Program to Display contents of a given file using Command Line Arguments

Week 16:

Review

Course Outcomes:

At the end of the course the student able to:

CO 1: Develop applications on user defined data types.
CO 2: Apply dynamic memory allocation through pointers.
CO 3: Use different data structures for create/update basic data files.
CO 4: Implement linear data structures through stacks and queues.
CO 5: Implement various searching and sorting techniques, Linked lists.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√	√									
CO 3	√	√									
CO 4	√	√			√						
CO 5	√	√			√						

ANURAG ENGINEERING COLLEGE

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I Year B.Tech. MECH - II Sem

L	T	P	C
0	0	2	1

(EN208HS) ENGLISH LANGUAGE COMMUNICATION SKILLS LAB - II

Prerequisite: Have the Basic knowledge of LSRW skills.

Course Objectives: The students will be able to

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. Sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
3. Bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
4. Improve the fluency of students in spoken English and neutralize their mother tongue influence.
5. Train students to use language appropriately for public speaking, group discussions and Interviews.

Syllabus: English Language Communication Skills Lab (ELCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab**
- **Interactive Communication Skills (ICS) Lab**

Exercise – I

CALL Lab:

Common Indian Variants in Pronunciation – Differences between British and American Pronunciation

ICS Lab:

Spoken vs. Written language- Formal and Informal English- Introducing Oneself and Others

Exercise – II

CALL Lab:

Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening

ICS Lab:

Features of Good Conversation – Strategies for Effective Communication

Role-Play- Making Requests and Seeking Permissions - Telephone Etiquette

Exercise – III

CALL Lab:

Intonation- Sentence Stress -Weak Forms and Strong Forms

ICS Lab:

Descriptions- Narrations- Giving Directions and Guidelines-Giving Instructions – Seeking Clarifications – Asking for and Giving Directions –Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice –Making Suggestions

Exercise – IV

CALL Lab:

Past Tense Marker and Plural Marker

ICS Lab:

Public Speaking – Exposure to Structured Talks - Non-verbal Communication-
Making a Short Speech – Extempore

Exercise – V

CALL Lab:

Information Transfer

ICS Lab:

Group Discussion-Mock Group Discussion sessions

Minimum Requirement of infra structural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer aided Language Lab for 30 students with 30 systems, one master console, LAN facility and English language software for self- study by learners.

System Requirement (Hardware component):

Computer network with Lan with minimum 30 multimedia systems with the following specifications:

i) P -IV Processor

a) Speed – 2.8 GHZ

b) RAM – 512 MB Minimum

c) Hard Disk – 80 GB

ii) Headphones of High quality

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System.

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

1. Suresh Kumar, E. & Sreehari, P. 2009. A Handbook for English Language Laboratories. New Delhi: Foundation
2. Speaking English Effectively 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
3. Sasi Kumar, V & Dhamija, P.V. How to Prepare for Group Discussion and Interviews. Tata McGraw Hill
4. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad.

5. **A textbook of English Phonetics for Indian Students** by T. Balasubramanian (Macmillan)
6. **Lab Manual:** A Manual entitled "**English Language Communication Skills (ELCS) Lab Manual- cum- Work Book**", published by Cengage Learning India Pvt. Ltd, New Delhi. 2013

Course Outcomes: The students will be able to

CO1: Understand the variants in Pronunciation.
CO2: Differentiate Spoken and Written English in formal and informal situations
CO3: Understand the emphasis on Pronunciation of English Language in the global world.
CO4: Apply strategies for Effective Communication in different situations.
CO5: Participate in conversation, Public Speaking and Group Discussion.

Co-Po's mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1							√			√	
CO 2						√	√		√	√	
CO 3							√		√	√	
CO 4						√	√		√	√	
CO 5						√	√		√	√	

ANURAG ENGINEERING COLLEGE

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B.Tech ME II Year I-Semester

L	T	P	C
3	0	0	3

(AM301BS)NUMERICAL METHODS & PARTIAL DIFFERENTIAL EQUATIONS

Prerequisite:

To study and understand the MATHEMATICS-III the student must have the basic knowle finding roots of an equation, functions, different types of equations, differentiation, inte and partial differentiation

Course objectives: To learn

1. Concept of solution of non linear equations and linear system of equations and Concept of interpolation.
2. Numerical differentiation and numerical integration methods.
3. Solutions of first order equation using numerical techniques.
4. Formation and solution of partial differential equations by various methods.
5. Solution of Second order partial differential equation and application to one dimensional Wave and heat equations.

UNIT-I:

Solution of Non- linear Equations

Solution of Algebraic and Transcendental Equations – The Bisection Method – The Method of False Position – Newton-Raphson Method.

Interpolations

Introduction- Finite differences (Forward Differences, Backward differences and divided difference) Lagrange's Interpolation formula, Newton divided, Newton's forward and backward difference interpolation formulae - Problems.

UNIT-II:

Numerical Differentiation using interpolation formulae.

Numerical integration: Newton's cotes qudrature formulae, Trapezoidal rule, Simpson's 1/3rd and 3/8 rules.

UNIT-III:

Numerical solution of Ordinary Differential Equations: Solution by Taylor's series-Picard's Method of successive Approximations- Euler and modified Euler's methods -Runge-Kutta Method.

UNIT-IV: Partial differential equations of First Order

Introduction and Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange) equation and nonlinear (Standard type) equations, Charpits Method.

UNIT-V: Partial differential equations of Second Order

Method of separation of Variables for second order equations. Classification of general second order partial differential equations. Applications of Partial Differential Equations-One dimensional wave equation, Heat equation.

Textbooks:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
3. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

Course outcomes:

CO1: Determination of roots of an equation and calculate some simple methods of obtaining approximate roots of algebraic and transcendental equation and Interpolate the values using the techniques of Newton's forward and backward, Gauss forward and backward, Lagrange's and spline interpolations.

CO2: Evaluate Numerical differentiation and Numerical integration

CO3: Able to solve first order equation using numerical techniques.

CO4: Evaluate the sol of PDE.

CO5: Evaluate the Solution of Second order partial differential equation and Able to solve one dimensional wave and heat equations.

Co-po mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√						
CO 2	√	√			√						
CO 3	√	√			√						
CO 4	√	√			√						
CO 5	√	√			√						

ANURAG ENGINEERING COLLEGE

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B.Tech ME II Year I-Semester

L	T	P	C
3	0	0	3

(ES302BS) ENVIRONMENTAL SCIENCES

Prerequisite: Have the basic knowledge of Biology and Chemistry.

Course objectives:

1. To explain the multidisciplinary nature of environment, essence of ecosystem, biodiversity and its conservation
2. To impart knowledge about natural resources and their protection
3. To explain about the causes and effects of environmental pollution as well as environmental issues
4. To discuss about rules, regulations for the protection of environment
5. To make the students to understand about sustainable development and the natural functioning of ecosystems

UNIT – I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance.

(a) Ecosystems: Definition, Classification of an ecosystem, structure and function of ecosystems(Forest, Pond, Grass Land ecosystems) - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids- Ecological succession Carrying capacity.

(b) Biodiversity and its conservation: Introduction - Definition: genetic, species and ecosystem diversity. - Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. IUCN categories of biodiversity and RED DATA book - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT - II

Natural Resources: Renewable and non-renewable.

Forest resources – Use and over – exploitation, deforestation,–

Water resources – Use and over utilization of surface and ground water,Rain water Harvesting& Watershed Management-Floods, drought, dams – benefits and problems

Mineral resources: environmental effects of extracting mineral resources-sustainable Mining activities.

Energy resources: Growing energy needs, renewable(solar,Wind) and non-renewable(coal,petroleum,Natural Gas) energy sources use of alternate energy sources(Waste to Energy & Biofuels-Biodiesel and Bioethanol).

Land resources: land degradation, Soil salinity,man induced landslides, soil erosion and desertification,Overuse of fertilizers and pesticides-organic farming.

UNIT – III

(a) Environmental Pollution: Definition, Cause, effects and control measures of different kinds of pollution(Air, Water, Soil, Noise, Nuclear, e –Waste, Municipal solid waste, Biomedical waste, Hazardous waste).

(a) Environmental Issues: Bhopal Gas Tragedy, Climate Change(Global Warming), Earth Summit, Kyoto Protocol, Paris Agreement, NAPCC(National Action Plan on Climate Change), Ozone layer depletion- Montreal protocol.

UNIT-IV

(a) Waste management technology: Solid waste Management, Air pollution control techniques, Waste water treatment techniques**:** primary, secondary**, t**ertiary treatments. Brief account on Bioremediation and Phyto-remediation of contaminated soils, Noise pollution control techniques. Disaster management: Cyclones, Floods, Earthquakes and Landslides.
Application of GIS and GPS system in environment.

(b) Environmental policy, Rules and regulations: Definition & overview of EIA (Environmental Impact Assessment), Environment Protection Act-1986, Air (Prevention and Control of Pollution) Act-1981, Water (Prevention and control of Pollution) Act-1974. Salient features of Municipal solid waste, Biomedical waste, Hazardous waste & e-waste rules.

UNIT – V

(a) Towards sustainable future: Concept of sustainable development, threats of sustainability, sustainable development goals(United Nations General Asembly-2015), population and its explosion, Environmental education, sustainable cities, Environmental effects of human health, Environmental ethics, concept of green building, Basic principles of Green engineering, Carbon foot print.

(b) Field work: Visit to a local polluted site, visit to water treatment plant/effluent treatment plant/sewage treatment plant, study of simple ecosystems-pond/river/hill slopes etc.

Text Book:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, University Press.
2. Environmental studies, From Crisis to cure by R.Rajagopalan,2005.
3. Environmental Science: towards a sustainable future by Richard T.Wright.2008 PHL Learning Private Ltd .New Delhi.
4. Environmental Engineering and science by Gilbert M.Masters and Wendell P.Ela.2008 PHI Learning Pvt. Ltd.

Course Outcomes:

After the completion of the course, the student will be able to understand

CO1: The multidisciplinary nature of environment, essence of environment, biodiversity and its Conservation
CO2: About the natural resources and their protection
CO3: About the causes and effects of environmental pollution as well as environmental issues
CO4: About the management of environmental wastes, disasters and rules, regulations, policies For the protection of environment
CO5: About the natural functioning of ecosystems

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1			√	√		√	√	√	√	√	
CO 2			√	√		√	√	√	√	√	
CO 3			√	√		√	√	√	√	√	
CO 4			√	√		√	√	√	√	√	
CO 5			√	√		√	√	√	√	√	

ANURAG ENGINEERING COLLEGE

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B.Tech ME II Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME303ES) METALLURGY AND MATERIAL SCIENCE

Pre-requisites: Engineering Physics,Chemistry

Objectives:

1. To introduce the basic concepts concerning the materials in the world.
2. To explain the structure and properties of crystalline and non-crystalline materials,
3. To explain the symmetry and defects of crystal structures, physical properties, mechanical properties and changes in structure.
4. To explain the different heat treatment approaches and technologies which have led to our understanding of materials structure and properties.
5. To provide sufficient background material to enable students to continue with more specialized courses, such as Nano Science and other physical science subjects.

UNIT-I

Structure of Metals: Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

Constitution of Alloys: Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

UNIT -II

Equilibrium of Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cu-Sn and Fe-Fe3C.

UNIT –III

Cast Irons and Steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys:

Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys.

UNIT –IV

Heat treatment of Alloys:

Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Harden ability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT – V

Ceramic materials:

Crystalline ceramics, glasses, cermets, abrasive materials, nonmaterial's-definition, properties and application of the above.

Composite Materials: Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and Carbon – Carbon composites.

Text Books

1. Introduction to Physical Metallurgy -Sidney H. Avener
2. Material science and Metallurgy- Kodgire-Everest Publishing House-31st Edition.
3. Materials Science and Engineering -William and callister

References

1. Elements of material science -V. Raghavan-PHI learning pvt.Ltd, 2004-5thEdition.
2. Science of Engineering Materials -Agarwal
3. Essential of Materials science and engineering -Donald R. Askeland- Thomson
4. Material Science & Material -C.D Yesudian & harris Samuel.

Course Outcomes:

CO1: Acquire an understanding of the main concepts related to the structure and properties of Materials.
CO2: Understand about phase rules and Iron-Iron Carbon equilibrium diagram, TTT diagrams.
CO3: Understand the basic concepts of Heat treatment processes.
CO4: Understand the micro structure of ferrous and non-ferrous materials.
CO5: Understand the basic methods of manufacturing various types of composite materials.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√										
CO 2	√		√	√	√						
CO 3	√		√		√						√
CO 4	√		√	√							
CO 5	√			√						√	√

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B.Tech ME II Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(EE304ES) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Pre-requisites: Basic Knowledge on Integration, Differentiation, Laplace Transforms and Semiconductors.

Course Objectives:

This course facilitates to study

1. The basic concepts of Basic Electrical Engineering.
2. DC machines concepts.
3. AC machines concepts.
4. Basic Electronics devices like diodes and transistors.
5. The cathode ray oscilloscope and its parts.

UNIT-I: ELECTRICAL CIRCUITS

Basic definitions, types of elements, ohms law, Kirchhoff' laws, resistive networks, inductive networks, capacitive networks, series, parallel circuits and star –delta transformations.

UNIT-II: DC MACHINES

DC generators: Construction, basic principle, EMF equation, types of dc generators, losses & efficiency, applications.

DC Motors: Basic principle, types of dc motors, torque equation, necessity of starters,3-point starter, characteristics, speed control of dc shunt motor, losses & efficiency, applications.

UNIT-III: AC MACHINES

Transformers: Principle of operation of 1-phase transformers, construction, oc & sc tests, losses, efficiency & regulation, applications.

Induction machines: Principle of operation of 3-phase induction machines, torque-slip characteristics. Losses and efficiency and applications.

UNIT-IV: DIODE AND TRANSISTOR

Diode: p-n junction diode, symbol, V-I characteristics, Diode Application, Rectifier-Half wave, Full wave and Bridge rectifier.

Transistor: PNP and NPN junction transistor, Transistor as an amplifier.

UNIT-V: CATHODE RAY OSCILLOSCOPE

Principles of CRT (Cathode Ray Tube), Deflection, sensitivity, Electroscopic and Magnetic deflection, Application of CRO-voltage, Current and frequency measurements.

Text Books:

1. Principles of Electrical and Electronics Engineering -V.K.Mehta, S.Chand & Co, 2nd Edition, 2008.
2. Fundamentals of Electrical Engineering and Electronics - J.B. Gupta, S.K. Kataria & sons Publications, Reprint 2012 Edition, 2012.

Reference Books:

1. A Text book of Electrical Technology, Vol 2 – B.L. Thereja and A.K. Theraja, S. Chand Publications, eprint 2015.
2. Basic Electrical Engineering–D.P.Kothari and I.J.Nagarath, McGraw-Hill Education Pvt. Ltd, 3rd Edition, 2009.
3. Basic Electrical Engineering – D.C.Kulshreshtha, McGraw-Hill Education Pvt. Ltd., 1st Edition,2012.
4. Electrical and Electronics Technology – Hughes, Pearson education, 10th Edition, 2010.

Course Outcomes:

After going through this course the student gets knowledge on

CO1: Introduction of Electrical Elements, Electrical circuits and applications of KVL, KCL, and Ohm's Law,

CO2: DC machines and their applications.

CO3: AC machines and their applications.

CO4: Electronic devices like Diode, Transistors and their applications.

CO5: Working principle of CRO and its internal parts.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√			√	√		
CO 2	√	√	√					√	√		√
CO 3	√	√	√					√			√
CO 4	√	√						√			√
CO 5		√	√		√			√	√		√

ANURAG ENGINEERING COLLEGE

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B.Tech M E II Year II-Semester

L	T	P	C
3	1	0	4

(ME305PC) MECHANICS OF SOLIDS

Pre-requisites: Engineering Mechanics

Course Objectives:

1. To develop an understanding of the relationship between external loads applied to a deformable body and the internal stresses, strains and deformation induced in the body.
2. To develop analytical & graphical problem solving skills.
3. To provide students with an understanding of advanced topics concerning the response of materials and structural elements to applied forces and deformations.
4. To develop an understanding of the Deflection of Beams with different methods.
5. To provide students with an understanding of Thick Cylinders and Thin Cylinders

UNIT – I

Simple Stresses & Strains : Introduction – Types of stresses & strains- Hook's law – stress – strain diagram for mild steel – Working stress – Factory of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic module & the relationship between them. Problems on Bars of varying section & composite bars – Temperature stresses, Strain energy – Resilience – problems on Gradual, sudden, impact and shock loadings.

UNIT – II

Shear Force And Bending Moment: Introduction– Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported, fixed and overhanging beams subjected to different types of loads, point of contra flexure.

UNIT – III

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of pure bending equation. Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (solid and hollow), I, T, L and channel sections – Design of simple beam sections.

Shear Stresses: Derivation of formula – shear stress distribution across various beams sections like rectangular, circular, triangular I, T angle sections.

UNIT – IV

Deflection Of Beams: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L, uniformly varying load, Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

UNIT – V

Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

Thick cylinders – lame's equation – cylinders subjected to inside & outside pressures – compound cylinders.

Text Books

1. Strength of Materials – A.Ramamrutham-Dinnu sobi publisher-1st edition, Chennai -600109, India.
2. Mechanics of Materials by Dr.B.C.Punmia-publisher firewall Media, 2002-1st edition.
3. Strength of Materials – by Jindal-Umesh Publications.

References

1. Analysis of structures by Vazirani and Ratwani.
2. Mechanics of structures Vol-III-by S.B. Junnarkar.
3. Strength of materials by S. Timshenko.
4. Strength of Material – S.S.Rattan-TMH Publications.

Course Outcomes:

CO1: Calculate stress, strain, and deformation for basic geometries subjected to axial loading and thermal effects.

CO2: Calculate bending and shear stresses from shear force and bending moment diagram for Cantilever, simply supported and over hanging beams of transverse loading.

CO3: Calculate shear stresses for torsional loading and identify the location of shear centers for the various sections of beams.

CO4: Calculate analytically and graphically (Mohr's Circle) the maximum and minimum normal and shear stresses and the orientations at which they occur for an arbitrary two-Dimensional stress/strain state for combined loading conditions.

CO5: Calculate Circumferential Stress, Longitudinal and Volumetric Strain.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√	√	√	√				√	√	√
CO 2	√	√	√	√	√	√			√	√	√
CO 3	√	√	√	√	√	√			√	√	√
CO 4	√	√	√	√	√	√			√	√	√
CO 5	√	√	√	√	√				√	√	√

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B.Tech ME II Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME306PC) THERMODYNAMICS

Pre-requisites: Engineering Chemistry, Physics.

Course Objectives:

1. To make students familiar with the basic concepts of thermodynamics and need of energy conservation.
2. To develop an understanding of the concepts underlying first and second laws.
3. To provide basic understanding of pure substance behavior.
4. To apply the basic concept of power cycles for External combustion engines and internal combustion engines.
5. To Evaluate the behaviour of ideal gas mixtures and Thermodynamic properties.

UNIT – I

Basic concepts: Introduction**-S**ystem, Control volume, Surrounding boundaries, Universe, Types of systems, Macroscopic and Microscopic view points, Concept of Continuum, Thermodynamics Equilibrium, state, Property, Process, Cycle – Reversibility – Quasi – static Process irreversible process, Causes of irreversibility – Energy in state and in transition, Types , Work and heat, Point and path function. Zeroth Law of Thermodynamics – Concept of equality of temperature – Principles of Thermometry – Reference points – Const. Volume gas thermometer – Scales of temperature, Ideal gas scale

UNIT – II

First law of thermodynamics: PMM I, Joule's experiments –– Corollaries – First law applied to a process – applied to a flow system – Steady flow energy equation. Limitations of the first law of Thermodynamics. Heat Engine, Heat pump, Refrigerator Parameters of performance.

Second law of thermodynamics: Kelvinplanck 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 – Energy equation, Availability and irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz functions, Maxwell Relations – Elementary Treatment of the third law of thermodynamics.

UNIT – III

Pure Substances: p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation, Property tables, Mollier charts – Various thermodynamic processes and energy transfer – Steam calorimetry.

UNIT –IV

Perfect Gas Laws: Equation of State, specific and universal Gas constants – various Non-flow processes, properties, end states, Heat and work Transfer, changes in internal energy – Throttling and free Expansion Processes – Flow processes – Deviations from perfect Gas Model– Vander walls Equation of State – Compressibility charts – variable specific Heats – Gas tables.

Mixtures Of Perfect Gases: Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and vapour.

UNIT – V

Power Cycles : Otto, Diesel, Dual combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Text Books:

1. Engineering Thermodynamics -PK Nag-TMH Publications- 3rd Edition.
2. Applied Thermodynamics -D.S.Kumar-S.K.Kataria, 2010-2nd Edition

References:

1. An introduction to Thermodynamics – YVS Rao-University press
2. Solution Manual to introduction to Thermodynamics, YVC Rao, University press
3. Engineering Thermodynamics – Jones & Dugan.
4. Thermodynamics – Robert Balmer, Jaico pub
5. Thermodynamics – J.P Holman, McGrawHill.
6. Engineering Thermodynamics – K.Ramakrishna, Anuradha publishers.
7. Fundamentals of thermodynamics – Sonntag, Borgnakke and van wylen, John wiley & sons (ASIA) Pvt Ltd.

Course Outcomes:

CO1: Understand The Fundamentals of Thermodynamics.
CO2: Apply mass and energy balances (First Law) to a variety of simple processes.
CO3: Determine the properties of a pure substance using thermodynamic tables.
CO4: Analyze Rankine's ideal power cycle.
CO5: Analyze and apply knowledge on power cycle.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√								
CO 2			√		√						
CO 3			√		√						
CO 4					√						
CO 5		√									

ANURAG ENGINEERING COLLEGE

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B Tech M E II Year I-Semester **L T P C**

0 0 2 1

(ME307ES) METALLURGY AND MECHANICS OF SOLIDS LAB

Pre-requisites: Engineering Physics, Mechanics, Chemistry

Course Objectives:

- Understand the need of proper simplification for different materials.
- Understand the significance microstructure of different materials under microscopic testing.
- Analyze the various tests to be conducted on engineering materials.
- The significance of tests in evaluating the corresponding mechanical properties.
- Analyze the importance of technical parameters used during tests.

(A) METALLURGY LAB:

1. Preparation and study of the Micro Structure of pure metals like iron, Cu and Al.
2. Preparation and study of the Micro Structure of Mild steel, low carbon steels, high – C steels.
3. Study of the Micro Structure of Cast irons.
4. Study of the Micro Structure of Non-Ferrous alloys.
5. Study of the Micro Structure of Heat treated steels.
6. Hardenability of steels by Jominy End Quench test.
7. To find out the hardness of various treated and untreated steels.

(B) MECHANICS OF SOLIDS LAB:

1. To determine the Tensile Strength of specimen.
2. To determine the values of Bending stress and young's modulus or elasticity of a simple supported at the ends and carrying a concentrated load at the centre.
3. To determine the modulus at rigidity of given specimen.
4. To find the Rockwell Hardness of test specimen.
5. To determine the stiffness and modulus at rigidity of spring material.
6. To determine the breaking stress of the given material by testing apparatus.
7. To study the Impact testing machine and perform Charpy Impact test.

NOTE: Any 10 experiments from the above are to be conducted taking at least 4 from each section.

Course Outcomes:

CO1: Analyze the behavior of the solid bodies subjected to various types of loading.
CO2: Apply knowledge of materials and structural elements to the analysis of simple structures.
CO3: Undertake problem identification, formulation and solution using a range of analytical Methods.
CO4: Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.

CO5: Expectation and capacity to undertake lifelong learning.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√	√	√	√				√		√
CO 2	√	√	√	√	√				√		√
CO 3	√	√	√	√	√				√		√
CO 4	√	√	√	√	√				√		√
CO 5	√	√	√	√	√				√		√

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B.Tech ME II Year I-Semester

L	T	P	C
0	0	2	1

(ME308PC) BASIC CAD LAB

Pre-requisites: NIL

Course Objectives:

Understand the ways in which 2D sketches using appropriate CAD package.

1. Know the procedure of building drawings and obtain drafted views from it.
2. To Gain Practical experience in handling 2D drafting and isometric views.
3. To be able to apply CAD in real life applications.
4. To be able to understand text and dimensioning Practice.

CAD PRACTICES:

1. Introduction to CAD.
2. Selecting commands & Working with drawing.
3. Viewing drawing and Working with coordinates.
4. Creating simple entities by using draw commands.
5. Modifying entities.
6. Getting Drawing information.
7. Working with text and practice.
8. Dimensioning drawing and practice.
9. **2D** Drawing practice.
10. Layers
11. Isometric views
12. Working with blocks

REFERENCE BOOKS

1. Auto CAD : 2D Reference Guide by Chetan Prakashan published by CCAD Solution, training and services.
2. Auto cad by George Omura,Brain C.Benton by Auto Desk
3. *Auto Cad Pocket Reference by Cheryl R.Shrock*

Course Outcomes:

After going through this course the student gets knowledge on

CO1: To get Practice on Draw and Modify Commands.
CO2: To get practice on dimensioning commands.
CO3: To get practice on Text commands.
CO4: To get practice on Layers.
CO5: Develop the Engineering Orthographic and isometric views.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1			√								
CO 2		√									
CO 3							√				
CO 4					√						
CO 5											√

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B.Tech ME II Year I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**0**

(HS309MC) GENDER SENSITIZATION

Pre-requisites: NIL

Course Objectives:

1. To develop students sensibility with regard to issues of gender in contemporary India.
2. To provide critical perspective or the socialization of men and women.
3. To introduce students to information about so0me key biological aspects of genders.
4. To expose the students to debates on the politics and economics of work.
5. To help students reflect critically on gender vigilance.
6. To expose students to more egalitarian interactions between men and women.

UNIT-I:-

UNDERSTANDING GENDER:

Gender: Why shoud we Study it? (Towards a world of equals: Unit - 1) **Socialization:** Making women, Making Men (Towards a world of equals: Unit – 2) Introduction. Preparing for Womanhood Growing up male. First lessons in Cases. Different masculinities.

Just Relationships: Being Together as Equals (Towards a world of equals: Unit – 12)
Mary Kom and onles love and Acid just do not Mix. Love Letters, Mothers and Fathers. Furthur Reading: Rose Parks The Brave Heart.

UNIT – II:

GENDER AND BIOLOGY:

Missing Women: Sex Selection and its consequences (Towards a world of equals: Unit – 4)Destining Sex Ratio, Demographic Consequences.
Gender Spectrum: Beyond the Binary (Towards a world of Equals unit – 10)Two or Many? Struggles with DiscriminationAdditional reading: Our Bodies, Our Health (Towards a world of equals: Unit – 13)

UNIT – III:

GENDER AND LABOUR:

Housework: the Invisible Labour (Towards a world of equals: Unit – 3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (Towards a world of equals: Unit – 7)
Fact and Fiction. Unrecognized and Unaccounted work. Further Reading: Wages and Conditions of Work.

UNIT – IV:

ISSUES OF VOLENCE:

Sexual Harassment: Say Not (Towards a world of equals: Unit – 6)
Sexual Harassment: not Eve teasing Coping with Everyday Harassment Further Reading: "*Chupalu"*.
Domestic Violence: Speaking Out (Towards a world of equals: Unit – 8)
Is home a safe place? – When women unite [Film]. Rebuilding lives Further Reading New Forums for Justice.
Thinking about Sexual Violence (Towards a world of equals: Unit – 11)
Blaming the Victim-"I fought for my life…." – Further Reading: The Caste Face of Violence

UNIT – V:

GENDER STUDIES:

Knowledge: Through the Lens of Gender (Towards a world of equals: Unit – 5) Point of view Gender and the structure of knowledge. Further Reading: Unacknowledged women Artists of Telangana.

Whose History? Questions for historians and others (Towards a world of equals: Unit – 9)Reclaiming a Past. Writing other Histories. Further Reading: Missing Pages from Modern Telangana History.

Essential Reading: All The Units In the Textbook, " Towards a World of Equals: A Billngual Textbook on Gneder" written by A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Thanu. **Note:** Since it is interdisciplinary course, Resource Persons can be drawn form the fields of English Literature or Sociology or political science or any other qualified faculty who has expertise in this field.

Reference Books:

1. Sen, Amartya. "More than One Million Women are Missing." New York of books 37.20 (20 December 1990). Print. "we Were Making History…" Life Stories of Women in the Telangana People's Struggle. New Delhi: Kall fcr Women. 1989.
2. Tripti Lahiri. "By the Numbers: Where Indian Women Work." Women's Studies Journal (14 November 2012) Availbale online at : http:// blogs.wsj.com/india real time/2J12/11/14/by-The numbers-wehere-Indian-women-work/>
3. K.Satyanaraya and Susie Tharu (Ed.) Steel Nibs Are Sorouting: New Dalit Writing From South India, Dussier 2. Telugu And Khannada http://harpercolling.co.in/BookDetail.aso?BookCodes3732
4. Vimala. "Vartillu (the Kitchen)". Women Writing in India: 600 BC to the Present. Volume II: The 20th Century. Ed. Susic Tharu and K.Lalits. Delhi:Oxford University Press, 1995. 599-601.
5. Shatruguna. Veana At . Women's Work and its Imapact on Child Health and Nutrition Hyderabad, National Institute of Nutrition . India council of research. 1993.
6. Stree Shakti Sangeetana. "We Were Making History … 'Life Stories of women in the Telangana People's Struggle. New Delhi: Kai for Women. 1989.
7. Menon. Nivedita. Seeing Like a Feminist New Delhi: Zubaan-Penguin Books, 2012.
8. Yayaprabha, A. "Chupulu (states)". Women Writing in India: 500BC to the Present. Volume II: The 20th Century Ed. Susie Tharu and K.Lalita Delhi: Oxford University Press. 1995.596-597.
9. Haveed Shayam and Anupam Maruhaar, "Women and Wage Discrimination in India: A Critical Analysis. " I International journal of Humanities and Social Science Invention 2.4(2013)
10. Gautam. Liela and Gita Ramaswamy. "A Conversation between a Daughter and a Mohter. " Eroadsheet on contemporary Politics. Special Issue on Sexually and Harassment: Gender Politics on Campus Today. Ed. Madhumeeta Sinha and Asma Rasheed. Hyderabad Anveshi
    Research Center for Women's Studies. 2014
11. Aodulali Sohaila. "I fought for My Life .. and Won. " Available online at http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand -won-sohala-abdula/
12. Jeganathan Pradeep. Partha Chattarjee (Ed). "Community, Gender and Violence Subaltern Studies XI". Parmanert Black and Ravi Dayal Publishers, New Delhi, 2000.
13. Kkapadia. The Violence of Development: The Plitics of Identity, Gender and Social Inequalities in india London: Zed Books. 2002
14. S.benhabib. Situaling the Self Gender, Community ana Postmoderism in Contemporary Ethics. London roullege. 1992
15. Virgnia Woolf. A Room of One's Own. Oxford Black Swan. 1992
16. T. Banuri and M. Mahmood, Just Development: Beyond Adjustment with a human Face, Karachi Oxford University Press, 1997

Course Outcomes:

CO1: Students will have developed a better understanding of important issues related to gender in contemporary India.

CO2: Students will be sensitized to basic dimensions of the biological, sociological, Psychological and legal aspects of gender. This will be achieved through discussion of materials from research, facts, everyday life, literature and film.

CO3: Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.

CO4: Students will acquire insight into the gendered division of labour and its relation to politics and economics.

CO5: Men and women students and professions a will be better equipped to work and live together as equals.

CO6: Students will develop a sense of appreciation of women in all walks of life.

CO7: Through providing accounts of studies and movements as well as the now laws that provide protection and relief to women, the textbook will empower students to understand respond to gender violence.

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1										√	
CO 2			√			√		√	√		
CO 3	√							√			
CO 4			√			√			√		
CO 5						√			√		
CO 6	√						√		√	√	

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

B.Tech ME II Year II-Semester

L	T	P	C
3	0	0	3

(PS401BS) PROBABILITY AND STATISTICS

Pre-requisites: To study and understand this subject the student must have the basic knowledge of set and relations theory, permutations, combinations, venn diagrams, mean, median, mode and testing of hypothesis of different samples

Course Objectives: To learn

1. Understand Chance causes and random variable that describes randomness or an uncertainty in certain realistic situation. It can be of either discrete or continuous type.
2. In the discrete case, study of the binomial and the Poisson random variables and the Normal random variable for the continuous case predominantly describe important probability distributions. Important statistical properties for these random variables provide very good insight and are essential for industrial applications.
3. The types of sampling, Sampling distribution of means ,Sampling distribution of variance, Estimations of statistical parameters, Testing of hypothesis of few unknown statistical parameters.
4. Understanding the Experiment and the design of experiment.
5. The random processes, The classification of random processes, Markov chain, Classification of states
6. Stochastic matrix (transition probability matrix),Limiting probabilities, Applications of Markov chains

UNIT-I: Introduction to Probability, Addition theorem, Multiplication theorem (Two events only), Baye's theorem.

Random variables, Discrete and continuous random variable, Definitions of Probability Distribution function, Probability mass function, Probability density function and properties. Definitions of Mathematical expectation, Variance of discrete and continuous random variable. Bivariate distributions and their properties, marginal and conditional distribution

UNIT-II:

Discrete Distributions: Bernoulli, Binomial, Poisson distributions (definition and problems) their mean, variance and moment generating function.

Continuous Distribution: Normal, exponential distributions (definition and problems) related properties.

UNIT-III:

Measures of Central tendency: Moments, Skewness and Kurtosis.

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Correlation and regression – Rank correlation

UNIT-IV:

Estimation: Concept of Point estimation and its properties (definition only), Concept of interval estimation with examples.

Test of Hypothesis: Null & Alternative Hypothesis, Critical region, Type I and Type II errors, level of significance, one tail, two-tail tests.

Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means

UNIT-V:

Small Sample tests: t-Test for single mean, difference of means, paired t-test, F-test.

Chi-square test for goodness of fit and independence of attributes.

ANOVA: Introduction, ANOVA for one way classification only.

Text Books:

1. Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, Academic Press.
2. Probability and Statistics for Engineers by Richard A Johnson, Pearson Education.

References:

1. Introduction to Probability by Charles M Grinstead, J Laurie Snell, American Mathematical Society.
2. Miller and John E. Freund, Probability & Statistics for Engineers, Prentice Hall of India.
3. Montgomery: Design and Analysis of Experiments, Wiley

Course Outcomes:

CO1: Students would be able to identify distribution in certain realistic situation.
CO2: It is mainly useful for circuit as well as non-circuit branches of engineering. Also able to differentiate among many random variables involved in the probability models. It is quite useful for all branches of engineering.
CO3: The student would be able to calculate mean and proportions (small and large sample) and to make important decisions from few samples which are taken out of unmanageably huge populations .It is Mainly useful for non-circuit branches of engineering.
CO4: The student would able to understand about the random process, Markov process and Markov chains which essentially models of many time dependent processes are such as signals in communications, time series analysis, queuing systems.
CO5: The student would be able to find the limiting probabilities and the probabilities in nth state. It is quite useful for all branches of engineering.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√						
CO 2	√	√			√						
CO 3	√	√			√						
CO 4	√	√			√						
CO 5	√	√			√						

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B.Tech ME II Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME402PC) KINEMATICS OF MACHINERY

Pre-requisites: Mechanics and Mechanics of Solids

Course Objectives:

1. Understand mechanisms for motion transmission.
2. Understand the construction methods for drawing velocity and acceleration diagrams.
3. Design engineering applications involving in selection, sizing of mechanism to accomplish motion objectives.
4. Understand the mechanism involving cams, gears and gear trains.
5. Understand the mechanism involving Belt, Rope and Chain Drives.

UNIT – I

Mechanisms: Elements of Links – Classification – Rigid Link, flexiable and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Kinematic chain – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

Straight Line Motion Mechanisms: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russell – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, pantograph.

UNIT – II

Introduction to Velocity and acceleration – Motion of link on machine – Determination of velocity and acceleration using Graphical method – Application of relative velocity method four bar mechanism.

Analysis of Mechanisms: Analysis of slider crank mechanism for displacement, Velocity and acceleration of slider – Acceleration diagram for a given mechanism, Coriolis acceleration.

Plane motion of body: Instantaneous center of rotation, centroid and axodes – Three centres in line theorem.

Steering Mechanisms: Conditions for correct steering – Davis Steering gear, Ackermann's steering gear – velocity ratio.

UNIT – III

Cams : Definition of cam and follower –applications, Types of followers and Cam terminology, Types of follower motions – Uniform velocity -simple harmonic motion-uniform acceleration and cycloid motion Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

UNIT – IV

Introduction to toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth, cycloidal and involute profiles, sliding of Velocity – phenomena of interferences – Causes of interference, Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – introduction of Helical, Bevel and worm gearing.

UNIT – V

Gear Trains: Introduction – Train value – Types – Simple and reverted wheel train – Epicyclic gear train, Methods of finding train value or velocity ratio – Epicyclic gear trains, Differential gear for an automobile.

Belt, Rope and Chain Drives: Introduction, Belt and rope drives, selection of belt drive – types of belt drives, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains -classification of chains, length, angular speed ratio.

Text Books:

1. Theory of Machines – Rattan .S.S, TMH, 2009 Edition.
2. Theory of Machines by Thomas Bevan-Pearson-3rd Edition.
3. Theory of Machines – R.K Bansal-Laxmi publications-9thEdition.
4. Theory of Machines -Shigley-Oxford.

References:

1. Theory of Machines – PL. Ballaney -kharina publishers.
2. Theory of Machines Sadhu Singh Pearsons Edn.
3. Mechanism and Machine Theory -JS Rao and RV Dukkipati-NewAge.
4. Theory of Machines R.S Khurmi & J.K Gupta.

Course Outcomes:

CO1: Analyze different mechanisms and machines.
CO2: Calculate position, velocity, and acceleration of linkages.
CO3: Develop the cam profiles. Calculate velocity, and acceleration of follower.
CO4: Calculate the length of path of contact, length of arc of contact, contact ratio, no of teeth's required to avoid interference and speed.
CO5: Calculate the velocity ratio and know the concept of belt, rope & chain drives.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√	√	√				√	√	√
CO 2	√		√	√	√	√			√	√	√
CO 3	√		√	√	√	√			√	√	√
CO 4	√		√	√	√	√			√	√	√
CO 5	√		√	√	√				√	√	√

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B.Tech ME II Year II-Semester

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(ME403PC) PRODUCTION TECHNOLOGY

Course Objective:

1. To understand basic manufacturing processes like casting.
2. To understand advanced manufacturing processes in casting.
3. To learn various aspects of different manufacturing techniques such as various welding methods.
4. To get knowledge on fundamentals on rolling process.
5. To impart knowledge on selection of suitable manufacturing process for the typical component.

UNIT – I

Casting: Introduction, Steps involved in making a casting –Advantage of casting and its applications, Molding sand and its properties- Patterns and pattern making – Types of patterns, Materials used for patterns, pattern allowances and their construction, principles of Gating, Gating ratio and design of Gating systems.

UNIT – II

Advanced casting process:

Solidification of casting – Concept – Solidification of pure metal and alloys, short & long freezing range alloys, Risers – Types, function and design, casting design considerations, special casting processes 1) centrifugal, 2) Die, 3) investment. Casting defects and methods. Methods of melting: Crucible melting and cupola operation, steel making processes, special.

UNIT – III

Metal joining processes:

a) **Welding:** Classification of welding processes, types of welds& welded joints, characteristics of welding, preparation of welded joints, Gas welding, Arc welding, Forge welding, Resistance welding, Thermit welding and Plasma welding.
b) **Cutting of Metals:** Oxy – Acetylene Gas cutting, water plasma, cutting of ferrous metals.
c) **Inert Gas welding:** TIG & MIG welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering & Brazing, Heat affected zones in welding, welding defects – causes and remedies – Destructive, Non destructive testing of welds.

UNIT – IV

Metal forming and working:

Hot working, cold working, advantages, disadvantages, and limitations, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of cold and Hot worked parts; Rolling fundamentals – theory of rolling, types of rolling mills and forces in rolling and power requirements.

Stamping, forming and other cold working processes, Blanking and piercing – Bending and Forming – Drawing and its types, Deep Drawing – wire drawing and Tube drawing – coining – Hot and cold spinning.

UNIT – V

Extrusion Of Metals: Basic extrusion process and its characteristics, Hot extrusion and cold extrusion – Forward extrusion and backward extrusion – impact extrusion, Hydrostatic extrusion.

Forging Processes: Principles of forging – Tools and dies – Types Forging – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – Forging defects.

Processing Of Plastics: Types of Plastics, Properties, applications and their Processing methods & Equipment -blow & injection molding.

Text Books:

1. Elements Of Work Shop Technology Volume-1 -media promoters-a.k.hajra choudhury, nirjhar roy-6th edition.
2. A Text Book of Production Technology -P.C.Sharma-published 2009 by Chand(s) Co Ltd-8th Edition.
3. Manufacturing Technology vol-1 3E-Tata McGraw-Hill Education2009-Rao-6th Edition.

References:

1. Production Technology-R.K Jain
2. Process And Materials Of Manufacturing – Lindberg-PE
3. Principles of Metal Castings – Roenthal.
4. Welding Process – Paramar
5. Production Engineering – Suresh Dalela & Ravi Shanker-Galgotia Publications Pvt. Ltd.
6. Manufacturing Engineering and Technology -Kalpakjin. S -Pearson Edu.
7. Manufacturing Processes for Engineering Materials – Serope Kalpakjian and Steven R Schmid, Pearson Publication.

Course outcomes

Learner will be able to…

CO 1: Select materials, types and allowances of patterns used in casting and analyze the components of moulds.
CO 2: Illustrate principles of advanced casting processes.
CO 3: Demonstrate applications of various types of welding processes.
CO 4: Principle of concept of metal forming and metal working process.
CO 5: Illustrate the concept of extrusion process and producing plastic components.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√				√	√	
CO 2			√			√			√	√	√
CO 3		√			√						
CO 4	√					√					√
CO 5								√	√		

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B.Tech ME II Year II-Semester

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3	0	0	3

(ME404PC) THERMAL ENGINEERING – I

Pre-requisites: Thermodynamics.

Course Objective:

The objective of this subject is to impart

1. The knowledge of engine components, working principles of I.C. Engines, auxiliary systems.
2. The combustion aspects of S.I. and C.I. Engines in addition to the methods of improving performance.
3. The students shall become aware on the latest developments in the field of I.C. Engines like MPFI, CRDI etc.
4. Shall become familiar about the working of Reciprocating and Rotary Compressors.
5. The student also shall apply the thermodynamic concepts in I.C. Engines and compressors.

UNIT-I

I.C. ENGINES : Definition of Engine and Heat Engine, I.C Engine Classification – Parts of I.C. Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C. Engines S.I.& C.I. Engines, Valve and Port Timing Diagrams.

UNIT-II

Fuel Supply System: Fuel Supply Systems in S.I. Engine, carburetor, Air Filters, Fuel Pumps – Gasoline Injection Systems, Fuel supply systems in C.I. Engines, fuel pumps, Common Rail Diesel injection (CRDI).

Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Siphon, Water and Forced Circulation System, Lubrication Systems-Flash, Pressurized and Mist Lubrication.

UNIT-III

Combustion in S.I. Engine: Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers.

Combustion in C.I. Engines: Four **S**tages Of Combustion – Delay Period and Its Importance – Effect Of Engine Variables – Diesel Knock– Combustion Chambers (DI and IDI), Fuel Requirements and Fuel Rating.

UNIT – IV

Testing and Performance : 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.

UNIT-V

Air Compressors: Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi -Stage Compressors, Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors.

- **Students are advised to refer the text book of "Internal Combustion Engine Fundamentals"** by John B. Heywood.

Text Books:

1. I.C. Engines-V. Ganesan- TMH.
2. Thermal Engineering –Rajput-Lakshmi Publications.

References:

1. IC Engines – Mathur& Sharma – DhanpathRai& Sons.
2. Internal Combustion Engines by K.K. Ramalingam, Scitech Publications.
3. Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI
4. Thermal Engineering, Rudramoorthy - TMH
5. Thermodynamics & Heat Engines, B. Yadav, Central Book Depot., Allahabad
6. I.C. Engines, Heywood, McGraw Hill.
7. Thermal Engineering – R.S. Khurmi&J.K.Gupta – S.Chand.
8. Thermal engineering data book-B.Srinivasulu Reddy, JK International Pub.

Course Outcomes:

CO 1: Analyze air standard cycles used in I.C. Engines.
CO 2: Understand the combustion phenomena in I.C.Engines.
CO 3: Analyze the performance of I.C engines.
CO 4: Understand the Concept About Reciprocating And Rotary Compressors.
CO 5: Understand the Concept About Centrifugal And Axial Compressors

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√		√						
CO 2	√		√			√		√			√
CO 3	√	√			√			√			
CO 4	√	√	√		√					√	√
CO 5	√	√	√		√					√	

ANURAG ENGINEERING COLLEGE

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B Tech M E II Year II-Semester

L	T	P	C
3	0	0	3

(ME405PC) MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

Pre-requisites: NIL

Course Objectives:

1. Understanding the properties of fluids, principles of buoyancy calculations.
2. Understanding the properties of flow, force and head calculations.
3. Evaluation of types of fluid flow, Laminar and dynamic
4. Knowledge on boundary layer principles applied to aerofoil's.
5. Principles of operation of different types of hydraulic machinery.

UNIT – I

Fluid Statics: Units and Dimensions: physical properties of fluids - specific gravity, viscosity, surface tension problems – vapour pressure and their influence on fluid motion – atmospheric, gauge and vacuum pressures, Measurement of pressure: Piezometer, U-tube and differential manometers.

UNIT – II

Fluid Kinematics: Steam line, path line and stream lines and steam tube, classification of flows: steady & unsteady, uniform & non uniform, laminar & turbulent, rational & irrational flows, equation of continuity for one dimensional flow and three dimensional flows.

Fluid Dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a 2-D stream line, momentum equation and its application on force on pipe bend-Problems.

UNIT – III

Closed Conduit Flow: Reynold's experiment-Darcy Weisbach equation-Minor losses in pipes – pipes in series and pipes in parallel – total energy line – hydraulic gradient line. Measurement of flow: pitot tube, venture meter and orifice meter.

Boundary Layer Theory Of Concepts: Thicknes, characteristics along the thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

UNIT – IV

Basics Of Turbo Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube theory – functions and efficiency.

UNIT – V

Performance Of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

Centrifugal Pumps: Classification, working principle, work done – barometric head – losses and efficiencies, specific speed – performance characteristic curves. NPSH

Reciprocating Pumps: Working, Discharge, slip, indicator diagrams.

Text Books:

1. Fluid Mechanics and Hydraulic Machinery MODI and SETH.
2. A Text Book Of Fluid Mechanics -R.K.Bansal-Laxmi publication (p) Ltd,2011-9th Edition.
3. Fluid Mechanics and Fluid Power Engineering By D.S. Kumar, Kotaria & Sons.

Reference Books:

1. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
2. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
3. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley ,John Wiley & Sons.
4. Fluid Mechanics and Hydraulic Machines by Rajput.

Course Outcomes:

1. Understand the Importance of fluid Mechanic, and behavior fluids Dimensions and units, physical properties of fluids, types of fluid flows, Stream line, path line and streak lines and stream tube, classification of flows.
2. Understand types of losses and measurement of fluid flows.
3. Apply the momentum principles for impact of jets.
4. Analyze the hydraulic pumps.
5. Analyze the hydraulic turbines.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√										
CO 2		√									
CO 3	√										
CO 4			√		√						
CO 5			√		√						

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B.Tech ME II Year II-Semester	**L**	**T**	**P**	**C**
	1	**0**	**4**	**3**

(ME406BS) MACHINE DRAWING

Pre-requisites: Engineering Drawing.

Course Objectives:

1. Remember the Principles of Machine Drawing Conventions.
2. Analyze the Machine Elements like Screw Threads, Nuts, Bolts, Keys and riveted joints.
3. Remember the Machine Elements and simple parts like Shaft couplings.
4. Remember the Machine Elements and simple parts like Journal, pivot, and collar bearings.
5. Evaluate the different views of Part Drawings and based on that, draw the Assembled Parts of Engine & Machine parts.

Machine drawing conventions: Need for drawing conventions – introduction to IS conventions

a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views, Parts not usually sectioned.
c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
d) Title boxes, their size, location and details – common abbreviations & their liberal usage.
e) Types of Drawings – working drawings for machine parts.

I. **Drawing of Machine Elements and simple parts:**
Selection of Views, additional views for the following machine elements and parts with every drawing proportion.
   a) Popular forms of screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
   b) Keys, cottered joints and knuckle joint.
   c) Riveted joints for plates
   d) Shaft coupling, spigot and socket pipe joint.
   e) Journal, pivot and collar and foot step bearings.

II. Assembly Drawings: Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

a) **Engine Parts** – stuffing boxes, cross heads, Eccentric, Petrol Engine connecting rod, piston assembly.
b) **Other Machine Parts** – Screws jacks, Machine vices Plummer block tailstock.
c) **Valves**: Steam stop valve, spring loaded safety valve, feed check valve and air cock.

Note: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

Text Books:

1. Machine Drawing – K.L Narayana, P.Kannaiah & K.Venkata Reddy/ New Age/publishers.
2. Machine Drawing – Sidhishwar/TMH Publications/International Edition.
3. Machine Drawing- N.D.Bhatt./poetmba 2013.

References:

1. Machine Drawing – P.S. Gill.
2. Machine Drawing – Luzzader
3. Machine Drawing – Rajput.
4. Machine Drawing – Ajeet Singh, TMH Publications.

Question Paper Pattern:
PART A:
TWO Questions need to be answered from 4 questions from Section - I for 2 X 15 = 30 Marks

PART B:
Only One question will be given from the Assembly Drawings for 45 marks. No Choice Compulsory Question.

Course Outcomes:
CO1: Identify the national and international standards pertaining to machine drawing.
CO2: Draw the conventional representation for screws, nuts, and bolts, keys, gears, webs and ribs.
CO3: Draw the machine elements for riveted joints and bearings.
CO4: Draw the machine elements for couplings and pipe joints.
CO5: Draw the assembly drawing for the machine parts.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√						√			√
CO 2	√	√						√			√
CO 3	√	√	√					√			√
CO 4	√	√	√								√
CO 5	√		√						√	√	√

ANURAG ENGINEERING COLLEGE

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B.Tech ME II Year II-Semester

L	T	P	C
0	0	2	1

(ME407PC) MECHANICS OF FLUIDS AND HYDRAULIC MACHINES LAB

Pre-requisites: NIL

Objectives:

The course will give the student an insight into working of various fluid machines and be able to compare performance of fluid machines under different working conditions

1. Impact Of Jets On Vanes
2. Performance Test On Pelton Wheel
3. Performance test on Francis Turbine.
4. Performance test on single stage centrifugal pump.
5. Performance test on Multi stage centrifugal pump.
6. Performance test on Reciprocating pump.
7. Calibration of Venturimeter.
8. Calibration of Orifice mater.
9. Determination of friction factor for a given pipe line.
10. Determination of loss of head due to sudden contraction in a pipeline.
11. Verification of Bernoulli's theorems.
12. Performance Test on Kaplan Turbine.

COURSE OUTCOMES:

After completion of this course the students will be able to:

CO 1: Understand the basic concept of types of pumps and study their performance.
CO 2: Analyze the impact of fluid jet on structure of vanes.
CO 3: Study the types of turbines and their overall efficiency.
CO 4: Study the losses in pipes due to different pipe fittings.
CO5: Measure fluid flow rates using flow measuring devices.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√	√								√
CO 2	√	√	√								√
CO 3	√	√	√		√						√
CO 4	√	√	√								√
CO 5	√	√	√								√

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L	T	P	C
0	0	2	1

(ME408PC) PRODUCTION TECHNOLOGY LAB

Pre-requisites: NIL

Objectives:

1. To study different testing methods for moulding sand and design of pattern.
2. To study Oxy-acetylene welding and resistance spot welding processes.
3. To learn the various methods sheet metal forming,
4. To learn the concept of bending operation.
5. To get the knowledge on processing of plastics.

Minimum of 12 Exercises need to be performed

I. Metal Casting Lab:

1. Pattern Design and making – for one casting drawing.
2. Sand properties testing – Exercise for strengths and permeability – 1
3. Moulding Melting and Casting – 1 Exercise

II. Welding Lab:

1. ARC Welding Lap & Butt Joint – 2 Exercises
2. Spot Welding – 1 Exercises
3. Gas Welding – 1. Exercise
4. Soldering and Brazing – 2 Exercises

III. Mechanical Press Working Lab:

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending operations.

IV. Plastics Lab:

1. Injection Moulding
2. Blow Moulding

Reference Book:

1. Dictionary of Mechanical Engineering – G.H.F Nayer, Jaico publishing.

Course Outcomes:

Attending the laboratory the students shall be able to,

1. Apply some of the manufactures process directly in the industry for preparation of complicated jobs.
2. At the end of the lab learn preparation of various joining process.
3. The student will be trained to implement similar features in preparation of jobs can be extended to implement in the preparation of complicated jobs.
4. At the end lab student should learn strength of metals.
5. Apply some of the plastic material manufactures product.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1		√			√						
CO 2			√						√		
CO 3					√			√			
CO 4								√			√
CO 5								√			√

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B.Tech ME II Year II-Semester

L	T	P	C
2	0	0	0

(HS409MC) HUMAN VALUES AND PROFESSIONAL ETHICS

Course Objectives:

1. To help the students appreciate the essential complementarities between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings?
2. To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with Nature.

UNIT - I:

Course Introduction - Need, basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education. Self Exploration - what is it? - its content and process; 'Natural Acceptance' and Experiential Validation - as the mechanism for self exploration. Continuous Happiness and Prosperity - A look at basic Human Aspirations. Right understanding, Relationship and Physical Facilities - the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT - II:

Understanding Harmony in the Human Being - Harmony in Myself! : Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

UNIT - III:

Understanding Harmony in the Family and Society - Harmony in Human - Human Relationship: Understanding harmony in the Family the basic unit of human interaction. Understanding values in human - human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; **Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.** Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astiva as comprehensive Human Goals. Visualizing a universal harmonious order in society - Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) - from family to world family!

UNIT - IV:

Understanding Harmony in the nature and Existence - Whole existence as Co-existence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astiva) of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

UNIT - V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order,
b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order.

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b. At the level of society: as mutually enriching institutions and organizations.

1. R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Prof. K. V. Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications, 3rd Edition.

1. Ivan IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
2. E. F. Schumancher, 1973, small is Beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.
3. A Nagraj, 1998 Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986, 1991.
5. P. L. Dhar, R. R. Gaur, 1990, Science and Humanism, Commonwealth Publishers.
6. A. N. Tripathy, 2003, Human Values, New Age International Publishers.
7. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth - Club of Rome's report, Universe Books.
9. E G Seebauer & Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
10. M Govindrajan, S Natrajan & V. S Senthil kumar, Engineering Ethics (including Humna Values), Eastern Economy Edition, Prentice Hall of India Ltd.

Relevant CDs, Movies, Documentaries & Other Literature:

1. value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. AI Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charle Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology - the Untold Story

Course Outcomes:

CO1: Understood the core values that shape the ethical behavior of an Engineer.
CO2: Exposed awareness on professional ethics and human values.
CO3: An ability to communicate effectively.
CO4: Known their role in technological development.
CO5: An understanding of professional and ethical responsibility.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1				√		√		√	√	√	
CO 2				√		√		√	√	√	
CO 3				√		√		√	√	√	
CO 4				√		√		√	√	√	
CO 5				√		√		√	√	√	

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(AE501HS) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course objective:

- To understand and enhancing the knowledge regarding managerial concepts and obtaining optimal solutions.
- Get an idea of production methods and technical relationships between input-out
- To share the concepts of like market structures.
- To provide awareness regarding capital budgeting decisions.
- To get an idea of firms financial position with the techniques of financial analysis and ratios.

UNIT – I

Introduction to Managerial Economics: Definition, Nature and scope of Managerial Economics, Demand Analysis- Demand Determinants, Law of Demand and its exceptions.

Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Methods of Demand Forecasting (Survey Methods, Statistical Methods, Expert Opinion Method, Test Marketing, Controlled Experiments, Judgmental Approach to Demand Forecasting)

UNIT – II

Theory of Production and Cost Analysis: Production Function – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Laws of Returns, Internal and External Economics of Scale.

Cost Analysis: Cost concepts, Opportunity Cost, Out of Pocket Costs vs. Imputed Costs. Breakeven Analysis (BEA) – Determination of Breakeven Point (simple problems), Managerial Significance and limitations of BEA.

UNIT – III

Market Structures& Pricing Policies:

Market structures: Types of Competition, Features of Perfect Competition, Monopoly and Monopolistic Competition, Price - Output determination in Perfect Competition and monopoly.

Objectives and Policies of Pricing: Objectives of pricing**,** Methods of Pricing - Cost Plus Pricing, Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Two - Part Pricing, Block Pricing, Peak Load Pricing, Cross Subsidization.

UNIT – IV

Capital and Capital Budgeting: Capital and its significance, Types of Capital, Estimation of Fixed and Working Capital requirements. Nature and scope of Capital Budgeting, features of Capital budgeting proposals, Methods of Capital Budgeting- Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method, Profitability Index, Internal Rate of Return (simple problems).

UNIT – V

Introduction to Financial Accounting: Accounting, Double-Entry Book Keeping, Journal, Ledger, and Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

Financial Analysis through ratios: Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital Structure Ratios (Debt – Equity, Interest Coverage Ratio), and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio, Operating Profit Ratio, P/E Ratio and EPS).

Text books:

1. Aryasri, Managerial Economics and Financial Analysis, TMH, 2012.
2. Varshney&Maheshwari, Managerial Economics, Sultan Chand& Sons, 2014.
3. S.A. Siddiqui and A.S. Siddiqui, Managerial Economics and Financial Analysis, New Age International Publishers, Hyderabad, 2013

References:

1. Raghunatha Reddy &Narasimhachary, Managerial Economics & Financial Analysis, Scitech, 2009.
2. V. Rajasekarn& R. Lalitha, Financial Accounting, Pearson Education, New Delhi, 2010.
3. Domnick Salvatore, Managerial Economics in a Global Economy, 4th Edition, Cengage, 2009.
4. Subhash Sharma & M. P. Vittal, Financial Accounting for Management, Text & Cases, Machmillan, 2012.
5. S. N. Maheshwari& S. K. Maheshwari, Financial Accounting, Vikas 2012.
6. Truet and Truet, Managerial Economics; Analysis, Problems and Cases, Wiley, 2012.
7. Dwivedi, Managerial Economics, Vikas 2012.
8. M. Kasi Reddy and S.Saraswathi, Managerial Economics and Financial Accounting, PHI, 2012.
9. Erich A. Helfert, Techniques of Financial Analysis, Jalco, 2007.

Codes / Tables: Present Value Tables need to be permitted into the Examination Hall.

Course Outcomes: Student will be able to understand

CO1: The market dynamics namely demand, demand forecasting, elasticity of demand.
CO2: Gain an insight in to how production function is carried out to achieve least cost combination of inputs and cost analysis.
CO3: Know the types of markets and pricing methods and Strategies.
CO4: Analyze how capital budgeting decisions are carried out.
CO5: The importance of Accounting and know How to analyze and Interpret the Financial statements through Ratio Analysis

CO's /PO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	✓	✓									
CO 2		✓	✓								
CO 3		✓									
CO 4		✓									
CO 5		✓					✓				

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

(ME502PC) DYNAMICS OF MACHINERY

Prerequisites: Kinematics of Machinery
Course Objectives: To impart knowledge on

1. Analysis of forces acting in mechanisms and gyroscope effect on aero plane, ships, two wheel and four wheel.
2. Functions of brakes and clutch.
3. The principles in mechanisms used for flywheel and governing of machines
4. Effects of unbalance forces for rotating and reciprocating masses.
5. Modeling and analyzing the vibration behavior of spring mass damper system.

UNIT – I

Static And Dynamic Force Analysis Of Slider Crank Mechanism - Displacement of piston - Velocity of Piston - Acceleration of Piston- Net or Effective force on the Piston- Crank Effort- Angular Velocity and Angular Acceleration of Connecting rod

Gyroscopes: Gyroscopic effect-Derivation of basic equation, Effect of Precession Motion on the Stability of Moving Vehicles Such As Motor Car, Motor Cycle, Aero Planes And Ships.

UNIT – II

Clutches: Friction Clutches – Single Disc Or Plate Clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

Brakes: Simple Block Brakes, Internal Expanding Brake, Band Brake of Vehicle.

UNIT – III

Turning Moment Diagram and Fly Wheels: Turning Moment – Inertia Torque - Angular displacement of Crank Diagrams – Fluctuation of Energy – Fly Wheels and Their Design.

Governor: Watt, Porter and Proell Governors, Spring Loaded Governors –Hartnell and Hartung with Auxiliary Springs, Sensitiveness, Isochronism's and Hunting.

UNIT – IV

Balancing: Balancing Of Rotating Masses Single And Multiple – Single And Different Planes Analytical Method. Balancing Of Reciprocating Masses, Primary and Secondary Balancing Of Reciprocating Masses. Analytical Method – Unbalanced Forces and Couples – Balancing Of Single Cylinder Engine.

UNIT – V

Vibration: Free Vibration of Mass Attached To Vertical Spring (Parallel and Series), Types of Free Vibrations, and Natural Frequency of Longitudinal Vibrations.

Forced Damped Vibration, Vibration Isolation & Transmissibility – Introduction to Natural Frequency Of Transverse and Torsional Vibrations.

Text Books:

1. Theory Of Machines By T. Beven, Pearson Education-Third Edition.
2. Kinematics And Dynamics Of Machinery By R.L.Norton, Mc Graw Hill. I ed.in SI units.

References:

1. Theory Of Machines By S S. Ratan, Mc Graw Hill. Third Edition.
2. Theory Of Machines And Mechanisms By P.L. Ballaney, Khanna Publishers.
3. Mechanism And Machine Theory / JS Rao And RV Dukkipati-New age
4. Theory Of Machines And Mechanisms By Uicker, Pennock And Shigley-Oxford.

Course Outcomes:

CO1: Attain a deeper understanding on the gyroscopic effects of rotating bodies for aero-Planes, naval ships, automobiles, and two wheelers.

CO2: To gain the knowledge on the Brakes and Clutches.

CO3: Analyze different types of governors which controls speed of the machine or engine

CO4: Understand how to balance several masses in different planes along with rotating and Reciprocating masses.

CO5: Analyze the response of the vibrating mass at different operating conditions Calculate Natural frequencies for different modes of vibrations for transverse and Torsional Loading conditions.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√						√
CO 2	√	√	√		√			√			
CO 3	√		√		√						√
CO 4	√				√						
CO 5	√	√	√		√			√			√

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME503PC) MACHINE TOOLS AND METROLOGY

Prerequisites: Production Technology

Course objective:

1. To gain the practical experience on the machines.
2. To make student familiar with various operations on machine tools.
3. To make the students familiar with the drilling operations.
4. To create awareness on various mechanical measuring instruments.
5. Usage of the instruments to measure the linear and angular measurements.

UNIT – I

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips.

Engine lathe – Principle of working, types of lathe, specifications. Taper turning,–Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

UNIT – II

Drilling and Boring Machines – Principles of working, specifications, types, and operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planning machines - Principles of working – machining time calculations.

UNIT – III

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters – methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations.

UNIT – IV

Limits, fits and tolerances: Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.

Limit Gauges: Taylor's principle, Design of GO and NO GO gauges.

Measurement of angles: Bevel protractor, Sine bar.

Measurement of flat surfaces: straight edges, surface plates, optical flat and auto collimator.

UNIT – V

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines.

Coordinate Measuring Machines: Types and Applications of CMM.

TEXT BOOKS:

1. Engineering Metrology -I C Gupta-Danpath Rai
2. Engineering Metrology - R.K. Jain-Khanna Publishers.
3. Principles of Machine Tools, Bhattacharya A and Sen.G.C.-New Central Book Agency.
4. Production Technology by R.K. Jain and S.C. Gupta.

REFERENCE BOOKS:

1. Production Technology by H.M.T. (Hindustan Machine Tools).
2. BIS Standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
3. Fundamentals of Dimensional Metrology-Connie Dotson-Thomson-4e.
4. Workshop Technology – Vol.-II, B.S. RaghuVamsi.
5. Elements of Work Shop Technology – Vol. II, Hajra Choudry, Media Promoters.
6. Fundamentals of Metal Machining and Machine Tools, Geofrey Boothroyd-McGraw Hill.

Course Outcomes:

CO1: Hands on experience on lathe machine to perform turning, facing, threading operations.
CO2: Skill development in drilling threading and slotting, shaping operations.
CO3: Practical exposure on flat surface machining, milling and grinding operations.
CO4: Get acquainted with limits, tolerances and gauge design and understand the principles Of Linear and angular measuring instruments.
CO5: Understand the surface roughness terminology and types of various surface roughness Measuring instruments and Coordinate Measuring Machines.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1			√								√
CO 2											√
CO 3		√									
CO 4	√		√					√			√
CO 5	√		√							√	

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME504PC) DESIGN OF MACHINE MEMBERS-I

Prerequisites: Engineering mechanics, Mechanics of solids.

Course objectives:

1. To apply the general design procedures and principles in the design of machine elements.
2. To apply different materials of construction and their properties and factors determining the selection of material for various applications.
3. To evaluate stresses under different loading conditions.
4. To apply the design procedure of different fasteners, joints.
5. To apply the design procedure of shafts and couplings.

UNIT-I

Introduction: General considerations in the design of Engineering Materials and their properties–selection–Manufacturing consideration in design. Tolerances and fits–BIS codes of steels.

Design for Static Strength: Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT – II:

Design for Fatigue Strength: Stress concentration – Theoretical stress Concentration factor – Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Modified Goodman's line– Soderberg's line.

UNIT – III:

Riveted, Welded And Bolted Joints:

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 under bending, torsion. Welded joints under eccentric loading.

Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

UNIT – IV:

Keys, Cotters and Knuckle Joints: Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

UNIT – V:

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code.

Shaft Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

Text Books:

1. Machine Design by V. Bhandari-TMH Publishers.
2. Machine Design, R.K.Jain-Khanna Publishers-New Delhi.

Reference Books:

1. Design of Machine Elements by V.M. Faires
2. Mechanical Engineering Design by JE Shigley
3. Machine Design by PC Sharma
4. Machine Design by pandya & shah, Chartor publications

Course Outcomes:

CO 1: Understand the design process, properties of materials and machining considerations in design and able calibrate the stresses in machine members.
CO2: They are able to know the component behavior subjected to fluctuating loads.
CO3: Analyze the Design of riveted joints and Bolted joints.
C04: They can understand the design of keys, cotters and also the design of knuckle joints.
CO5: Students are able to know the Design of Shafts and Shaft couplings.

Note: Use of Machine Design Data Book by PSG Tech is permitted.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√						√
CO 2	√	√	√		√			√			
CO 3	√	√	√		√						√
CO 4	√				√						
CO 5	√	√	√		√			√			√

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME505PC)THERMAL ENGINEERING – II

Prerequisites: Thermodynamics

Course Objective:

1. To apply the laws of Thermodynamics to analyze Rankin cycle.
2. To apply Thermodynamics concept for boilers and their analysis.
3. To apply Thermodynamics concept for Nozzles, Condensers and their performances in Industries.
4. To perform analysis of Steam Turbines and their applications.
5. To perform analysis of Gas Turbines, jet propulsion and their applications.

UNIT – I:

Basic Concepts Of Rankine Cycle: Schematic Layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat Addition, Methods to Improve Cycle Performance – Regeneration – Reheating.

UNIT – II:

Boilers: Classification Based on Working Principles & Pressures of Operation – L.P & H.P. Boilers – Mountings and Accessories.

Draught: Classification – Height of Chimney for Given Draught and Discharge, Condition for Maximum Discharge, Efficiency of Chimney – Artificial Draught, Induced and Forced Draught.

UNIT – III:

Steam Nozzles: Function of Nozzle – Applications - Types, Flow through Nozzles, Thermodynamic Analysis – Assumptions -Velocity of Nozzle at Exit-Ideal And Actual Expansion in Nozzle, Velocity Coefficient, Condition for Maximum Discharge, Critical Pressure Ratio. **Condensers:** Classification, Air Leakage, Vacuum Efficiency, condenser efficiency, problems.

UNIT IV:

Impulse Turbine: Mechanical Details – Velocity Diagram – Effect of Friction – Power Developed Axial Thrust Blade or Diagram Efficiency – Condition for Maximum Efficiency. De-Laval Turbine – Its Features. Methods To Reduce Rotor Speed - Velocity Compounding And Pressure Compounding, Velocity And Pressure Variation Along The Flow – Combined Velocity Diagram For A Velocity Compounded Impulse Turbine.

Reaction Turbine: Mechanical Details – Principle of Operation, Thermodynamic Analysis of a Stage, Degree of Reaction –Velocity Diagram – Parson's Reaction Turbine – Condition for Maximum Efficiency.

UNIT V:

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.

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, Turbo Prop, Pulse Jet Engines – Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

Text Books:

1. Thermal Engineering -R.K Rajput- Lakshmi Publications.
2. Gas Turbines – V. Ganesan-TMH.

References:

1. Thermodynamics and Heat Engines-R.Yadav -Central Book Depot.
2. Gas Turbines and Propulsive Systems – P. Khajuria & S.P.Dubey Dhanpatrai.
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo -Addison Wesley – Longman.
4. Thermal Engineering – P.L Bellaney-Khanna publishers.
5. Thermal Engineering M.L. Mathur & Mehta -Jain Bros.
6. Basic and Applied Thermodynamics.-P.K. Nag- TMH.
7. Thermal Engineering Data Book, B.S. Reddy and K.H. Reddy, I.K. International.

NOTE: Steam tables and Mollier charts to be supplied for exam.

Course Outcomes:

At the end of the course,

CO1: Student shall be able to know the basic concepts of Rankine cycles and methods to Improve the performance.

CO2: Shall acquire knowledge on principles of working accessories and safety features of steam Generators.

CO3: Shall acquire knowledge on stream flow through varying areas and capable of solving related problems and to understand functioning of steam condenser.

CO4: To be able to determine the efficiency of the impulse and reaction turbine using velocity Triangles.

CO5: Analyze gas turbines cycles and compare the operational aspects of jet engines.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√		√						
CO 2	√		√			√		√			√
CO 3	√	√			√			√			
CO 4	√	√	√		√					√	√
CO 5	√	√	√		√					√	

ANURAG ENGINEERING COLLEGE

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME511PE) AUTOMOBILE ENGINEERING
(P E-I)

Pre requisites: Nil

Course objectives: To import Knowledge on

1. The basics principles of actual automobile systems and modern trends in Automotive Vehicles.
2. The functions of Ignition and generating system.
3. To study importance and features of differential systems.
4. The students get the working knowledge of suspension and steering system.
5. Learn about the various braking systems and current scenario of Automobile Emissions and standards study and its significance.

UNIT – I

Introduction: Introduction about evolution of modern automobiles- hybrid vehicles **-** components of a Four Wheeler Automobile – Chassis and Body – Power Unit – Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging – Oil Filters- Air filters - Oil Pumps -M.P.F.I system- Common Rail Diesel injection- fuel injection pump- fuel injector- nozzle- spray formation- injection timing- Crank Case Ventilation.

UNIT – II

Ignition System: Function of an ignition system, battery ignition system – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism. entire

Electrical System: Charging circuit, generator, current – voltage regulator –starting system, bendix drive mechanism solenoid switch, lighting system, Horn, Wiper, fuel gauge – oil pressure gauge- engine temperature indicator- Automobile air-conditioning system.

UNIT – III

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear Box- Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter. Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

UNIT – IV

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages- Power steering.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT – V

Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems, automobile wheels and tyres.

Emissions from Automobiles – Pollution Standards National and International – Pollution Control–Modern Techniques in automobiles –Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits and Demerits.

Course Outcomes:

CO1: Analyze the basic lay-out of automobile and modern trends, working and other details about I.C Engines used in automobiles.

CO2: To gain the knowledge on working of ignition, generating and air-conditioning systems.

CO3: Understand how the transmission system works and the working knowledge of various Components in transmission system.

CO4: Students will able to explain working principle of various parts of automobile such as axles, Wheels, tires and steering system.

CO5: Understand the various braking systems and pollution standards and its significance.

Text Books:

1. Automobile Engineering-William Crouse-TMHILL Publishers10th edition, 2006.
2. A systems Approach to Automobile Technology-Jack Erjavec-YESSDEEPublishers Pvt. Ltd. New Delhi.
3. Automotive Mechanics – Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors.

References:

1. Automobile Engineering BY Joseph Heitner.
2. Automobile Engineering, R.K.Rajput,Laxmi Pub, 1st edition, 2013.
3. Automobile Engineering – R.B. Gupta, SatyaPrakashan 10th edition 2018-19.
4. Automotive Mechanics / G.B.S.Narang.
5. Automotive Engines / S. Srinivasan,Tata McGraw-Hill Education.
6. Automobile Engineering – K.K Ramalingam / SciTech Publications.
7. Automotive Engineering / Newton steeds & Garrett.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√					√		√			√
CO 2	√		√	√		√		√			√
CO 3	√					√					√
CO 4	√		√	√		√		√			√
CO 5	√		√	√		√		√			√

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B.Tech ME III Year I-Semester

L	T	P	C
3	0	0	3

(ME512PE) WELDING TECHNOLOGY
(P.E- I)

Pre requisites: Nil

Course objectives:

1. To understand different types of welding process.
2. To study process parameters, tool geometry of different alloys.
3. To defective analysis of friction welded components.
4. To understand the EBW process parameters.
5. To understand the LBW process parameters.

UNIT- I

Solid state welding: classification of solid state welding processes, Adhesive bonding, advantages and applications.

UNIT-II

Friction welding: Friction welding process variables, welding of similar and dissimilar materials, Defective analysis of friction welded components, Friction welding of materials with inter layer.

UNIT-III

Friction stir welding: Processes parameters, tool geometry, welding of Aluminum alloys, Friction stir welding of Aluminum alloys and Magnesium alloys.

UNIT-IV

Electron Beam welding (EBW): Electron Beam welding process parameters, atmospheric affect Defective analysis of Electron beam welds and Electron Beam welding dissimilar materials.

UNIT-V

Laser Beam welding (LBW): Laser Beam welding process parameters, atmospheric affect and Laser Beam welding of steels. Selection power source, Constant voltage and constant current power sources.

Weld ability of cast iron and steel: Weld ability studies of cast iron and steel.

Textbooks:

1. Nadkarni S.V., Modern Welding Technology, Oxford IBH Publishers, 1996.
2. Parmar R. S., Welding Engineering and Technology, Khanna Publishers, 2005.

References:

1. D. L. Olson, T. A. Siewert, *Metal Hand Book, Vol 06,* Welding, Brazing and Soldering, ASM International Hand book Metals Park, Ohio USA, 2008.

Course Outcomes:

At the end of the course, the student should be able to

CO1: Understand the different types of welding process.
CO2: Understand the operation of FSW, EBW, and LBW.
CO3: Understand the principles of various surface hardness techniques.
CO4: Understand the ability of cast iron and steel.
CO5: Understand the principles of various welding Techniques.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√					√		√			√
CO 2	√		√	√		√		√			√
CO 3	√					√					√
CO 4	√		√	√		√		√			√
CO 5	√		√	√		√		√			√

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME513PE) TURBO MACHINERY

(P.E- I)

Pre-requisite: Thermodynamics, Thermal engineering- I.

Course objectives:

1. To impart knowledge on IC Engine working, Fuel, Cooling and lubrication systems of IC engines.
2. To apply the principles of Thermodynamics to analyze performance of the engines.
3. To impart knowledge on Compressors and Steam Nozzle.
4. To apply the principles of Thermodynamics to analyze different types of refrigeration systems.
5. To impart knowledge on air conditioning systems and to understand the functionality of the heat recovery systems.

UNIT-I

IC Engines: Review of construction and working of two stroke and four stroke engines – Types of carburetor – Wankel engines – SI engines – Fuel systems – Simple carburetor – Ignition systems – Combustion – Detonation factors and remedies – Rating of fuels – Introduction to multi point and microprocessor based fuel injection system CI engines – Fuel injection system – Fuel pump – Combustion – Knocking – Factors and remedies – Rating of fuels – Cooling and lubrication of IC engines.

UNIT II

Performance of IC Engines:

Supercharging and turbo charging of IC engines and their effect on various parameters – Stratified charged engines – Lean burn engines; Performance test- Measurement of brake power – Indicated power – Fuel consumption – Air consumption; Heat balance test – heat carried away by exhaust gases and Morse test on IC engines – Standard testing procedure of IC engines – Performance curves and effect of various parameters on the performance of the engines.

UNIT III

Positive Displacement Compressors and Steam Nozzles

Reciprocating compressors – Construction – Working – Effect of clearance volume – Multi staging volumetric efficiency - Isothermal efficiency. Steam Nozzle – One-dimensional steady flow of steam through a convergent and divergent nozzle – Equilibrium and Meta stable flow.

UNIT IV

Refrigeration

Reverse Carnot cycle- Bell-Colman's cycle – Air craft refrigeration cycles – Vapor compression cycle – Components – Working – P-H and T-S diagrams – Calculation of COP – Effect of sub-cooling and super-heating – Vapor absorption system – Ideal and actual cycles – Cryogenic engineering- Introduction – Liquefaction of gases – Application.

UNIT V

Air Conditioning and Waste Heat Recovery Systems

Psychometric - Processes – Chart – Summer and winter air conditioning – Cooling load calculations – SHF – RSHF – GSHF – ESHF components used in air conditioner – Types of air conditioning units. Sources of waste heat – Heat recovery for industrial application – Thermal storage principles and applications of hot and cold systems – Sensible heat and latent heat system – Phase change storage materials.

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Text Books:

1. Rajput R.K., (2010), Thermal Engineering, Eighth Edition, Laxmi Publications (P) Ltd.
2. Mathur.M.L & Sharma R.P, (2009), Internal Combustion Engine, Dhanpat Rai Publications.

References:

1. Manohar Prasad., (2007), Refrigeration and Air Conditioning, New Age International.
2. Soman.K, (2011), Thermal Engineering, PHI Learning Private Ltd. Mode of Evaluation Quiz/Assignment/ Seminar/Written Examination

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Basic understanding of IC engine working and thermodynamics in association with turbo Machinery.
C02: Analyze Performance of Internal Combustion Engines.
CO3: Analyze Compressors and Steam Nozzles for energy transfer.
CO4: Understanding of Refrigeration cycles and cooling effects.

CO5: Design and performance evaluation of air-conditioning and heat recovery systems

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√						
CO 2	√	√			√						
CO 3	√	√									
CO 4	√	√			√						
CO 5	√		√		√			√			

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B.Tech ME III Year I-Semester

L	T	P	C
0	0	2	1

(ME506PC) MACHINE TOOLS AND METROLOGY LAB

Course Objectives:

1. Get exposure to hand tools, equipments and machines.
2. Understand the mechanisms of all the machine tools
3. Understand the usage of different types of machine tools.
4. Understand the procedure for setting the given object to a required angle using sine bar.
5. Measure the effective diameter of thread profile by using the three wire method.

List of Experiments:

SECTION – A:

1. Introduction of general purpose machines – lathe, Drilling machine, Milling machine, shaper.
2. Planing machine, slotting machine, Cylindrical grinder, surface grinder and tool and cutter grinder.
3. Step turning and taper turning on lathe machine.
4. Thread cutting and knurling on lathe machine.
5. Drilling and tapping
6. Machining Flat surfaces using Shaping and planing machines.
7. Making internal spines using Slotting machine.
8. Gear Cutting on milling machine.
9. Cylindrical surface grinding.
10. Grinding of tool angles.
11. Surface Grinder.

SECTION B:

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Use of gear teeth vernier calipers and checking the chordal addendum and choral height of spur gear.
3. Machine tool " alignment test on the lathe.
4. Machine tool alignment test on milling machine.
5. Tool makers microscope.
6. Angle and taper measurements by Bevel protractor & sine bars.
7. Use of spirit level in finding the flatness of surface plate.
8. Thread measurement by Two wire / Three wire method or Tool makers microscope.

Course Outcomes:

At the end of this course the student will be able to

CO1: Get knowledge on hand tools, equipments and machines.

CO2: Get knowledge on the mechanisms of all the machine tools.

CO3: Get Practical exposure on milling, grinding and slotter operations.

CO4: Get knowledge procedure for setting the given object to a required angle using sine bar.

CO5: Use different measuring instruments towards quality control.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√	√						√			
CO 3	√				√						
CO 4	√	√			√						
CO 5	√		√								

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B.Tech ME III Year I-Semester

L	T	P	C
0	0	3	2

(ME507PC) THERMAL ENGINEERING LAB

Course Objectives:

1. To understand the basic principles in area of IC engines and fuels.
2. To provide hands on experience in operating various types of IC engines.
3. To understand performance characteristics of air compressors.
4. To understand functioning and performance of IC engines.
5. To understand operating mechanism of two and four stroke IC engines.

LIST OF EXPERIMENTS:

1. I.C. Engines valve / Port Timing Diagrams.
2. I.C. Engines Performance test (4 – Stroke Diesel Engine)
3. I.C. Engines Performance test on 2 – stroke petrol engine.
4. Evaluate of engine friction by conducting morse test on 4 stroke Multi cylinder petrol engine.
5. Evaluate of engine friction by conducting retardation test on 4 stroke diesel engine.
6. Heat balance on IC Engines.
7. Determination of A/F Ratio and volumetric efficiency on IC engine.
8. Determination of Economical speed test for fixed load on IC engine.
9. Performance test on variable compression ratio engine.
10. Dis-assembly / assembly of engines.
11. Performance test on reciprocating air-compressor unit.
12. Study of boilers.

PERFORM ANY 10 OUT OF THE 12 EXERCISES

Course Outcomes:

CO1: Measure the thermal properties of different fuels.
CO2: Analyze the properties of various fuels and emission standards.
CO3: Determine the efficiency of compressor and blower.
CO4: Analyze the performance and determine the operating characteristics of I.C engines [2-stroke, 4-stroke, petrol, Diesel] using rope brake, hydraulic and, electrical Dynamometers.
CO5: Draw the valve and port timing diagrams of two and four stroke engines.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√	√						√			
CO 3	√				√						
CO 4	√	√			√						
CO 5	√		√								

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B.Tech ME III Year I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**0**

(HS508MC) CONSTITUTION OF INDIA

Course Objectives:

- To understand the Indian constitution and its salient features.
- To understand the fundamental rights and duties of Indian citizen.
- To understand legal and legislative structure in India.
- To elaborate constitution of India and its amendments.
- To enlighten the scope of local - self government.

Course Content:

1) Meaning of the constitution law and constitutionalism
2) Historical perspective of the Constitution of India
3) Salient features and characteristics of the Constitution of India
4) Scheme of the fundamental rights
5) The scheme of the Fundamental Duties and its legal status
6) The Directive Principles of State Policy – Its importance and implementation
7) Federal structure and distribution of legislative and financial powers between the Union and the States
8) Parliamentary Form of Government in India – The constitution powers and status of the President of India
9) Amendment of the Constitutional Powers and Procedure
10) The historical perspectives of the constitutional amendments in India
11) Emergency Provisions : National Emergency, President Rule, Financial Emergency
12) Local Self Government – Constitutional Scheme in India
13) Scheme of the Fundamental Right to Equality
14) Scheme of the Fundamental Right to certain Freedom under Article 19
15) Scope of the Right to Life and Personal Liberty under Article 21.

Recommended Books:

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law.

Course Outcomes:

- **CO 1:** Understand the meaning and historical perspective of constitution of India.
- **CO 2:** Knows fundamental rights of Indian citizen.
- **CO 3:** Know structure, rights of federal and legislative bodies.
- **CO 4:** President and parliament powers given by constitution.
- **CO 5:** Know the local bodies rights and limitations.

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B.Tech ME III Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(IM601HS) INDUSTRIAL MANAGEMENT

Course Objectives:

- To enable the students to observe different organizational structures and managerial functions.
- To understand about standard techniques and methods for production.
- To learn about different HRM & Marketing Functions.
- To know about How to use Network to calculate the Time period required to complete the project.
- To identify about corporate planning process, strategy implementation and Contemporary management issues.

UNIT-I:

Introduction to Management: Nature and importance of management, Functions of Management, Taylor's Scientific Management Theory, Fayol's principles of management, Maslow's theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two factor Theory of Motivation. Systems Approach to Management, Leadership Styles, Social Responsibilities of Manager, Organization levels and types of organization structures.

UNIT-II:

A) Operations Management: Principles and Types of Plant Layout-Methods of production (Job, batch and Mass production), Work Study - Basic procedure involved in Method Study and Work measurement- Statistical Quality Control - X chart, R chart, C chart, P chart, (simple problems), Acceptance Sampling, Deming's contribution to quality.

B) Materials Management: Objectives, Need for inventory control, EOQ, ABC Analysis, Purchase procedure, Stores management and Stores records, Supply chain management.

UNIT –III:

A) Human Resources Management (HRM): Evolution of HRM, Concepts of HRM, Basic functions of HR Manager - Manpower Planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating.

B) Marketing: Functions of Marketing, Marketing Mix, Marketing strategies based on Product Life cycle, Channels of distribution.

UNIT –IV:

Project Management(PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing.(Simple problems)

UNIT –V:

Strategic &Contemporary Management Practices: Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of corporate planning process, Environmental Scanning, SWOT analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Basic concepts of Just-In-Time(JIT) system, Total Quality Management(TQM), Six Sigma and Capability Maturity Model(CMM) levels, Value chain Analysis.

Text books:

1. Aryasri, Management Science, TMH, New Delhi, 2009

References:

1. Kotler Philip and Keller Kevin Lane, Marketing Management, Pearson, 2012.
2. Koontz and Weihrich, Essentials of Management, McGraw Hill, 2012.
3. Thomas N. Duening and John M. Ivancevich Management,Principles and Guidelines, Biztantra, 2012.
4. KanishkaBedi, Production and Operations Management, Oxford University Press, 2012.
5. Samuel C. Certo, Modern Management, 2012.
6. Schermerhorn, Capling, Poole and Wiesner, Management, Wiley, 2012.
7. Parnell, Strategic Management, Cengage, 2012.
8. Lawrence R Jauch, R. Gupta and William F. Glueck: Business Policy and Strategic Management Science, McGraw Hill, 2012.

Course Outcomes: Student will able to learn

CO 1: About management functions, theories and Organizational structures.

CO 2: About Production methods, Techniques under quality control and inventory control.

CO 3: About functions & importance of HRM , Marketing functions and product life cycle.

CO 4: About techniques in Networking for time required to complete the project.

CO 5: About Carporate strategy implementation methods and other few contemporary management practices.

Co-Po Mapping:

CO's/PO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1			✓			✓	✓	✓		✓	
CO 2	✓			✓							✓
CO 3				✓	✓	✓	✓			✓	
CO 4	✓				✓			✓		✓	✓
CO 5			✓		✓		✓			✓	

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B.Tech ME III Year II-Semester	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

(ME602PC) HEAT TRANSFER

Pre-requisites: Thermodynamics

Course Objectives:

1. To impart knowledge on basic laws of heat transfer and conduction heat transfer.
2. To understand steady state and transient conduction heat transfer.
3. To provide knowledge on forced convective heat transfer analysis.
4. To impart knowledge on heat exchangers and natural convection heat transfer.
5. To understand radiation and heat transfer with phase changing process.

UNIT – I

INTRODUCTION: Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.

CONDUCTION HEAT TRANSFER: Fourier rate equation – General 3-dimensional heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Simplification and forms of the field equation – steady, unsteady and periodic heat transfer – initial and boundary conditions.

UNIT – II

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Variable thermal conductivity – systems with heat sources or Heat generation, Extended surface (Fins) Heat Transfer – Long Fin, Fin with insulated tip and short Fin, Application to error measurement of temperature.

ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers – Chart solutions of transient conduction systems – Concept of Functional body.

UNIT – III

CONVECTIVE HEAT TRANSFER: Classification of systems based on causation of flow, condition of flow, medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem and method , application for developing semi – empirical non – dimensional correlation for convection heat transfer – Significance of non – dimensional numbers – Concepts of Continuity, Momentum and Energy equations.

FORCED CONVECTION: EXTERNAL FLOWS: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer - Flat plates and cylinders.

UNIT – IV

INTERNAL FLOWS: Concepts of hydrodynamic and thermal entry lengths – Division of internal flow based on this – Use of empirical relations for Horizontal Pipe Flow and annulus flow.

FREE CONVECTION: Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for Vertical plates and pipes.

HEAT EXCHANGERS: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods – Problems using LMTD and NTU methods.

UNIT – V

HEAT TRANSFER WITH PHASE CHANGING: Boiling **-** Pool boiling – Regimes Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation on vertical and horizontal cylinders using empirical correlations.

RADIATION HEAT TRANSFER: Emission characteristics and laws of black-body radiation – irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefen 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.

Text books:

1. Fundamentals of Engg. Heat and Mass Transfer-R.C. SACHDEVA-New Age International.
2. Heat Transfer – P.K.Nag-TMH

Reference books:

1. Heat Transfer-HOLMAN -TMH
2. Heat Transfer – Ghoshdastidar – Oxford University Press – II Edition
3. Heat and Mass Transfer – Cengel – McGraw Hill.
4. Heat and Mass Transfer – R.K.Rajput – S.Chand & Company Ltd.
5. Heat and Mass Transfer – Christopher A Long -Pearson Education.
6. Heat and Mass Transfer – D. S Kumar-S.K.Kataria & Sons
7. Heat and Mass Transfer – Kondandaraman *C.P. New Age Publ.*
8. Fundamentals of Heat Transfer & Mass Transfer – incropera & Dewitt -John Wiley Pub.
9. Thermal Engineering Data Book, B.S.Reddy and K.H.Reddy Rev/e, I.K. International,

NOTE: **Heat and Mass Transfer Data Book is Permitted for Exam.**

Course Outcomes:
At the end of the course, the student should be able to

CO1: Formulate heat conduction problems in rectangular, cylindrical and spherical coordinate System, by transforming the physical system into a mathematical model.
CO2: Familiarize with time dependent heat transfer.
CO3: Compute convective heat transfer coefficients in forced convection for external flows.
CO4: Know the design fundamentals of heat transfer coefficients in natural convection for internal Flows and heat exchangers, which include the LMTD and ε-NTU approaches.
CO5: Understand the fundamental mechanism involved in boiling and condensation and radiation Heat between black and non-black bodies.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√						
CO 2	√				√						
CO 3	√		√		√						
CO 4	√		√		√						√
CO 5	√	√									

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B.Tech ME III Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME603PC) DESIGN OF MACHINE MEMBERS – II

Pre-requisites: Engineering mechanics, Design of machine Members-I.

Course objectives:

1. To gain knowledge about designing the commonly used important machine members such as Bearings, springs, belts, gears etc.
2. Design the components using the data available in design data books.
3. To Gain knowledge about designing in Engine Parts.
4. To Gain knowledge about designing of different springs.
5. To Gain knowledge about designing of gears.

UNIT–I:

Sliding contact bearings: Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings –Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

UNIT–II:

Rolling contact bearings: Ball and roller bearings – Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings.

UNIT–III:

Engine Parts: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

UNIT–IV:

Mechanical Springs: Stresses and deflections of helical springs – Extension and compression springs – Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity – helical torsion springs– Design of co-axial springs, Design of leaf springs.
Belts &Pulleys: Transmission of power by Belt and Rope ways, Transmission efficiencies,
Belts – Flat and V types– Ropes - pulleys for belt and rope drives.

UNIT–V:

Gears: Spur gears& Helical gears- important Design parameters – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

Text Books:

1. Machine Design by V. Bhandari TMH.
2. Machine Design, R.K.Jain, Khanna Publishers, New Delhi.

Reference Books:

1. Machine Design by P.Kannaiah, SciTech
2. Machine Design Volume II by S.Md.Jalaludeen
3. Machine Design Data Book by PV Ramana Murti & M .Vidyasagar, BS Publications
4. Machine Design by Pandya & Shah, Charotar.

Course Outcomes:

CO1: To apply the design principles for the design of various engine parts

CO2: Estimate the life of rolling element bearings and their selection for given service conditions.

CO3: Acquaintance with design of the components as per the standard, recommended Procedures which is essential in design and development of machinery in industry.

CO4: Understand the design of springs, Belt & pulleys.

CO5: Understand the design of Gears with design parameters.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√						√
CO 2	√	√	√		√			√			
CO 3	√	√	√		√						√
CO 4	√				√						
CO 5	√	√	√		√			√			√

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	3	**0**	**0**	**3**

(ME604PC) OPERATIONS RESEARCH

Course Objectives:

1. Analyze any real life system with limited constraints and convert the problem into a mathematical model.
2. Minimize Transportation cost to transport from source to destination and minimize the Assignment cost to assign the jobs to person.
3. Minimize the Total elapsed time i.e minimize time to complete starting of the first job to the ending of last job.
   Replacement gives best profits when we replace the machine if it is not working or damaged or maintains cost is too high.
4. Using game theory we can find which player wins or loss the game.
   Inventory: To maintain sufficient stock without damage and to decrease the rent for Godowns.
5. We can find waiting time and number of customers in the system, number of customer in the line or que and capacity of the customer to serve.

UNIT-I

Development-definition- characteristics and phases- types of models-operation research models-applications.

Allocation: linear programming problem formulation-graphical solutions-simplex method-artificial variables techniques, two- phase method big M method.

UNIT-II

Transportation Problem- formulation-optimal solution, unbalanced transportation problem-degeneracy.

Assignment Problem-formulation- optimal solution-variants of assignment problem-travelling sales man problem

UNIT-III

Sequencing: Introduction – flow- shop sequencing –n jobs through two machines –n job through n machines-job shop sequencing-two job 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

UNIT-IV

Theory of games: Introduction-terminology-solution of games with saddle points-and without saddle point's 2 by 2 games- dominance principle- m by 2 and 2 by N games- graphical method

Inventory Models: Definition- Functions-Inventory associated costs- Statement of inventory problem-Classification of inventory problems/Models: Deterministic inventory models- Constant price models-without shortage, with shortage, infinite production rate, finite production rate, and with shortage and finite production rate. Price break models: Single price break & Multi price break model. Stochastic Inventory models: Single period models-Discrete and Continuous models.

UNIT-V:

Waiting lines: Introduction-terminology single channel-poission arrivals and exponential service times -with infinite population and finite populations' models- and exponential service times with infinite populations

Dynamic programming: Introduction -terminology - bell mans principle of optimality - applications of dynamic programming -shortest path problem- linear programming problem

Advantages and disadvantages applications of simulation to queuing and inventory.

Text books:

1. Operation Research-J K Sharma 4e -Macmillan.
2. Introduction to OR-Hiller & Liberman-TMH

Reference books:

1. Introduction to OR-Taha-PHI
2. Operation Research-NVS Raju-SMS education-3rd revised edition
3. Operation Research-AM Natarajan,P Balasubrmanian,A Tamilarasi-person education
4. Operation Research-Wagner-PHI Publications
5. Operation Research-MV Durga prasadh, vijaykumar Reddy, J Suresh kumar-Cengage learning.

Course Outcomes:

CO1: Identify and develop O.R models from the verbal description of the real system.
CO2: Understand the mathematical tools to solve assignment, transportations and travelling Salesman problem.
CO3: Able to calculate the Total Elapsed Time and idle time for different machines and minimize The cost.
CO4: Able to calculate saddle point of games and Able to solve Inventory models.
CO5: Calculate service time for different models and able to apply dynamic programming and Able to know the advantages and disadvantages of simulation.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√						√
CO 2	√	√	√		√			√			
CO 3	√	√	√								√
CO 4	√										
CO 5	√	√	√		√			√			√

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	3	**0**	**0**	**3**

(ME621PE) REFRIGERATION AND AIR CONDITIONING (PE-II)

Prerequisites: Thermodynamics.

Course Objectives:

1. To impart knowledge on working principle of refrigeration cycle.
2. To apply the principles of Thermodynamics to analyse different types of refrigeration systems.
3. To impart knowledge on different types of refrigeration systems
4. To impart knowledge on Fundamentals of psychrometry.
5. To impart knowledge on Applications of air-conditioning and heat pumps.

UNIT – I:

Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, Unit of Refrigeration, COP, Different Refrigeration Methods, Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Refrigeration Needs of Air Crafts, Application of Air Refrigeration, Types of systems – Problems.

UNIT – II:

Vapour Compression Refrigeration (VCR) System: Basic cycle- Working principle and essential components of the plant – COP – Representation of cycle on T-S and p-h charts –effect of sub cooling and super heating – cycle analysis – Actual cycle - numerical problems.

Refrigerants: Desirable Properties – Classification of Refrigerants Used – Nomenclature- Secondary Refrigerants- Lubricants – Ozone Depletion – Global Warming- Newer Refrigerants.

UNIT – III:

Vapour Absorption Refrigeration (VAR) System: Description and working of NH_3 – water system and Li Br – water (Two shell & four shell) system - Calculation of max COP. Principle and operation of Three Fluid absorption refrigeration system.

Steam Jet Refrigeration System: Working Principle and Basic Components, Principle and operation of i) Thermo-Electric Refrigerator, ii) Vortex Tube or Hilsch tube.

UNIT – IV:

Introduction to Air Conditioning: Psychrometric Properties & Processes – Characterization of Sensible and Latent Heat Loads –– Need For Ventilation, Consideration of Infiltrated Air – Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling), Window, Split, summer, winter, Year Round, Central Air Conditioning Systems.

UNIT V:

Human Comfort: Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort Chart. Heat Pump – Heat Sources – Different Heat Pump Circuits. Air Conditioning Equipment: Humidifiers – Dehumidifiers – Air Filters, Fans and Blowers.

Text Books:

1. Refrigeration and Air Conditioning-CP Arora-TMH.
2. A Course in Refrigeration and Air conditioning-SC Arora & Domkundwar-Dhanpatrai
3. Refrigeration and Air Conditioning- Manohar Prasad -New Age.

References:

1. Principles of Refrigeration – Dossat- Pearson Education.
2. Refrigeration and Air Conditioning - P.L. Ballaney
3. Basic Refrigeration and Air Conditioning –P.N. Ananthanarayanan-TMH.

NOTE: Tables/Codes: Thermal Engineering Data Book containing Refrigerant and Psychometric property Tables and charts are permitted in Exam.

Course Outcomes:

At the end of the course, the student should be able to

CO1: Ability to understand various refrigeration systems.

CO2: Ability to understand the operation of various devices of VCR system.

CO3: Ability to demonstrate the working of refrigeration equipment.

CO4: Ability to understand various psychometric processes.

CO5: Ability to explain the air-conditioning equipment and heat pump circuits.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√						
CO 2	√	√	√			√		√			√
CO 3	√		√		√				√		
CO 4	√	√							√		√
CO 5	√		√		√						

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	3	**0**	**0**	**3**

(ME622PE) NANO TECHNOLOGY
(P.E-II)

Pre-requisites: Engineering physics, chemistry and Material science.

Course Objectives:

1. To understand fundamentals of Nano materials and technologies.
2. To get knowledge about carbon nano tubes and structures.
3. To understand the Characterization Techniques of nano scale.
4. To explore the Nano and Molecular Electronics.
5. To get knowledge on heat transfer in nano fluids.

Unit – I

Introduction to Nanotechnology: Importance of Nano Scale, Nanostructure Types, Electronic, Magnetic, Optical Properties of Nano Materials, Top-Down and Bottom – Up Approach to Nanostructures.

Unit – II

Carbon Nano Structures: Carbon Nano Tubes (CNT), Fullerenes, C60, C80 and C240 Nanostructures, Properties (Mechanical, Optical and Electrical) and Applications.

Fabrication Of Nano Materials: Physical Methods; Inert Gas Condensation, Arc Discharge, Rf Plasma, Plasma Arc Technique, Ion Sputtering, Laser Ablation, Laser Pyrolysis, Molecular Beam Epitaxy, Chemical Vapour Deposition Method.

Unit – III

Nano Scale Characterization Techniques: Scanning Probe Techniques (AFM, MFM, STM, SEM, TEM & XRD).

Nano devices And Nano medicine: Lab On Chip For Bio analysis, Core / Shell Nanoparticles In Drug Delivery Systems (Site Specific And Targeted Drug Delivery), Cancer Treatment, And Bone Tissue Treatment.

Unit- IV

Nano And Molecular Electronics: Resonant – Tunneling Structures, Single Electron Tunneling, Single Electron Transistors, Coulomb Blockade, Giant Magneto Resistance, Tunneling Magneto Resistance.

Unit – V

Properties of Nano fluids: Scientific and Engineering Significance - Possible Mechanisms of Thermal Conduction Enhancement. Convective Heat Transfer in Nano fluids - Thermo physical Properties of Nano fluids - Heat Transfer Coefficients in Laminar Flow - Heat Transfer Coefficients in Turbulent Flow.

Text Books:

1. Phani Kumar, Principles of Nanotechnology, SciTech Publications.
2. Nanotechnology, a Gentle introduction to the next big idea. Mark Ratner, Daniel Ratner.PEARSON EDUCATION LPE Publications.

Reference Books:

1. David Ferry " Transport In Nano Structures" Cambridge University Press 2000
2. Nan biotechnology; Ed. C.M.Niemeyer, C.A. Mirkin.
3. Nanofabrication Towards Biomedical Application, Techniques, Tools, Application And Impact – Ed. Challa S.S.R.Kumar, J.H.Carola.

Course Outcomes:

CO1: Apply engineering and physics concepts to the nano-scale and non-continuum domain.
CO2: Understand Carbon Nano Tubes structures and manufacturing process.
CO3: Understand characterization techniques through various measurements to study electrical, mechanical, thermal properties of nano materials.
CO4: Understand the principles and microelectronics fabrication.
CO5: Understand the concept of Convective Heat Transfer in Nano fluids.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√		√		√						
CO 3	√	√			√						
CO 4	√	√	√								
CO 5	√	√							√		

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B.Tech ME III Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME623) TRIBOLOGY
(P.E-II)

Pre-requisites: Fluid mechanics, Design of Machine members-II.

Course objectives:

1. To expose the student to different types of bearings, bearing materials,
2. To understand friction characteristics and power losses in journal bearings.
3. To learn theory and concepts about different types of lubrication.
4. To learn theory and concepts about Materials which is used in bearings.
5. To learn current concepts of boundary friction and dry friction.

UNIT - I

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used. Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT - II

Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti-friction bearing.

UNIT – III

Friction and power losses in journal bearings: Calibration of friction loss friction in concentric bearings, bearing modulus, Somerfield number, heat balance, practical consideration of journal bearing design considerations.

UNIT -IV

Air lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

UNIT - V

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings.

Bearing materials: General requirements of bearing materials, types of bearing materials.

Text Book:

1. Fundamentals of Tribology, Basu, SenGupta and Ahuja-PHI
2. Tribology in Industry**:** Sushil Kumar Srivatsava, S. Chand &Co.

References:

1. Tribology – B.C. Majumdar

Course Outcomes:

CO1: Understanding friction characteristics in journal bearings.
CO2: Knowledge about different theories of lubrication to reduce friction and wear.
CO3: Knowledge about Materials which is used in bearings.
CO4: Understanding the concepts of boundary friction and dry friction.
CO5: Understanding friction characteristics and power losses in journal bearings.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									√
CO 2	√		√		√			√			√
CO 3	√	√			√			√			√
CO 4	√	√	√		√			√			√
CO 5	√	√			√			√	√		√

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B.Tech ME III Year II-Semester

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(EN605HS) ADVANCED ENGLISH COMMUNICATION SKILLS LAB

Course Objectives:

1. Focus on using computer-aided multimedia instruction for language development.
2. To improve the students' fluency in English through audio-visual aids.
3. Train students to use language appropriately for public speaking.
4. Develop employability skills by participating in group discussions and Interviews.
5. Enhance communication skills and professional skills.

Syllabus:

1. **Vocabulary Building** –Word Roots, Prefixes and Suffixes, Study of Word Origin, Analogy, One-Word Substitutes, Synonyms and Antonyms, Idioms and Phrases.
2. **Reading Comprehension –** Reading for Facts, Guessing meanings from context, Skimming, Scanning, Inferring Meaning, and Critical Reading.
3. **Writing Skills** – Sub-skills in writing, Letter Writing, Resume Writing, Covering Letter, e-correspondence. Technical Report Writing- Formats and Styles of Technical Report Writing, Research Abilities/Data Collection/Organizing Data/Tools/Analysis.
4. **Presentation Skills** – Oral presentations (individual and group) through JAM sessions/Seminars, Written Presentations (Projects/ PPTs) through e-mails.
5. **Group Discussion and Interview Skills** -Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency. Strategies of Pre, During and Post – Interview Skills, Opening, Answering Strategies, Interview through Telephone and Video-Conferencing.

6. Minimum Requirement: The English Language Lab shall have two parts:

i) The Computer aided Language Lab for 30 students with 30 systems, one master console, LAN facility and English language software for self- study by learners.

ii) The Communication Skills Lab with chairs and audio-visual aids with a P.A System, a T. V., a digital stereo –audio & video system and camcorder etc.

System Requirement (Hardware component): Computer network with Lan with minimum 30 multimedia systems with the following specifications:

i) P – IV Processor

a) Speed – 2.8 GHZ

b) RAM – 512 MB Minimum

c) Hard Disk – 80 GB

ii) Headphones of High quality

Books:

1. Sudha Rani, D. 2011. **Advanced Communication Skills Laboratory Manual**. Pearson Education.
2. Meenakshi Raman & Sangeeta Sharma. 2009. **Technical Communication**. Oxford University Press.

References:

1. English Language Communication: A Reader cum Lab Manual Dr A. Ramakrishna Rao, Dr G. Natanam & Prof S.A. Sankaranarayanan, Anuradha Publications, Chennai 2008.
2. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
3. English for Technical Communication for Engineering Students, Aysha Vish hwamohan, Tata Mc Graw-Hil 2009.

Course Outcomes:

CO1: Understand the importance of vocabulary and using in real life situations.

CO2: Apply reading strategies to enhance reading comprehension skills
CO3: Compose different kinds of Writing: Formal Letters, Précis Writing, Essay Writing and Technical Report Writing.
CO4: Develop presentation skills to apply in professional life.
CO5: Apply Techniques to clear group discussions and Interviews.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1						√	√	√	√	√	
CO 2							√	√		√	
CO 3						√	√	√	√	√	
CO 4						√	√	√			
CO 5						√	√	√			

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B.Tech ME III Year II-Semester

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(ME606PC) HEAT TRANSFER LAB

Course Objectives: `

1. To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications
2. To provide the practical exposure to the students.
3. To determination of amount of heat exchange in various modes of heat transfer.
4. To evaluate the heat transfer for condensation and boiling.
5. To determination of heat transfer for several geometries.

List of Experiments

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat Transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin.
6. Experiment on Transient Heat Conduction
7. Heat Transfer in forced convection apparatus
8. Heat Transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissive apparatus.
11. Stefan Boltzman Apparatus
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Experiment on film wise and drop wise condensation.
15. Vapor Compression Refrigerant Test Rig

PERFORM ANY 12 OUT OF THE 15 EXERCISES

Course Outcomes:

CO1: Perform the steady state conduction experiments to estimate thermal conductivity of Different materials

CO2: Evaluate Perform of transient heat conduction experiment.

CO3: Estimate heat transfer coefficients in forced convection, free convection , condensation and correlate with theoretical values

CO4: Obtain variation of temperature along the length of the pin fin under forced and free Convection

CO5: Perform the radiation experiment to Determine surface emissivity of a test plate and Stefan- Boltzmann's constant and compare with theoretical value

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√				√						
CO 3	√	√			√						
CO 4	√	√									
CO 5	√	√			√					√	

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B.Tech ME III Year II-Semester

L	T	P	C
0	0	2	0

(HS607MC) INTELLECTUAL PROPERTY RIGHTS

Course objectives:

1. To acquaint the students with basics of intellectual property rights.
2. To compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.
3. To provide an overview of the statutory, procedural, and case law underlining these processes and their interplay with litigation.
4. To encourage and protect innovation in the form of intellectual property rights.
5. To provide a superior environment to students for commercialization of intellectual property.

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III:

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV:

Trade Secrets: Trade secrete law, determination of trade secretes status, liability for misappropriations of trade secrets, protection for submission, and trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V:

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Text Books & References:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

Course Outcomes:

CO1: Skill to understand the concept of intellectual property rights.

CO2: Develops procedural knowledge to Legal System and solving the problem relating to Intellectual property rights.

CO3: Skill to pursue the professional programs in Company Secretary Ship, Law, Business, Patent laws, International Affairs, Public Administration and Other fields.

CO4: Employability as the Compliance Officer, Public Relation Officer and Liaison Officer.

CO5: Establishment of New development of intellectual property.

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME701PC) CAD/CAM

Pre-requisites: NIL

Course objectives:

1. To provide an overview of how computers are being used in design.
2. To impart knowledge on graphical entities of CAD/CAM.
3. Develop programs for CNC to manufacture industrial components.
4. Understand the different types of Computer Aided Quality Control.
5. To understand the need for integration of CAD and CAM.

UNIT – I

Introduction: Computers in industrial Manufacturing, Product cycle, CAD/CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, and storage devices.

Computer Graphics: Coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations.

UNIT – II

Geometric modeling: Requirements, geometric models, modeling facilities desired.

Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, and solid modeling.

UNIT – III

Numerical control: NC, NC modes, NC elements, NC machine tools structure of CNC machine tools, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming DNC, Adaptive control systems.

Group Technology: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

UNIT – IV

Computer aided Quality Control: Terminology in quality control, the computer in QC, contact inspection methods, non contact inspection methods – optical, non contact, and inspection methods – non optical, computer aided testing, integration of CAQC with CAD/CAM.

UNIT – V

Computer integrated manufacturing systems: Types of Manufacturing systems, Machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.

Text Books:

1. CAD / CAM A Zimmers & M.Groover -PE -PHI.
2. CAD / CAM Theory and Practice -ibrahim Zeid -TMH.

References:

1. Automation, Production systems & Computer integrated Manufacturing / Groover / P.E
2. Computer Aided Design and Manufacturing – Lalit Narayan , etal – PHI
3. CAD / CAM / CIM / Radhakrishnan and Subramanian / New Age
4. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
5. CAD / CAM : Concepts and Applications / Alavala / PHI

Course Outcomes:

CO1: Understand geometric transformation techniques in CAD.
CO2: Model engineering components using solid modeling techniques.
CO3: Develop programs for CNC to manufacture industrial components.
CO4: Understand the integrate various inspection methods with Computer Aided Design and Computer Aided Manufacturing.
CO5: To understand the application of computers in various aspects of Manufacturing viz. Design, proper planning, Manufacturing cost, Layout & Material Handling system.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√		√						
CO 2	√						√				
CO 3			√	√							
CO 4	√						√			√	
CO 5	√			√				√			√

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME702PC) INSTRUMENTATION & CONTROL SYSTEMS

Pre-requisites: Mathematics-I, Basic of Electrical and electronic Engineering.

Course Objectives:

1. Understanding the basic characteristic of a typical instrument.
2. Identifying errors and their types that would occur in an instrument.
3. Identifying properties used for evaluating the thermal systems.
4. The concept of transducer and various types and their characters.
5. Knowledge in Measuring Parameters like speed, pressure, velocity, force, torque and temperature etc.

UNIT – I

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.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, inductive capacitance, resistance, ionization and Photo electric transducers Calibration procedures.

UNIT – II

Measurement of Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance Thermistor – Thermocouple – Pyrometers – Temperature indicators.

Measurement Of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure guage.

UNIT – III

Measurement of Level: Direct method – indirect methods – capacitive, ultrasonic, magnetic, cryogenic fuel level indicators – Bubbler level indicators.

Flow Measurement: Rota meter, magnetic, ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

UNIT – IV

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer.

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 Rosettes

UNIT – V

Measurement Of Humidity: Moisture content of gases, sling psychomotor, Absorption psychomotor, Dew point meter.

Measurement of Force, Torque and Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

Elements of Control Systems: Introduction, Importance-Classification – Open and closed systems Servomechanisms- Examples with block diagram- Temperature, speed & position control systems.

Course Outcomes: After completion of the course the student can able to

CO1: Understand the basic principles and performance characteristics of measurement.

CO2: Apply the basic principles to measure the temperature, pressure with the help of Thermocouple and different pressure gauges.

CO3: Measure speed, flow and level with the help of various instruments.

CO4: Understand the measurement of Acceleration, Vibration and Stress Strain.

CO5: Understand the Measurement of Humidity, Force, Torque and measurement of power and Applications of various control Systems.

Text Books:

1. Measurement Systems: Applications & Design by D.S Kumar, Anuradha Agencies.
2. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH

Reference Books:

1. Instrumentation and Control systems-S.Bhaskar-Anuradha Agencies
2. Experimental Methods for Engineers-Holman
3. Mechanical and industrial Measurements-R.K Jain-Khanna Publishers.
4. Mechanical Measurements-Sirohi and Radha Krishna-New Age
5. Instrumentation & mechanical Measurements by A.K.Tayal, Galotia Publications.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√		√	√						
CO 2	√	√		√	√						
CO 3	√	√		√	√						
CO 4	√	√		√	√						
CO 5	√	√		√	√						

ANURAG ENGINEERING COLLEGE

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME731PE) POWER PLANT ENGINEERING
(P.E-III)

Pre-requisites: Thermal engineering- I & II.

Course Objectives:

1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
2. Fundamental concepts of diesel power plant and gas turbine power plant.
3. To study hydrological cycle, hydrographs, hydro power plant and projects.
4. A working knowledge of the basic design principles of nuclear, wind, tidal, solar, and alternate power plants.
5. Awareness of the economic, environmental, and regulatory issues related to power generation.

UNIT – I

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 equipments, 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 draught system, cyclone furnace design and construction, Dust collectors, Electrostatic precipitators, cooling towers and heat rejection, corrosion and feed water treatment.

UNIT – II

Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage

Gas Turbine Plant: Introduction – Classification - Construction – Layout with Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages and Disadvantages Combined Cycle Power Plants.

UNIT III

Hydro Electric Power Plant: Water power – Hydrological cycle – Hydrographs – storage and Poundage – construction of Hydrograph, Load duration curves -classification of dams and spill ways.

Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation and pumped storage plants.

UNIT – IV

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, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

Power from Non-Conventional Sources: Utilization of solar – Collectors – Principle of working, Wind energy – Types – HAWT, VAWT – Tidal energy.

UNIT – V

Direct energy conversion: solar energy, Fuel cells, Thermo electric and thermo ionic, MHD generation.

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 numerical exercises, Effluents from power plants and impact on environment – pollutants and pollution standards – Methods of Power Plant Pollution control.

Text Books:

1. A Text book of Power Plant Engineering / R.K. Rajput / Laxmi Publications
2. A Course in Power Plant Engineering: / Arora and S.Domkundwar.

References:

1. Power Plant Engineering – P.C.Sharma -S.K.Kataria Publications.
2. Power plant Engineering-S. Ram lingam- SciTech Publishers.
3. Power Plant Engineering: P.K.Nag - ii Edition-TMH.
4. An introduction to Power Plant Technology-G.D. Rai.
5. Power plant Engg – Elanchezhian – I.K international Publications.

Course Outcomes:

CO1: Understand the principle of various sources of energy, resources and development of power.

CO2: To know the concept of internal combustion engine and gas turbine power plant.

CO3: To know the concept of hydroelectric power plant.

CO4: To know the concept of nuclear power stations and non-conventional power sources.

CO5: Understand the power plant economics and environmental considerations.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√					√			√		
CO 2	√		√					√			
CO 3	√		√					√			
CO 4	√		√						√		
CO 5	√		√					√			

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME732PE) INTRODUCTION TO FINITE ELEMENT METHODS (PE-III)

Pre-requisites: Mechanics of Solids, Heat Transfer and Mathematics.

Course Objectives:

1. Apply governing principles of the problem at element level and develop element matrices
2. Gain a Fundamental understanding of the finite Element Method for Solving 1-D Problems
3. Formulate the Finite Element Equations for truss and Beam Elements.
4. Study 2-D problems such as plain stress, plain strain and Elasticity problems.
5. Analyze of linear structural and steady state heat transfer problems.

UNIT – I

Introduction to Fem: Basic concepts, Historical back ground, application of FEM, general description, comparison of FEM with other methods. Basic equations of elasticity, Stress – Strain and strain – displacement relations. Rayleigh – Ritz method, weighted residual methods.

UNIT – II

One Dimensional Problems: Stiffness equations for a axial bar element in local co-ordinates using Potential Energy approach and Virtual energy principle – Finite element analysis of uniform, stepped and tapered bars subjected to mechanical and thermal loads – Assembly of Global stiffness matrix and load vector – Quadratic shape functions – properties of stiffness matrix.

UNIT – III

Analysis Of Trusses: Stiffness equations for a truss bar element oriented in 2D plane – Finite Element Analysis of Trusses – Plane Truss and space Truss elements – methods of assembly.

Analysis Of Beams: Hermite shape functions – Element stiffness matrix – Load vector – Problems.

UNIT – IV

2-D Structural Problems: CST – Stiffness matrix and load vector – Isoperimetric element representation – Shape functions – convergence requirements – problems.

Two dimensional four noded isoperimetric elements – Numerical integration – Finite element modeling of Axi symmetric solids subjected to Axi symmetric loading with triangular elements.

UNIT – V

Analysis Of Heat Transfer Problems: 1D Heat conduction – 1D fin elements – 2D heat conduction – analysis of thin plates – Composite slabs – problems.

Dynamic Analysis: Dynamic equations – Lumped and consistent mass matrices – Eigen Values and Eigen Vectors – mode shapes – modal analysis for bars and beams.

Text Books:

1. Introduction of Finite Element Analysis – S. Md. Jalaludeen – Anuradh publications.
2. The Finite element method in engineering science – O.C. Zienkoitz, McGraw-Hill.

References:

1. Introduction to finite elements in engineering – Tirupathi K. Chandrupatla and Ashok D. Belagundu.
2. The finite element methods in Engineering – S.S.Rao – Elsevier 4th edition.
3. Concepts and applications of finite element analysis – Robert Cook – Wiley.
4. An introduction to Finite Element Methods – J.N. Reddy – Mc Grawhill.

Course Outcomes:

At the end of the course, the student should be able to

CO1: Understand the Finite Element formulation procedure for structural problems.

CO2: Able to evaluate field variables for members of 1-D bars.

CO3: Able to evaluate field variables for Trusses, Beams using stiffness and shape function Equations.

C04: Familiar with triangular and quadrilateral elements and solve problems on numerical Integration Gaussian quadrature and axi symmetric elements.

CO5: Formulate and Solve Simple Heat Transfer Problem and solve linear structural Problems.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1					√						√
CO 2		√			√				√		
CO 3		√			√				√		
CO 4					√						√
CO 5					√						√

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME733PE) UNCONVENTIONAL MACHINING PROCESSES
(PE – III)

Pre-requisites: Theory of metal cutting, Machine Tools.

Course Objectives:

1. To understand the need for the development of Unconventional machining processes.
2. To know various methods of material removal processes.
3. To know the principles and applications of Non-Conventional machining processes.
4. To know the concepts of Powder Metallurgy Technology.
5. To understand the Process of micromachining and LIGA.

UNIT – I

Introduction–Need for non-convention machining methods, Classification of non -conventional machining processes, considerations in process selection, materials, general characteristics and applications of un-conventional machining processes.

UNIT – II

Mechanical Material Removal Processes: Ultrasonic machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining – basic principles, components, process variables, advantages and disadvantages, applications.

UNIT – III

Thermal Material Removal Processes: General Principle and applications of Electric Discharge Machining, Electric discharge grinding and electric discharge wire cutting processes – Power circuits for EDM, mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection, wire EDM, principle applications.

UNIT – IV

Chemical Material Removal Processes: Electro Chemical Machining, Electro Chemical Grinding, Electro Chemical Honing, and Electro Chemical De burring - basic principles, components, process variables, advantages and disadvantages, applications.

Powder Metallurgy Technology: Concepts of PM Technology, Production process & Applications.

UNIT-V

Micro Machining: Bulk micromachining, surface micromachining and LIGA process – General description, basic principles, components, process variables, advantages and disadvantages, applications.

Text Books:

1. Non-Traditional Machining-P.K.Mishra (New Age)
2. Advanced machining processes-VK Jain-Allied publishers.
3. Manufacturing engineering and Technology, serope kalpakjian and Steven R. Schmid, Ed-4, pearson publications,2001.

Reference Books:

1. MEMS & Microsystems – Design and Manufacture by Tai-Ran Hsu, Tata McGraw Hill
2. Modern Machining Process-Pandey P.C. and Shah H.S-TMH
3. New Technology-Bhattacharya-The Institution of Engineers, India 1984.
4. Unconventional Machining Processes-C. Elanchezhian, B.vijaya Ramnath and M. Vijayan-Anuradha publications-2005

Course Outcomes:

CO1: Student will identify the problem faced in traditional metal cutting and come to an Understanding of the need for the development of Unconventional machining processes.

CO2: Gain the knowledge of basic mechanism of various Unconventional machining processes and related equipment, variables, advantages, disadvantages, applications.

CO3: Given a set of physical, electrical and other parameters. Student can identify a suitable Unconventional machining process.

CO4: Student will identify the different types of chemical removal process.

CO5: Student will identify the different types of micro machining process.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√					√			√		
CO 2	√		√					√			
CO 3	√		√					√			
CO 4	√		√						√		
CO 5	√		√					√			

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B.Tech ME IV Year I-Semester

L	T	P	C
3	0	0	3

(ME741PE) AUTOMATION IN MANUFACTURING
(PE – IV)

Pre-requisites: NIL

Course Objectives:

1. Describe the basic concepts of automation in manufacturing systems.
2. Acquire the fundamental concepts of automated flow lines and their analysis.
3. Analyze the knowledge on automated assembling System.
4. Classify automated material handling, automated storage and retrieval systems.
5. Illustrate adaptive control systems and automated inspection methods.

UNIT – I

Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools, Mechanical feeding and too changing and machine tool control transfer the automation.

Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

UNIT – II

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – III

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

Automated storage systems, automated storage and retrieval systems, work in progress storage, interfacing handling and storage with manufacturing.

UNIT – IV

Fundamentals of industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing.

UNIT – V

Business process Re-engineering: introduction to BPE logistics, ERP, Software configuration of BPE, concurrent Engineering, Techniques of rapid Proto typing.

Text Book:

1. Automation, Production systems and computer integrated manufacturing : M.P.Groover 3E -PE -PHI, 2009.

References:

1. Computer Aided Manufacturing, Tien – chien chang, Richard A Wysk and Hsu-Pin Wang, Pearson,2009.
2. Automation by W.Buekinsham.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1. Illustrate the basic concepts of automation in machine tools.

CO2. Analyze various automated flow lines, Explain assembly systems and line balancing methods.

CO 3. Describe the importance of automated material handling and storage systems.

CO4. Knowledge about various components of automation like sensors, actuators, PLC.

CO5. Interpret the importance of adaptive control systems, automated inspection systems.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√			√	√						
CO 2		√			√			√			√
CO 3	√					√					√
CO 4								√			√
CO 5	√							√	√		√

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B.Tech ME IV Year I-Semester

L	T	P	C
3	0	0	3

(ME742PE) PLANT LAYOUT AND MATERIAL HANDLING
(PE – IV)

Pre-requisites: NIL

Course Objective:

1. To know the basic concepts involved in Plant Layout and its types.
2. Evaluate the basic concepts involved in Process Layout and Product Layout.
3. To know the basic concepts involved in Group Layout.
4. To know the basic concepts of Material Handling Equipments and Systems.
5. To know the basic concepts of Methods to minimize material Handling Cost.

UNIT – I

Important Factors in Location/Site Selection - Specific Location Factors for Service Organization - Dominant Factors - Secondary Factors. Objectives of Layouts - Principles of Plant Layout - Good and Poor Layout Characteristics - Overview of the Plant Layout.

UNIT – II

Classification of Layout - Functional Layout (Process Layout) - Line Layout (Product Layout) -P-Q Analysis - Comparison of Product and Process Layout. Static Product Layout (Fixed Position) - Group Layout (Cellular Layout) -Combination Layout (Hybrid Layout). Advantages and Limitations of Different Layouts, Selection, Specification, Implementation.

UNIT – III

Computerized Layout Planning-Types-Construction Programs-Improvement Programs – Program in Detail Algorithm and Problems On CRAFT. Program in Detail Algorithm and Problems on ALDEP and CORELAP.

UNIT – IV

Material Handling Principles - Planning Principle – Operation Principle – Equipment Principle – Costing Principle Classification of Material Handling Equipment, Relationship of Material Handling to Plant Layout.

UNIT – V

Basic Material Handling Systems, Selection, Material Handling Method – Path, Equipment, Function Oriented Systems. Methods to Minimize Cost of Material Handling – Maintenance of Material Handling Equipments - Safety in Handling.

Text Books:

1. Operations Management-Pb Mahapatra -PHI
2. Aspects of Material Handling / Dr. Kc Arora & Shinde, Lakshmi Publications.

References:

1. Mikell .p. Groover “Automation Production System and Computer Integrated Manufacturing”, Prentice Hall of India Pvt. Ltd, First edition, 1987
2. Govindan K.R. “Plant Layout And Material Handling”, Anuradha Agencies, First Edition, 1997
3. James M Apple “Plant Layout And Material Handling” John Willey & Sons-New york, Third Edition, 1983.
4. Facility Layout & Location An Analytical Approach-Rl Francis-Lf Mc Linnis Jr. White - PHI
5. Production And Operations Management-R. Paneerelvam-PHI.
6. Introduction To Material Handling-Ray, Siddhartha-New Age.

Course Outcome:

CO1: Understand the basic concepts involved in different types of plant layouts and Computerized Layout Planning.

CO2: Understand the basic concepts involved in Material Handling systems.

CO3: Understand the basic concepts involved in Material Handling Oriented systems.

CO4: Understand the basic concepts involved in methods to minimizing Material Handling Systems.

CO5: Understand the basic concepts involved in Safety of Material Handling equipments.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√			√	√						
CO 2		√			√			√			√
CO 3	√					√					√
CO 4								√			√
CO 5	√							√	√		√

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME743PE) COMPUTATIONAL FLUID DYNAMICS
(PE – IV)

Pre-requisites: Heat Transfer and Fluid Mechanics.

Course Objective:

1. CFD is an important tool in engineering analysis and design of fluid systems.
2. In this course Students will develop the equations describing fluid flow and numerical solutions to these equations.
3. Emphasis will be placed on understanding different approaches employed for both time and spatial discretization and how to evaluate these approaches.
4. Students will look at time accurate and steady-state methods, explicit and implicit techniques, laminar and turbulent flow, compressible and incompressible approaches, stability considerations, etc.
5. These techniques will be applied to applications of mixing and heat transfer.

UNIT – I

Need-Applications- Mathematical description of physical phenomena- Governing differential equations- Derivation of , momentum, energy equations by model of infinitesimally small element fixed in space Exact Solutions Fully-developed flow between infinite parallel plates. Plane Poiseuille flow - Couette flow Solution of energy equation for hydro dynamically and thermally fully-developed flow between infinite parallel plates - Fully-developed flow in a pipe with circular cross-section (Circular Poiseuille flow)

UNIT – II

Initial and Boundary conditions. Classification of Partial Differential Equations. Methods of discretization, Basics of discretization methods- Taylor series formulation- Finite difference representation- central-forward-backward differences. One dimensional steady state conduction in slabs Solution by Tri-Diagonal Matrix Algorithm and Gauss Seidel iterations - relaxation parameter. Numerical errors- Optimum step size- grid independence test.

UNIT – III

Convective and Radiative fins with I, II and III kind boundary conditions for tip- solution by Tri-Diagonal Matrix Algorithm and Gauss Seidel iterations. Two-dimensional steady state Conduction in slab with various boundary conditions by finite difference approach.

One-dimensional transient conduction- Explicit – Implicit - Semi Implicit Schemes. Stability and convergence. Two-dimensional transient conduction in slabs- Alternating Direction Implicit scheme. One-dimensional radial conduction problems in cylindrical and spherical coordinates.

UNIT – IV

Governing equations- Stream function vorticity method (including derivation)- Solution - Algorithm- Specification of boundary conditions. Creeping flow. Determination of pressure for viscous flow (including derivation).

Primitive variable approach- Staggered grid- simple procedure- simple algorithm. Steady one dimensional convection and diffusion –Upwind scheme- False diffusion, one dimensional unsteady convection diffusion.

UNIT – V

Steady Flow, Dimensionless Form of Momentum And Energy Equations, Stokes Equation, Conservative Body Force Fields, Stream Function – Vorticity Formulation.

Finite Volume Method: Approximation Of Surface Integrals, Volume Integrals, Interpolation And Differentiation Practices, Upwind Interpolation, Linear Interpolation And Quadratic Interpolation.

Text Books:

1. Computational Fluid Flow and Heat Transfer- Muralidharan&Sundarajanan-Narosa Publications
2. Finite Difference Method in Heat Transfer – NecatiOzisik, CRC Press.
3. Computer Simulation of Flow and Heat Transfer – Ghoshdastidar, Tata McGraw Hill.
4. Numerical Methods – Chapra and Canale, TMH
5. Numerical Methods –Balaguruswamy-TMH.

Reference Books:

1. Computational Fluid Dynamics basics with applications- John.D, Anderson-Mc graw hill.
2. Computational Methods for Fluid Dynamics –Firziger&peric-springer.

Course Outcomes:

CO1: The information about some techniques for numerical solutions for flow problems. These Equations are applicable to time and space marching solutions especially parabolic Hyperbolic and elliptic equations.

CO2: How to discretize partial differential equations, including the governing flow equations which is the foundation for the finite difference method?

CO3: Explicit and implicit approaches represent the fundamental distinction between various Numerical techniques.

CO4: The fundamental principles of fluid mechanics, its governing differential equations and Boundary conditions.

CO5: Understand and to appreciate the need for validation of numerical solution.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√				√	√			√		
CO 2	√		√		√			√			
CO 3	√		√		√			√			
CO 4	√		√		√				√		
CO 5	√		√		√			√			

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B.Tech ME IV Year I-Semester	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

(ME703PC) ADVANCED CAD/CAM LAB

Course objectives:

1. To gain practical experience in handling 2D drafting and 3D modeling software system.
2. To be able to apply CAD in real life applications.
3. To be able to understand and handle design problems in a systematic manner.
4. To be understand the basic principles of different types of analysis
5. To know the application of various CNC machines like CNC lathe.

List Of Experiments:

1. Development of part drawings for various components in the form of orthographic view.
2. Generation of various 3D Models through Protrusion, revolve, shell sweep Creation of various features.
3. Feature based and Boolean based modeling surface and Assembly Modeling. Design simple components.
4. Stress and deflection analysis of Cantilever beam with end load.
5. Stress and deflection analysis of simply supported beam.
6. Stress and deflection analysis of truss.
7. Stress analysis of an Axi-symmetric component.
8. Stress analysis of a rectangular plate with a circular hole.
9. Steady state heat transfer analysis of plate.
10. To write the manual part program to the given dimensions and execute in CNC Lathe for Step Turning Using Canned Cycle.
11. To write the manual part program to the given dimensions and execute in CNC Lathe for Taper turning.
12. Write the manual part program to the given dimensions and execute in CNC Lathe for Grooving Cycle.

Textbooks:

1.2D and 3D Reference Guide by Chetan Prakashan published by CCAD Solution, Training and services.David D. Bedworth.

Course out comes:

CO1: Ability to develop 2D and 3D models using modeling software.

CO2: Modeling of simple machine parts and assemblies from the part drawing using Standard CAD packages.

CO3: Ability to understand the basic principles of different types of analysis.

CO4: Ability to understand CNC control in modern manufacturing system.

CO5: Ability to prepare CNC part programming and perform manufacturing.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√		√								
CO 2		√									
CO 3			√								
CO 4			√								√
CO 5	√			√	√					√	

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B.Tech ME IV Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME851PC) INDUSTRIAL ROBOTICS

(PE – V)

Pre-requisites: Basic principles of Kinematics and Mechanics.

Course Objective:

1. To learn the concepts of Robotics. Understand the basic components of robots.
2. Model forward and inverse kinematics of robot manipulators.
3. Analyze forces in links and joints of a robot.
4. Programme a robot to perform tasks in industrial applications
5. Design intelligent robots using sensors.

UNIT – I

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.

UNIT – II

Motion Analysis: Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.

Manipulator Kinematics: D-H notations – joint coordinates and world coordinates – Forward and inverse kinematics – problems.

UNIT – III

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.

UNIT – IV

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: Actuators- Pneumatic and Hydraulic actuators, Electric Actuators: DC servo motors – stepper motors.

UNIT – V

Feed Back Components: position sensors – potentiometers, resolvers and encoders – velocity sensors – Tactile sensors.

Robot Application In Manufacturing: Material Transfer and loading/unloading Material handling – Assembly and inspection.

Text Books:

1. Industrial Robotics-Groover M.P-Pearson Edu.
2. Introduction to Robotic Mechanics and control by JJ Craig, Pearson, 3rd edition.

References:

1. Robotics-Fu K.S-McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall.
3. Robot Analysis and intelligence-Asada and Slotine -Wiley inter Science.
4. Robot Dynamics & Control – Mark W. Spong and M.Vidyasagar -John Wiley & sons (ASIA) Pte. Ltd.
5. Robotics and control-Mittal R.K & Nagrath I.J-TMH.

Course Outcomes:

CO1: At the end of the course, the student will be able to understand the basic components of robots and differentiate types of robots and robot grippers.

CO2: Model forward and inverse kinematics of robot manipulators.

CO3: Analyze forces in links and joints of a robot.

CO4: Programme a robot to perform tasks in industrial applications.

CO5: Design intelligent robots using sensors.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1					√						√
CO 2					√						
CO 3					√						
CO 4				√							
CO 5			√								

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B.Tech ME IV Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME852PC) MECHATRONICS
(PE – V)

Pre-requisite: Basic Electronics Engineering.

Course Objective:

1. To make the students to learn about the Basic electronics, electrical and mechanical components used to control the machines and industries.
2. Various types of sensors, signal conditioning systems.
3. Various pneumatic and hydraulic components used in control systems.
4. Micro controllers, PLCS and PLC program.
5. Programmable motion control systems.

UNIT – I

Introduction: Definition – Trends – Control Methods; Stand alone, PC Based (Real Time Operating Systems, Graphical User interface, simulation) – Applications; SPM, Robot, CNC, FMS, CIM.

Signal Conditioning: introduction – Hardware – Digital I/O, Analog input – ADC, resolution, speed channels filtering noise using passive components – Resistors, capacitors – Amplifying signals using OP amps – Software – Digital Signals Processing – Low pass, high pass, notch filtering.

UNIT – II

Precision Mechanical Systems: Pneumatic Actuation Systems – Electro – pneumatic Actuation Systems – Timing Belts – Ball Screw and Nut – Linear Motion Guides – Linear Bearing – Harmonic Transmission – Bearings – Motor / Drive selection.

UNIT – III

Electronic interface sub systems: TTL, CMOS interfacing – Sensor interfacing – Actuator Interfacing – solenoids, motors isolation schemes – opto coupling, buffer IC's- Protection schemes – circuit breakers, over current sensing, reset able fuses, thermal dissipation – Power Supply – Bipolar transistors / mosfets

Electromechanical Drives: Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors – 4 quadrant servo drives, PWM's – Pulse width Modulation – Variable Frequency Drives, Vector Drives – Drive system load calculation.

UNIT – IV

Microcontrollers Overview: 8051 Microcontroller, micro processor structure – Digital interfacing – Analog interfacing – Digital to analog convertors – Analog to Digital convertors – Applications, Programming – Assembly, C (LED Blinking, Voltage measurement using ADC)

Programmable Logic Controllers: Basic structure programming; Ladder diagram – Timers internal Relays and counters – Shift registers – Master and jump controls – Data handling – Analog input / output – PLC Selection – Application.

UNIT – V

Programmable Motion Controllers: introduction – system transfer function – laplace transform and its application in analyzing differential equation of a control system – feedback devices; Position velocity sensors – optical incremental encoders – Proximity sensors; inductive, capacitive, infrared – continuous and discrete processes.

control system performance & turning – digital controllers – P, PI, PID control – control modes – position, velocity and torque – velocity profiles – Trapezoidal – S Curve, electronic gearing – controlled velocity profile – multi axis interpolation, PTP, Linear, Circular – Core functionalities – home, record position, Go to position – applications; SPM, Robotics.

Text Books:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
2. Mechatronics – N. Shanmugam -Anuradha Agencies Publishers.
3. Mechatronics System Design-Devdas shetty-Richard-Thomson.

References:

1. Alciatore David G & Histand Michael B, “Introduction to Mechatronics and Measurement systems”, 4th edition, Tata McGraw Hill, 2006.

Course Outcomes:

At the end of the course, the student will be able to,

CO1: Model, analyze and control engineering systems.
CO2: Identify sensors, transducers and actuators to monitor.
CO3: Control the behavior of a process or product.
CO4: Develop PLC programs for a given task.
CO5: Evaluate the performance of mechatronic systems.

Co-Po Mapping:

PO’S / CO’S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√			√	√					√	
CO 2	√		√	√	√			√		√	
CO 3	√		√	√	√			√		√	
CO 4	√		√	√	√			√		√	
CO 5	√			√	√					√	

ANURAG ENGINEERING COLLEGE

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B.Tech ME IV Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME853PC) COMPOSITE MATERIALS

(PE-V)

Pre-requisite: Material science and Advanced Engineering Materials**.**

Course Objective:

1. To be familiar with classification and characteristics of composite material and their applications.
2. To gain the knowledge about manufacturing methods of composites
3. To understand about Mechanical Properties of composites.
4. To knows the preparation process of different laminates
5. To knows the testing methods related to composite materials.

UNIT-I

Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

UNIT-II

Manufacturing methods: Hand and spray lay -up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.

UNIT-III

Mechanical Properties -Stiffness and Strength: Geometrical aspects –volume and weight fraction. Unidirectional continuous fiber, discontinuous fibers, Short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

UNIT-IV

Laminates: Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Module, Hydrothermal Stresses.

UNIT-V

Joining Methods and Failure Theories: Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.Tsai-Hill Failure Theory and Tsai-Wu Failure Theory.

Text Books:

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York
2. B.T. Astrom, (1997), Manufacturing of Polymer Composites, Chapman & Hall3.Composite materials by J.N.Reddy.

References:

1. B. D. Agarwal and L.J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw, Publisher: CRC
3. Ever J. Barbero, Finite Element Analysis of Composite Materials CRC Press, 2007.
4. 3.L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.
5. Madhujit Mukhopadhyay, Mechanics of Composite Materials and Structures, University Press, 2009.
6. Krishan K. Chawla, Composite Materials Science and Engineering, Springer, 2009, Ed. 6. Robert M. Jones, Mechanics of Composite Materials, 1999, Ed. 2.

Course Outcomes:

CO1: Provide knowledge on characteristics of composites.
CO2: Get knowledge on manufacturing and testing methods and mechanical behavior of composites
CO3: Get the exposure of different properties of material.
CO4: Understand the preparation of composite laminates.
CO5: Provide knowledge on test procedure and failure theories of composite materials.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√							√		
CO 2	√		√		√						
CO 3	√	√			√						
CO 4	√		√								√
CO 5	√				√						

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B.Tech ME IV Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME861PE) PRODUCTION PLANNING AND CONTROL
(PE-VI)

Pre-requisites: Management Science.

Course Objectives:

1. Understand the importance of Production planning & control.
2. Learning way of carrying out various functions so as to produce right product, right quantity at right time with minimum cost.
3. Optimum schedule of resources.
4. Coordinate other department relating to production to achieve regular balanced and uninterrupted production flow.
5. Materials Planning and Control.

UNIT – I

Introduction: Definitions – 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 – internal organizations department.

Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting techniques – Qualitative methods and quantitative methods.

UNIT – II

Inventory management – Functions inventory – Relevant inventory cost – ABC analysis – VED Analysis – EOQ model – inventory control systems – P – Systems and Q – Systems.

Introduction to MRP and ERP, jit inventory, Japanease concepts, Ranked positional concepts.

UNIT – III

Line balancing: definition, methods to LOB and Terminology, RPW METHOD, Largest candidate Method, Routing – Definition – routing procedure – Route sheets-factors affecting routing procedure.

UNIT – IV

Scheduling policies, Schedule – definition – difference with loading – techniques, standard scheduling methods – job shop, flow shop.LOB (Line of balance).

UNIT – V

Dispatching – Activities of dispatcher – Dispatching procedure – follow up – definition – reasons for existence of functions – types of follow up, – Chase planning, expediting, control aspects.

Applications of computer in production planning control.

Text Books:

1. Production Planning and Control – Samuel and Eon
2. Production Planning and Control Jain & Jain – Khanna publications

Reference Books:

1. Production Planning and Control – Text & cases -SK Mukhopadhyaya.
2. Production and operations Management – R.Paneer Selvam – PHI
3. Operations Management by Chase - phi
4. Operations Management by Steven son

Course Outcomes:

At the end of the course, the student will be able to,

CO1: Understand production systems and their characteristics.
CO2: Evaluate MRP and JIT systems against traditional inventory control systems.
CO3: Understand basics of variability and its role in the performance of a production system and
CO4: Analyze aggregate planning strategies.
CO5: Apply forecasting and scheduling techniques to production systems.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√							√		
CO 2	√		√		√						
CO 3	√	√			√						
CO 4	√		√								√
CO 5	√				√						

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B.Tech ME IV Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME862PE) MECHANICAL VIBRATIONS

(PE-VI)

Pre-requisite: Dynamics of Machines.

Course objectives:

1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. Understand various levels of vibrations and remedies for each of them.
4. To reduce the vibration and noise and improve the life of the components.
5. To understand experimental model analysis for multi degree of freedom System.

Unit I:

Introduction: Causes and effects of vibration, Classification of vibrating system, Discrete and continuous systems, degrees of freedom, Identification of variables and Parameters, Linear and nonlinear systems, linearization of nonlinear systems, Physical models, Schematic models and Mathematical models.

Unit II:

SDF systems: Formulation of equation of motion: Newton –Euler method, De Alembert's method, Energy method,

Free Vibration: Undimmed Free vibration response, Damped Free vibration response, Case studies on formulation and response calculation.

Unit III:

Forced vibration response: Response to harmonic excitations, solution of differential equation of motion, Vector approach, Complex frequency response, Magnification factor Resonance, Rotating/reciprocating unbalances, Force Transmissibility, Motion Transmissibility, Vehicular suspension, Vibration measuring instruments, Case studies on forced vibration.

Unit IV:

Two degree of freedom systems: Introduction, Formulation of equation of motion: Equilibrium method, Lagrangian method, Case studies on formulation of equations of motion

Free vibration response, Eigen values and Eigen vectors, Normal modes and mode superposition, Coordinate coupling, decoupling of equations of motion, Natural coordinates, Response to initial conditions, free vibration response case studies, Forced vibration response, undamped vibration absorbers, Case studies on undamped vibration absorbers.

Unit V:

Multi degree of freedom systems: Introduction , Formulation of equations of motion, Free vibration response, Natural modes and mode shapes, Orthogonally of model vectors, normalization of model vectors, Decoupling of modes, model analysis, mode superposition technique, Free vibration response through model analysis, Forced vibration analysis through model analysis, Model damping, Rayleigh's damping, Introduction to experimental model analysis.

Text books:

1. L. Meirovich, Elements of Vibration analysis, 2nd Ed. Tata Mc-Grawhill 2007

Reference Books:

1. Singiresu S Rao, Mechanical Vibrations. 4th Ed.Pearson education 2011
2. W.T., Thompson, Theory of Vibration. CBS Publishers.
3. Clarence W. de Silva, Vibration: Fundamentals and Practice, CRC Press LLC, 2000.

Course Outcomes:

At the end of the course, the student will be able to,

CO1: Understand the causes and effects of vibration in mechanical systems.
CO2: Develop schematic models for physical systems and formulate governing equations of Motion.
CO3: Understand the role of damping, stiffness and inertia in mechanical systems.
CO4: Analyze rotating and reciprocating systems and compute critical speeds.
CO5: Analyze and design machine supporting structures, vibration isolators and absorbers.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√		√		√				√	
CO 2	√	√	√	√	√	√		√		√	
CO 3	√	√	√	√	√	√		√		√	
CO 4	√		√	√	√	√		√		√	
CO 5	√			√		√				√	

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B.Tech ME IV Year II-Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME863PE) FLEXIBLE MANUFACTURING SYSTEMS (PE-VI)

Pre-requisites: NIL

Course Objective:

At the end of this course, students will be able to:

1. Understand the role of Flexible Manufacturing Systems (FMS) in manufacturing.
2. Understand the concept of Group Technology.
3. Understand the benefits of automation.
4. Know types of Material Handling Systems.
5. To get the Knowledge on design of Flexible Manufacturing Systems.

UNIT I:

Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications of FMS

UNIT II:

Processing stations: Machining Centers, Turning centers, CMM, Washing/ Deburring station, etc. Different Layouts and their Salient features

UNIT III:

Material Handling System: An introduction, Conveyor, AGV, ASRS, Robots, etc. and their salient features.

UNIT IV:

Management technology: Tool Management, Configuration planning and routing, Production Planning and Control, Scheduling and control

Computer networks and control: Hardware, Software and database of FMS

UNIT V:

Design of FMS: Performance Evaluation, Analytical model and Simulation model of FMS.

Case studies: Typical FMS problems from researches papers.

Textbooks:

1. Groover, M.P “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India Pvt.Ltd. New Delhi 2009.
2. Tempelmeier.H and Kuhn.H. “Flexible Manufacturing system: Decision support for design and operation”, John Wiley and Sons 2003.
3. Maleki A. “Flexible Manufacturing Systems: the technology and management”. Prentice Hall International –2009.

Course Outcomes:

At the end of the course, the student will be able to

CO1: Understand FMS and job-shop and mass production manufacturing systems.

CO2: Understand processing stations and material handling systems used in FMS environments.

CO3: Design and analyze FMS using simulation and analytical techniques.

CO4: Understand tool management in FMS.

CO5: Analyze the production management problems in planning, loading, scheduling, routing and Breakdown in a typical FMS.

Co-Po Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√				√				√	
CO 2	√	√	√		√	√		√		√	
CO 3	√	√	√		√	√		√		√	
CO 4	√		√		√	√		√		√	
CO 5	√					√				√	

OPEN ELECTIVE I

ANURAG ENGINEERING COLLEGE

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(CE611OE) Construction Materials

(OPEN ELECTIVE –I)

Course objectives:

1. Students Will Get Knowledge of Various Materials Like Stones, Bricks, Concrete Blocks
2. Students Will Gain Basic Knowledge on Materials Like Lime, Cement, Aggregates And Mortar.
3. Students Will Learn About Concrete Ingredients, Manufacturing Process And Tests on It.
4. Students Will Gain About Basic Knowledge on Timber And Other Materials
5. Students Will Learn About Modern construction materials.

UNIT I: Stones – Bricks – Concrete Blocks

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption

UNIT II: Lime – Cement – Aggregates – Mortar

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Impact strength– Grading – Sand Bulking.

UNIT III: Concrete

Concrete – Ingredients – Manufacturing Process – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction Factor

UNIT IV: Timber And Other Materials

Timber – Market forms – Industrial timber– Plywood – Veneer – Thermacole – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminum composite panel – Uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumen’s.

UNIT V: Modern Materials

Glass – Ceramics – Sealants for joints – Fiber glass reinforced plastic – Clay products – Refractory’s – Composite materials

Text Books:

1. Building Materials Construction by Arora and Bindra, Dhanpat Roy Publications, New Delhi.
2. Building Construction by B. C. Punmia, Ashok Kr. Jain and Arun Kr. Jain, Laxmi Publications Pvt. Ltd, New Delhi.

Reference Books:

1. Building Materials by S. K. Duggal, New Age International Publications, New delhi.
2. Building Construction by P. C. Verghese, PHI Publications, New Delhi.

Course Outcomes:

On successful completion of this course, it is expected that

CO 1: Students are get knowledge of various Materials Like Stones, Bricks and Concrete Blocks

CO2: Students are Gain Basic Knowledge on Materials like Lime, Cement, Aggregates and Mortar.

CO 3: Students are known About Concrete Ingredients, Manufacturing Process and Tests on It.

CO 4: Students are Gain About Basic Knowledge on Timber and Other Materials

CO 5: Students are get knowledge on Modern construction materials.

Co-Po Mapping:

CM	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	√	√	√	√	√	√		√	√	√	√	√
CO 2	√			√	√	√			√			√
CO 3		√	√	√	√			√	√	√		√
CO4		√	√	√	√	√			√	√	√	
CO5	√	√		√	√			√	√		√	

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(CE612OE) WASTE MANAGEMENT

(OPEN ELECTIVE –I)

Course Objectives:

The objective of this course is to impart,

1. The knowledge about quality standards of feed water and waste management theories.
2. The knowledge about the problems that associated with waste water discharging into streams.
3. The knowledge about the working processes and liquid waste origin in various industries.
4. The knowledge about the manufacturing process and origin of liquid waste from various industries.
5. The knowledge regarding waste disposal methods and requirement of treatment plants.

UNIT – I

Quality requirements of boiler and cooling waters – Quality requirements of process water for Textiles – Food processing and Brewery Industries – Boiler and cooling water treatment methods. Basic Theories of Industrial Waste Water Management – Volume reduction – Strength reduction – Neutralization – Equalization and proportioning. Joint treatment of industrial wastes and domestic sewage – consequent problems.

UNIT – II

Industrial waste water discharges into streams. Lakes and oceans and problems. Recirculation of Industrial Wastes – Use of Municipal Waste Water in Industries.

UNIT-III

Manufacturing Process and design origin of liquid waste from Textiles, Paper and Pulp industries, Thermal Power Plants and Tanneries, Special Characteristics, Effects and treatment methods.

UNIT - IV

Manufacturing Process and design origin of liquid waste from Fertilizers, Distillers, and Dairy, Special Characteristics, Effects and treatment methods.

Manufacturing Process and design origin of liquid waste from Sugar Mills, Steel Plants, Oil Refineries, and Pharmaceutical Plants, Special Characteristics, Effects and treatment methods.

UNIT – V

Common Effluent Treatment Plants – Advantages and Suitability, Limitations, Effluent Disposal Methods.

Text Book:

1. Waste Water Treatment by M.N. Rao and Dutta, Oxford & IBH, New Delhi.

References:

1. Liquid waste of Industry by New merow.
2. Water and Waste Water technology by Mark J. Hammer and Mark J. Hammer (Jr).

Course Outcomes:

At the end of the course student will be able to,

CO 1: Understand the standards for feed water in various industries and different theories in reducing the concentration of waste water.

CO 2: Understand the effects of discharging waste water into streams and the direct and indirect impacts on aquatic animals and humans.

CO 3: Understand the working procedure in various industries, sources, characteristics and effects of waste, also the treatment methods depending upon the type of waste.

CO 4: Know the combined treatment methods of liquid waste, effective methods of waste disposal and their limitations.

CO 5: Understand the waste disposal methods and requirement of treatment plants.

Co-Po Mapping:

WM	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	√	√	√	√	√	√		√	√	√	√	√
CO 2	√		√	√	√	√			√			√
CO 3		√	√		√			√	√	√	√	
CO4	√	√	√	√	√			√		√		
CO5	√	√		√	√	√		√	√		√	√

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(EE611OE) SOLAR PHOTOVOLTAIC SYSTEMS

(Open Elective-I)

Course Objectives: Objectives of this course are

To introduce solar energy and its geometry.
To deal with various technologies of solar PV cells.
To know about the protection and measurement of solar photovoltaic system.
To understand the design considerations of solar photovoltaic system.
To know about the various maximum power point tracking techniques.

UNIT I: Solar Energy

Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation ,Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT II: Solar Cells

Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, encapsulation systems, manufacture, power rating, hotspot effect, Design qualifications.

UNIT III: Protection And Measurements

Flat plate arrays, support structures, module interconnection and cabling, lightning protection, Performance measurement – using natural sun light and simulator, determination of temperature coefficients, internal series resistance, curve correction factor.

UNIT IV: Photovoltaic Systems

Photovoltaic systems- types- general design considerations- system sizing-battery sizing- inverter sizing-design examples – Balance of PV systems.

UNIT V: Maximum Power Point Trackers

Maximum power point trackers-algorithms- perturb and observe-incremental conductance method, hill climbing method, , hybrid and complex methods, data based and other approximate methods, instrument design, other MPP techniques-Grid interactive PV system.

Text books:

1. F.C.Treble, “Generating electricity from Sun”, Pergamon Press, 1991.
2. A.K.Mukherjee, Nivedita Thakur, “Photovoltaic systems: Analysis and design”, PHI, 2011.

Reference books:

1. C.S.Solanki, “Solar Photovoltaics: Fundamentals, Technologies and applications”, PHI, 3 rd edition ,2015.
2. R.D.Begamudre, “Energy Conversion Systems”, New Age International, 1st edition 2014.

Course Outcomes: After completion of this course, the student will be able to

CO 1: Understand the basics of solar energy and its geometry.
CO 2: Analyze the various topologies of solar photovoltaic cells.
CO 3: Understand the protection and measurement of solar photovoltaic system.
CO 4: Understand the design considerations of solar photovoltaic system.
CO 5: Analyze the various maximum power point tracking techniques.

CO-PO Mapping:

PO'S / CO'S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	√		√		√			√	√		
CO 2	√	√			√			√			
CO 3		√	√		√						
CO 4			√		√						
CO 5	√	√			√						√

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B.Tech MECHANICAL ENGINEERING	L	T	P	C
	3	0	0	3

(EE612OE) ELECTRICAL POWER GENERATION SYSTEMS

(Open Elective-I)

Course Objectives:

Students will be able to

- To introduce the concepts and phenomenon of different sources of power generation
- To learn various conventional energy sources
- To learn various renewable energy sources
- To gain understanding of integrated operation of renewable energy sources.
- To understand fuel cells

UNIT-I : THERMAL POWER STATIONS & NUCLEAR POWER STATIONS

Thermal Power Stations: Line diagram of Thermal Power Station (TPS) showing paths of coal, steam, water, air, ash and flue gasses.- Brief description of TPS components: Economizers, Boilers, Super heaters, Turbines, Condensers, Chimney and Cooling towers

Nuclear Power Stations: Nuclear Fission and Chain reaction - Nuclear fuels - Principle of operation of Nuclear reactor.-Reactor Components: Moderators, Control rods, Reflectors and Coolants - Radiation hazards: Shielding and Safety precautions.- Types of Nuclear reactors and brief description of PWR, BWR and FBR.

UNIT-II: HYDROELECTRIC POWER STATIONS & GAS POWER STATIONS

Hydroelectric Power Stations: Classification of turbines - impulse and reaction turbines, Elements of hydro electric power station- types –concept of pumped storage plants-storage requirements, mass curve (explanation only) estimation of power developed from a given catchment area, heads and efficiencies

Gas Power Stations: Principle of Operation and Components (Block Diagram approach only).

UNIT- III: SOLAR ENERGY SYSTEMS

Introduction – solar radiation - solar thermal energy conversion - Flat plate collector - concentric collectors- solar pond - central receiver system- solar pumping - Solar photovoltaic systems - characteristics of PV cell- Photo voltaic modules - Types of Photo voltaic systems.

UNIT-IV: WIND ENERGY & BIOMASS

Wind Energy: Basics of wind energy - classification of turbines - wind characteristics - energy extraction - Betz limit - Modes of wind power generation.

Biomass: Biomass energy conversion - Anaerobic Digestion - Aerobic Digestion - Gasification- Biogas Plants.

UNIT-V: OCEAN ENERGY & FUEL CELLS

Ocean Energy: Tidal Energy generation - characteristics of Tides - Power generation schemes - Components in Tidal power plant- Wave Energy - Principle of wave energy plant - Wave energy conversion machines - Ocean Thermal Energy conversion - Principle - cycles of operation - Types of OTEC plants – Applications

Fuel cells: Introduction - Principle of operation - Types of FUEL CELLS - State of art fuel cells- energy output of a fuel cell - operating characteristics of fuel cells

Text Books:

1. V.K Mehta and Rohit Mehta, “Principles of Power Systems”, S.Chand Company Pvt. Ltd, New Delhi, 2006.
2. D.P.Kothari, K.C.Singal, R.Ranjan,”Renewable Energy Resources and emerging technologies”- PHI private limited 2nd edition, 2011.

References Books:

1. M.L. Soni & P.V. Gupta, “Power System Engineering”, Dhanpat Rai & Co publishers, 2010.
2. John Twidell and Tony Weir ,“Renewable Energy Resources”, Routledge 3 edition, 2015.
3. Rakosh Das Begamudre, “Energy conversion systems”- New Age International Publishers, 1st edition 2014-New Delhi - 2000.
4. Volker Quaschning, “Understanding Renewable Energy Systems”, Earthscan/Routledge London, 2nd edition, 2015.

Course Outcomes:

After completion of this course, the student will be able to

CO 1: Understand the electrical power generation process from Thermal and Nuclear power stations.
CO 2: Analyze the electrical power generation from Hydro and Gas power stations.
CO 3: Analyze the electrical power generation by using solar energy.
CO 4: Understand the electrical power generation from wind energy & biomass energy.
CO 5: Know the working of fuel cells and ocean energy conversion.

CO-PO Mapping:

PO’S / CO’S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	√			√	√				√		√
CO 2	√					√		√			√
CO 3	√			√	√				√		√
CO 4	√			√	√			√			√
CO 5	√	√			√						√

ANURAG ENGINEERING COLLEGE

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME611OE) ADVANCED ENGINEERING MATERIALS

OPEN ELECTIVE I

Pre-requisites: Metallurgy& Material Science, Composite Materials.

Course Objectives:

1. To introduce the basic concepts concerning the Advanced Engineering materials in the world.
2. To explain the ferrous and non ferrous metals and alloys have led to our understanding of advanced materials structure and properties.
3. To explain the ceramic, plastic, composite materials and super alloys.
4. To provide sufficient background material to enable students to continue with more specialized courses, such as Nano Science and other physical science subjects.
5. To explain the intermetallic materials and their applications.

UNIT I:

Ferrous Metals & Alloys:

Special topics in materials engineering: Selection for economy in manufacture, guidelines for selection of materials.

UNIT II:

Non Ferrous Materials & Alloys:

Aluminium: Wrought & cast aluminium alloys – properties.

Copper: Properties of wrought copper alloys & copper alloy castings. Selection & application of copper alloys.

Zinc & Tin: Properties, selection & application.

UNIT III:

Plastics:

General properties of plastics: Introduction, Polymeric materials to design selection of plastics. Plastic additives. Mechanical behaviour of plastics.

UNIT IV:

Composites:

Introduction: Conventional engineering materials, what are composites? Functions of fibre & matrix, special features, drawbacks, processing, product fabrication, applications. Ceramics Oxide surfaces, ceramic forming & metal ceramic interface.

UNIT V:

Intermetallic:

Properties and application of Titanium aluminides, Nickel aluminides, Iron luminides, Beryllides & Silicide.

Super alloys

Properties, selection & engineering application of: Nickel based super alloys, Cobalt based super alloys & Iron based super alloys.

Text Book:

1. Engineering Materials, Properties & Selection - Ken Budinski & Michael K.Budinski, Prentice Hall.

Reference Books:

1. Materials Selection in Mechanical Design - Michael Ash by Butterworth – Heinemann.
2. Materials Selection & Applications in Mechanical Engineering - Dr.A.Raman, Industrial Press Inc.
3. Selection & Use of Engineering Materials **-** F.A.A.Crane, J.A.Charles & Justin Furness, Butterworth – Heinemann.

Course Outcomes:

CO1: Acquire an understanding of the main concepts related to the structure and properties of Advanced materials
CO2: Understand the basic concepts of ferrous and non ferrous metals and alloys.
CO3: Understand the ceramics and composite materials
CO4: To understand the application of super alloys and intermetalic
CO5: Understand the basic methods of manufacturing various types of composite materials.

CO-PO Mapping:

PO'S / CO'S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1				√		√				√	
CO 2				√		√				√	
CO 3				√		√				√	
CO 4				√		√				√	
CO 5				√		√				√	

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L	T	P	C
3	0	0	3

(ME612OE) INTRODUCTION TO AUTOMOBILE ENGINEERING

(OPEN ELECTIVE I)

Pre requisites: Nil

Course objectives:

1. The basics principles of actual automobile systems.
2. The functions of Ignition and generating system.
3. To study importance and features of differential systems.
4. The students get the working knowledge of suspension and steering system.
5. Learn about the various braking systems and current scenario of Automobile Emissions and standards study and its significance.

UNIT – I

Introduction: Introduction of automobiles**-**Hybrid vehicles components of a four wheeler automobile–chassis and body – power unit –power Transmission – rear wheel drive, front wheel drive, four wheel drive –types of automobile engines, engine construction, fuel injection pump-fuel injector.

UNIT--II

Ignition System: Function of an ignition system, battery ignition system– Magneto coil ignition system, electronic ignition system using contact breaker.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism, solenoid switch, lighting system, Horn, Wiper.

UNIT – III

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Fluid Fly Wheel – Gear Box- Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Propeller Shaft – Universal Joint, Differential, Rear Axles.

UNIT – IV

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Centre Point Steering. Types of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Power steering.

Suspension System: Objects of suspension systems–torsion bar, shock absorber, independent suspension system.

UNIT-V

Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

Emission from Automobiles –Pollution Standards National and International – Pollution Control– Modern Techniques in automobiles.

Text books:

1. Automobile Engineering -William Crouse, TMHILL Publishers.
2. A systems Approach to Automobile Technology, Jack Erjavec, YESSDEE Publishers Pvt. Ltd. New Delhi.
3. Automotive Mechanics – Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors,

References:

1. Automotive Mechanics-G.B.S.Narang
2. Automotive Mechanics-Heitner
3. Automotive Engines-Srinivasan
4. Automobile Engineering -K.K Ramalingam -Scitech Publications
5. Automotive Engineering-Newton steeds & Garrett.
6. Automobile Engineering –R B Gupta,Satyaprakshan-10th edition.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Analyze the basic lay-out of automobile, working and other details about I.C Engines used in automobiles.

CO2: To gain the knowledge on working of ignition, Electrical systems.

CO3: Understand how the transmission system works and the working knowledge of various Components in transmission system.

CO4: Students will able to explain working principle of various parts of automobile such as axles, steering system and Suspension System.

CO5: Understand the various braking systems and pollution standards and its significance.

CO-PO Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√					√		√			√
CO 2	√		√	√		√		√			√
CO 3	√					√					√
CO 4	√		√	√		√		√			√
CO 5	√		√	√		√		√			√

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B.Tech MECHANICAL ENGINEERING	L	T	P	C
	3	0	0	3

EC611OE: PRINCIPLES OF COMMUNICATIONS
(OPEN ELECTIVE – I)

Course Objectives:

The objective of this subject is to:

1. Introduce the students to modulation and frequency translation
2. Various analog and digital modulation schemes.
3. They can have a broad understanding of satellite, optical,
4. They can have a broad understanding of satellite, optical, cellular, mobile, wireless and telecom concepts**.**
5. They can have a broad understanding of cellular, mobile, wireless and telecom concepts.

UNIT I:

Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT II:

Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

UNIT III:

Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony.

Networking and Local Area Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

UNIT IV:

Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

Optical Communication: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT V:

Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.

Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

Text Books:

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Kennady, Davis, Electronic Communications systems, 4e, TMH, 1999

Reference Books:

1. Tarmo Anttalainen, Introduction to Telecommunications Network Engineering, Artech House Telecommunications Library.
2. Theodore Rappaport, Wireless Communications-Principles and practice, Printice Hall, 2002.
3. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications. Wayne Tomasi,
4. Introduction to data communications and networking, Pearson Education, 2005.

Course Outcomes:

By completing this subject, the student can

1. Work on various types of modulations.
2. Should be able to use these communication modules in implementation.
3. Will have a basic understanding of various telephone communication systems.
4. Will have a basic understanding of various satellite and optical communication systems.
5. Will have a basic understanding of various wireless and cellular, mobile and telephone communication systems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	H		H	H	L	M		M	L	L	L	H
CO2	H	H		H		M		M		L	L	H
CO3		M	M	M	M	L		L	L	L		
CO4	H	H		H	H				L		L	M
CO5	H	M	M		M	M	M	M	L	L	L	M

H-HIGH **M-MEDIUM** **L-LOW**

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B.Tech MECHANICAL ENGINEERING	L	T	P	C
	3	0	0	3

EC612OE: BASIC ELECTRONC CIRCUITS SIMULATION & DESIGN

(OPEN ELECTIVE – I)

Course objectives:

In this course it is aimed to introduce to the students with

1. To understand and develop a simulation circuits for different domain.
2. To analyze the performance of electronic circuits using DC analysis and frequency response.
3. To analyze the performance of electronic circuits using Transient analysis.
4. To analyze the performance of electronic circuits using AC analysis.
5. To know the applications of Pspice model devices

UNIT-I

Introduction to Pspice: Introduction**-**Description of Spice-Types- input files-Element values-Nodes-Circuit Elements-Sources-Types of Analysis-Output Variables-Pspice Output Commands– structure of Pspice programs-Limitations of Pspice- -Examples.

UNIT-II

DC Circuit Analysis: Introduction-Resistors-Operating Temperature-Modelling of Elements-Independent DC Sources-Dependent Sources-D C Output Variables-Example problems-Types of Output-Types of DC Analysis-Finding the venin's equivalent-transfer function-DC transfer characteristics with varying resistors.

UNIT-III

Transient Analysis: Introduction- AC Output Variables- Capacitors and Inductors- Modelling of Transient Sources-transient source-transient output commands-Transient response-switches- Example.

UNIT-IV

AC Circuit Analysis: Introduction- AC Output Variables - Independent AC Sources-AC analysis- Magnetic Elements - Transmission Lines- Multiple Analyses – Examples.

Advanced Pspice Commands: Table- Laplace – freq – ends - PARAM-Fourier analysis - Noise analysis-Subckt.

UNIT-V

Application of Pspice: Introduction- Pspice model for -Diode- BJT-FET and MOSFET -VI characteristics of Diode - zener diode - CB- CC- CE characteristics-Drain- Transfer characteristics- Introduction to Orcad capture.

Text Books:

1. Muhammad H. Rashid- Introduction to PSpice® Using OrCAD® for Circuits and Electronics- third edition-Pearson 2004.
2. Paul W. Tuinenga- A guide to circuit simulation and analysis using spice-Pearson Education-1995.

References:

1. Nillson Introduction to PSpice Using OrCad Release 16.2: Electric Circuits 9th Edition - 2011
2. L. H. Fenical- PSpice@: A Tutorial-Prentice Hall- Prentice Hall -1992
3. John O Attia Pspice and Matlab for Electronics CRC Publication 2002.
4. James W.Nilson Introduction to PSpice for Electric Circuits Aug 2007.
5. James A.svaboda Wiley PSpice for Linear Circuits (uses PSpice version 15.7)- 2nd Edition

Course Outcomes

At the end of the course the student should be able to

- Describe circuits for PSpice simulation.
- Understand the types of DC circuit their output variables analysis
- Understand the response of Transient analysis and obtain their output variables.
- Understand the types of AC circuit their output variables analysis.
- Students can able to analyze and develop simulation circuit for different applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1		H								H		L
CO2	H		M	L	M		M		M			H
CO3				H		M		M			L	
CO4	L	H							H			H
CO5	M		M			M		L		M		L

H-HIGH **M-MEDIUM** **L-LOW**

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	3	0	0	3

(CS504PC/CS611OE) SOFTWARE ENGINEERING

(OPEN ELECTIVE-I)

Prerequisites: Any programming language

Course Objectives:

- Understanding of software process models such as waterfall and evolutionary models.
- Understanding of software requirements and SRS document.
- Understanding of different software architectural styles.
- Understanding of software testing approaches such as unit testing and integration testing.
- Understanding on quality control and how to ensure good quality software.

UNIT- I:

Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, Software myths.

A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), personal and team process models.

UNIT- II:

Process models: The waterfall model, Incremental process models, Evolutionary process model, Agile process.

Software Requirements: Functional and non- functional requirements, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management

UNIT- III:

System models: Context Models, Behavioral models, Data models, Object models, structured methods.

Design Engineering: Design process and Design quality, Design concepts, the design model,

Modeling component level design: design class based components, conducting component level design. Performing User interface design: Golden rules.

UNIT- IV:

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black- Box and White- Box testing, Validation testing, System testing,

Product metrics: Software Quality, Metrics for Analysis Model- function based metrics, Metrics for Design Model- object oriented metrics, class oriented metrics, component design metrics, Metrics for source code, Metrics for maintenance.

UNIT- V:

Metrics for Process and Products: Metrics for software quality. Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

Quality Management: Quality concepts, Software Reviews, Formal technical reviews, Software reliability, The ISO 9000 quality standards.

Text Books:

1. Roger S. Pressman, Software Engineering - A practitioner's Approach, 6th edition. McGraw Hill International Edition,2005.
2. Somerville, Software Engineering, 7th edition, Pearson education, 2009.

Reference Books:

1. K.K. Agarwal & Yogesh Singh, Software Engineering, New Age International Pub, 3rd edition, 2008
2. James F. Peters, Witold Pedrycz, Software Engineering - an Engineering approach, John Wiely, 2007.
3. Shely Cashman Rosenblatt, Systems Analysis and Design, Thomson Publications.
4. Waman S Jawadekar, Software Engineering Principles and Practice, the McGraw- Hill Companies, 2013.

Course Outcomes:

Upon the successful completion of this course, the student will be able to:

1. Apply software engineering principles and techniques.
2. Analyze software system requirements.
3. Produce efficient, reliable, robust and cost-effective software solutions.
4. Apply testing strategies.
5. Ensure good quality software.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓											
CO 2		✓	✓				✓					
CO 3					✓							
CO 4				✓	✓							
CO 5						✓						

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B.Tech MECHANICAL ENGINEERING	L	T	P	C
	3	0	0	3

(CS406PC/CS612OE) DATABASE MANAGEMENT SYSTEMS
(OPEN ELECTIVE-I)

Prerequisites: Any programming language.

Course Objectives:

- To provide a sound introduction to Database management systems, Databases and its applications,
- To familiarize the participant to give a good formal foundation on the relational model of data
- To present SQL and procedural interfaces to SQL comprehensively
- To give an introduction to systematic database design approaches conceptual design, logical design ,schema refinement and physical design
- To introduce the concepts of transactions and transaction are processing and the issues and techniques relating to concurrency and recovery manager.

UNIT- I:

Introduction to Database System Concepts: Database- System Applications, Purpose of Database Systems, View of Data, Database Language, Database Design, Database Architecture, Database Users and Administrators.

Introduction to the Relation Models and Database Design using ER Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations Overview of the Design Process, The Entity- Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity- Relationship Diagrams, Entity- Relationship Design Issues, Extended E- R Features.

UNIT- II:

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions Nested Sub queries, Modification of the Database.

Intermediate and Advanced SQL: Join Expressions, Views , Integrity Constraints, SQL Data Types, Authorization. Functions and Procedures, Triggers, Advanced Aggregation Features.

UNIT- III:

Formal Relational Query Languages: The Relational Algebra, Tuple Relational Calculus, The Domain Relational Calculus.

Relational Database Design: Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Decomposition Using Multi valued Dependencies, More Normal Forms.

UNIT- IV:

Indexing: Basic Concepts, Ordered Indices, B+- Tree Index Files, B+- Tree Extensions, Multiple-Key Access.

Transactions: Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels.

UNIT – V:

Concurrency Control: Lock- Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp- Based Protocols, Validation- Based Protocols, Multi version schemes

Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Nonvolatile Storage, ARIES, Remote Backup Systems

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Sixth Edition, Tata Mc Graw- Hill2006.
2. Raghu Rama Kirshna, Johannes Gchrke, Database Management System, Third Edition, TATA MC Graw Hill,2003

Reference Books:

2. Peter Rob & Carlos Coronel, Data base Systems design, Implementation and Management, 7th Edition,2007.
3. Ramez Elmasri, Shamkanth B. Navrate, Fundamentals of Database Systems, Pearson Education,2008.
4. C.J. Date ,Introduction to Database Systems, Pearson Education

Course Outcomes:

Upon the successful completion of this course, the student will be able to:

1. Design Entity- Relationship Model for enterprise level databases.
2. Develop the database and provide restricted access to different users of database and formulate the Complex SQL queries.
3. Analyze various Relational Formal Query Languages and various Normal forms to carry out Schema refinement
4. Use of suitable Indices and Hashing mechanisms for real time implementation.
5. Analyze various concurrency control protocols and working principles of recovery algorithms.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓		✓	✓	✓	✓	✓		✓			
CO 2	✓				✓	✓	✓		✓			
CO 3	✓	✓		✓	✓				✓			
CO 4		✓	✓	✓	✓	✓			✓			
CO 5	✓	✓	✓	✓	✓	✓	✓		✓			

OPEN ELECTIVE II

ANURAG ENGINEERING COLLEGE

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	3	**0**	**0**	**3**

(CE721OE) DISASTER MANAGEMENT
OPEN ELECTIVE -II

UNIT - I:

Environmental Hazards & Disasters: Meaning of Environmental hazards, Environmental Disasters and Environmental stress. Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Different approaches & relation with human Ecology - Landscape Approach - Ecosystem Approach - Perception approach - Human ecology & its application in geographical researches.

UNIT - II:

Types of Environmental hazards & Disasters: Natural hazards and Disasters - Man induced hazards & Disasters - Natural Hazards - Planetary Hazards / Disasters - Extra Planetary Hazards / disasters - Planetary Hazards - Endogenous Hazards - Exogenous Hazards

UNIT - III:

Endogenous Hazards - Volcanic eruption - Earthquakes - landslides - Volcanic Hazards / Disasters - Causes and distribution of Volcanoes - Hazardous effects of volcanic eruptions - Environmental impacts of volcanic eruptions - Earthquake Hazards / disasters - Causes of Earthquakes - Distribution of earthquakes - Hazardous effects of - earthquakes - Earthquake Hazards in India - Human adjustment, perception & mitigation of earthquake.

UNIT - IV:

Exogenous hazards / disasters - Infrequent events - Cumulative atmospheric hazards / disasters infrequent events: Cyclones - Lightning - Hailstorms

Cyclones: Tropical cyclones & Local storms - Destruction by tropical cyclones & local storms (causes, distribution human adjustment, perception & mitigation) Cumulative atmospheric hazards/ disasters :- Floods - Droughts - Cold waves - Heal waves Floods :- Causes of floods - Flood hazards India - Flood control measures (Human adjustment, perception & mitigation) Droughts :- Impacts of droughts - Drought hazards in India - Drought control measures - Extra Planetary Hazards / Disasters - man induced Hazards / Disasters - Physical hazards / Disasters - Soil erosion

Soil Erosion: Mechanics & forms of Soil Erosion - Factors 7 causes of Soil Erosion - Conservation measures of Soil Erosion.

Chemical hazards / disasters: Release of toxic chemicals, nuclear explosion - Sedimentation processes Sedimentation processes. Global Sedimentation problems - Regional Sedimentation problems - Sedimentation & Environmental problems - Corrective measures of Erosion & Sedimentation

Biological hazards / disasters: Population Explosion.

UNIT - V:

Emerging approaches in Disaster Management - Three stages

1. Pre-disaster Stage (preparedness)
2. Emergency Stage
3. Post Disaster stage - Rehabilitation

Text books:

1. Disaster Mitigation: Experiences And Reflections by Pradeep Sahni
2. Natural Hazards & Disasters by Donald Hyndman & David Hyndman - Cengage Learning

References:

1. R. B. Singh (Ed) Environmental Geography, Heritage Publishers New Delhi, 1990
2. Savinder Singh Environmental Geography, Prayag Pustak Bhawann 1997
3. Kates, B. I & White, G. F The Environment as Hazards, oxford, New York, 1978
4. R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000
5. H. K. Gupta (Ed) Disaster Management, Universities Press, India, 2003
6. R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994
7. Dr. Satender, Disaster Management in Hills, Concept Publishing Co., New Delhi, 2003
8. A. S. Arya Action Plan For Earthquake, Disaster, Mitigation in V. K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994
9. R. K. Bhandani An overview on Natural & Manmade Disaster & their Reduction, CSIR, New Delhi
10. M. C. Gupta Manuals on Natural Disaster Management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.

Course outcomes:

CO 1: Application of different approaches, human ecology in geographical research

CO 2: Have the knowledge on planetary hazards/disasters

CO 3: Know the principles and measures to control various disasters/exogenous hazards

CO 4: Plan for face types of exogenous hazards, impacts and mitigation techniques & management system

CO 5: Apply emerging approaches in different types of disasters

CO-PO Mapping:

DM	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		√	√	√	√	√		√	√	√	√	√
CO 2	√	√		√	√	√			√		√	
CO 3			√	√	√			√	√	√	√	√
CO4		√	√	√	√	√		√	√	√	√	
CO5	√	√		√	√	√		√	√		√	√

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(CE511PE/CE722OE) REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

OPEN ELECTIVE -II

Course Objectives:

1. To understand the principles involved and basics concepts of remote sensing.
2. To know about interpretation techniques and their basic elements.
3. To study about Geo graphic information system and basic terminology.
4. To know GS spatial analysis.
5. To understand the RS & GS applications in various aspects

UNIT – I

Introduction to Photogrammetric: Principle and types of aerial photographs, stereoscopy, Map Vs Mosaic, ground control, Parallax measurements for height, determinations.

Remote Sensing – I: Basic concepts and foundation of remote sensing – elements involved in remote sensing, electromagnetic spectrum, remote sensing terminology and units.

UNIT – II

Remote Sensing – II: 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.

UNIT – III

Geographic Information System: Introduction, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS. Types of data representation: 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.

UNIT – IV

GIS Spatial Analysis: Computational Analysis Methods (CAM), Visual Analysis Methods (VAM), Data storage-vector data storage, attribute data storage, overview of the data manipulation and analysis. Integrated analysis of the spatial and attribute data. Water Resources Applications-I: 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

UNIT – V

RS & GIS applications: Transportation Watershed management, Geology, Emergency Management, Agriculture, Land use and Land Cover Mapping.

Text books:

1. Remote Sensing and its applications by LRA Narayana University Press 1999.
2. Principals of Geo Physical Information Systems – Peter A Burragh and Rachael Mc Donnell, Oxford Publishers 2004.

References:

1. Concepts & Techniques of GIS by C.P.Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Remote Sensing and Geographical Information systems by M.Anji Reddy JNTU Hyderabad 2001, B.S.Publications.
3. GIS by Kang – tsung chang, TMH Publications & Co.,
4. Basics of Remote sensing & GIS by S.Kumar, Laxmi Publications.
5. Fundamental of GIS by Mechanical designs John Wiley & So

Course outcomes:

On successful completion of this course, it is expected that the students will be able to,

CO 1: To apply photogrammetry in different aspects in basic remote sensing elements.

CO 2: Analyze the Energy interaction in the atmosphere in earth surface features.

CO 3: Application of GIS data, data representation in various elements like manual digitizing and scanning.

CO 4: Analyze spatial & attribute data for solving spatial problems .

CO 5: Use the RS & GIS applications in various aspects.

CO-PO Mapping:

RS&GIS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	√	√	√	√	√	√		√	√	√	√	√
CO 2	√	√	√	√		√		√	√		√	√
CO 3	√		√	√	√	√		√		√	√	
CO4	√	√	√		√	√			√	√	√	√
CO5	√	√	√	√	√			√	√		√	√

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B.Tech MECHANICAL ENGINEERING	L	T	P	C
	3	0	0	3

(EE721OE) MAINTAINANCE OF ELECTRICAL SYSTEMS
(Open Elective-II)

Course Objectives:

- To comprehend the basics of Engineering Materials. Tools & meters testing.
  Know the UPS and SMPS and Maintenance.
  Know maintenance of batteries, dc & ac motors, transformer and circuit breakers.
  Understand the various Safety Procedures.

UNIT I:

Engineering Materials

Low Resistive Materials – Properties and applications, High Resistive Materials – Properties and applications, Insulating Materials - Properties and Applications, Thermocouple, Soldering.

UNIT II:

Testing of Electrical Domestic Appliances

Tools & meters required for testing and repair of Domestic appliances-Principle, construction & working with fault finding, dismantling, assembling and testing after repair of the Domestic appliances. Open circuit, Short circuit, Earth fault and Leakage tests on Electrical Domestic appliances

UNIT III:

UPS and SMPS

Commercial power supply-Disturbances and Spikes in supply voltages- UPS – SMPS

UNIT IV:

Maintenance of Electrical Power devices

Preventive and periodical maintenance schedule of Batteries (Dry / Wet), UPS / Inverters, DC & AC Motors, Motor starters (AC & DC), Air conditioners, Power transformers, Pole mounted & Plinth mounted transformer yards, Circuit breakers

UNIT V: Safety

Need of safety - Equipment used in Electrical and general safety - Different types of Electrical hazards / accidents - Causes of different Electrical hazards / accidents - Methods to avoid Electrical hazards / accidents - First-Aid methods followed to rescue a person met with Electric shock - Do's & Don't's of Electrical supervisor at Electrical substations - Different fire extinguishers- operation and application of different fire extinguishers.

Text books:

1. B.K.Agarwal , "Introduction to Engineering materials", TATA McGraw-HILL Edition, 1989.
2. K.B.Bhatia , "Study of Electrical Appliances and devices", Khanna publication, 1983.

Reference books:

1. B. L. Theraja, “Electrical Technology Vol I to IV”, S. Chand & Co publishers, 1959.
2. B. V. S. Rao, “Operation & Maintenance of Electrical Machines Vol – I” Media Promoters & Publisher Ltd. Mumbai, 1963.
3. B. V. S. Rao, “Operation & Maintenance off Electrical Machines Vol – II”, Media Promoters & Publisher Ltd. Mumbai, 1967.
4. C.J. Hubert, “Operating, Testing, and Preventive Maintenance of Electrical Power Apparatus” , Pearson; 1 edition, 2002.

Course Outcomes: After completion of this course, the student will be able to

CO 1: Identify the Engineering materials, properties and applications.
CO 2: Test the domestic appliances.
CO 3: Know the use of UPS and SMPS and maintenance of power devices.
CO 4: Understand the maintenance of batteries, ups/inverter, motors and starters.
CO 5: Rescue a person met with Electric shock.

CO-PO Mapping:

PO’S / CO’S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	√	√	√								
CO 2		√	√								√
CO 3			√								
CO 4									√		√
CO 5								√			

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(EE722OE/ EE511PE) RENEWABLE ENERGY SOURCES

(Open Elective-II)

Prerequisite: Nil

Course Objectives:

- Ability to learn the principles of solar radiation and collection of solar energy.
- To introduce the various solar energy storage methods and applications.
- To introduce the wind energy and biomass energy.
- To introduce the geothermal energy and ocean energy.
- To introduce the direct energy conversion devices.

UNIT – I

Principles of Solar Radiation & Solar Energy Collectors

Principles of Solar Radiation: 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.

Solar Energy Collectors: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-II

Solar Energy Storage & Solar Applications

Solar Energy Storage: Different methods, Sensible, latent heat and stratified storage, solar ponds.

Solar Applications: solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT-III

Wind Energy & Bio-Mass

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.

UNIT-IV

Geothermal Energy & Ocean Energy

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.

UNIT-V

Direct Energy Conversion

Need for DEC, Carnot cycle, limitations, principles of DEC. See beck effect, MHD generators.

Text books:

1. G.D. Rai,''Non-Conventional Energy Sources'', Khanna Publishing House, 2011.
2. Ramesh & Kumar,''Renewable Energy Technologies'', Narosa Publishing House, 1997.

Reference books:

1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007.
2. Ashok V Desai,"Non-Conventional Energy", Wiley Eastern Ltd, New Delhi, 2003.
3. K Mittal, "Non-Conventional Energy Systems", Wheeler Publishing Co.,1999.
4. Sukhame, "Solar Energy", Tata McGraw-Hill Education, 3rd edition, 2008.

Course Outcomes:

The student will be able to

CO 1: Learn the principles of solar radiation and collection of solar energy.
CO 2: Understand the various solar energy storage methods and solar applications.
CO 3: Analyze the Wind energy conversion and Biomass energy conversion.
CO 4: Analyze the geothermal energy conversion and ocean energy conversion.
CO 5: Analyze the various direct energy conversion devices.

CO-PO Mapping:

PO'S / CO'S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	√	√							√		√
CO 2	√			√	√			√	√		
CO 3	√			√	√			√	√		
CO 4	√			√	√			√	√		
CO 5	√			√	√				√		

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(ME721OE) FUNDAMENTALS OF REFRIGERATION&AIR CONDITIOING

(OPEN ELECTIVE II)

Prerequisites: NIL

Course Objectives:

1. To impart knowledge on working principle of refrigeration cycle.
2. To understand the principles of refrigeration systems.
3. To impart knowledge on different types of refrigeration systems
4. To impart knowledge on Fundamentals of psychometric.
5. To impart knowledge on Applications of air-conditioning and heat pumps.

UNIT - I

Introduction to Refrigeration: Necessity and Applications, Unit of Refrigeration, COP, Different Refrigeration Methods, Air Refrigeration: Bell-Coleman Cycle, Open and Dense Air Systems - Refrigeration Needs of Air Crafts, Types and application of Air Refrigeration.

UNIT – II

Vapour Compression Refrigeration (VCR) System: Basic cycle- Working principle and essential components of the cycle – COP – Representation of cycle on T-S and p-h charts.

Refrigerants: Desirable Properties – Classification of Refrigerants, Secondary Refrigerants- Ozone Depletion – Global Warming.

UNIT – III

Vapour Absorption Refrigeration (VAR) System: Description and working of NH_3 – water system and Li-Br water system - Calculation of max COP. Principle and operation of Three Fluid absorption refrigeration system.

UNIT – IV

Introduction to Air Conditioning: Psychometric Properties & Processes –Need For Ventilation. Air Conditioning Systems: Air Cooler (Evaporative Cooling), Window, Split, summer, winter, Year Round, Central Air Conditioning Systems.

UNIT V

Human Comfort: Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort Chart. Air Conditioning Equipment: Humidifiers, Dehumidifiers, Air Filters, Fans and Blowers.

Text books:

1. Refrigeration and Air Conditioning-CP Arora-TMH.
2. A Course in Refrigeration and Air conditioning-SC Arora & Domkundwar-Dhanpatrai
3. Refrigeration and Air Conditioning-Manohar Prasad-New Age.

References:

1. Principles of Refrigeration – Dossat-Pearson Education.
2. Refrigeration and Air Conditioning - P.L. Ballaney
3. Basic Refrigeration and Air Conditioning –P.N. Ananthanarayanan-TMH.

NOTE: Tables/Codes: Thermal Engineering Data Book containing Refrigerant and Psychometric Property Tables and charts are permitted in Exam.

Course Outcomes:

At the end of the course, the student should be able to

CO1: Ability to understand various refrigeration systems.

CO2: Ability to understand the operation of various devices of VCR system.

CO3: Ability to demonstrate the working of refrigeration equipments.

CO4: Ability to understand various psychometric processes.

CO5: Ability to explain the air-conditioning equipment.

CO-PO Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√			√						
CO 2	√	√	√			√		√			√
CO 3	√		√		√				√		
CO 4	√	√							√		√
CO 5	√		√		√						

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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(ME722OE/ME851PE) INDUSTRIAL ROBOTICS

OPEN ELECTIVE II

Pre-requisites: Basic principles of Kinematics and mechanics.

Course Objective:

1. To learn the concepts of Robotics. Understand the basic components of robots.
2. Model forward and inverse kinematics of robot manipulators.
3. Analyze forces in links and joints of a robot.
4. Programme a robot to perform tasks in industrial applications
5. Design intelligent robots using sensors.

UNIT – I

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.

UNIT – II

Motion Analysis: Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.

Manipulator Kinematics: D-H notations – joint coordinates and world coordinates – Forward and inverse kinematics – problems.

UNIT – III

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.

UNIT – IV

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: Actuators- Pneumatic and Hydraulic actuators, Electric Actuators: DC servo motors – stepper motors.

UNIT – V

Feed Back Components: position sensors – potentiometers, resolvers and encoders – velocity sensors – Tactile sensors.

Robot Application In Manufacturing: Material Transfer and loading/unloading Material handling – Assembly and inspection.

Text books:

1. Industrial Robotics-Groover M.P -Pearson Edu.
2. Introduction to Robotic Mechanics and control by JJ Craig, Pearson, 3rd edition.

References:

1. Robotics - Fu K.S-McGraw Hill.
2. Robotic Engineering -Richard D. Klafter, Prentice Hall
3. Robot Analysis and intelligence -Asada and Slotine -Wiley inter Science.
4. Robot Dynamics & Control – Mark W. Spong and M.Vidyasagar -John Wiley & sons (ASIA) Pvt. Ltd...
5. Robotics and control -Mittal R.K & Nagrath I.J -TMH.

Course Outcomes:

CO1: At the end of the course, the student will be able to understand the basic components of Robots and differentiate types of robots and robot grippers.
CO2: Model forward and inverse kinematics of robot manipulators.
CO3: Analyze forces in links and joints of a robot.
CO4: Programme a robot to perform tasks in industrial applications.
CO5: Design intelligent robots using sensors.

CO-PO Mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1					√						√
CO 2					√						√
CO 3					√			√			√
CO 4				√				√			√
CO 5			√					√			

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	3	**0**	**0**	**3**

EC721OE: PRINCIPLES OF SIGNAL PROCESSING

(OPEN ELECTIVE-II)

Course Objectives:

1. To understand Fourier, transform and z-transform analysis on signals and systems
2. To analyze and process signals using various transform techniques
3. To understand various factors involved in design of digital filters
4. To understand the IIR digital filter design
5. To understand the FIR digital filter design

UNIT I

Fourier Transform: Fourier transform and relation between Fourier series and Fourier transform (F.T), Properties of Fourier Transform, Conditions for existence of F.T, Linear system, Impulse response, Response of a linear system, Linear time invariant (LTI) system, Transfer function of a LTI system, Filter characteristics of linear systems, Distortion less transmission through a system, Physical Realizability of LTI systems

Z-Transform (Z.T): Concept of Z.T, Properties of Z-Transform, Region of Convergence, Inverse Z-Transform, Solution to difference equations, Relation between F.T, L.T and Z.T, Problems.

UNIT II:

Discrete Time Fourier Transform

Discrete Time (DT) signals and sequences, Properties of DT LTI system- Linearity, Time invariance, Stability, Causality, Memoryless, Linear Constant Coefficient Difference Equations and its solution, Concept of Discrete Time Fourier Transform (DTFT), Frequency domain representation of discrete time signals and systems, Properties of DTFT, Problems.

UNIT III

Discrete Fourier representation

Discrete Fourier Series (DFS): DFS representation of periodic sequences, Properties, Problems Discrete Fourier Transform (DFT): Discrete Fourier Transform, Properties of DFT, Linear convolution of sequences using DFT, Computation of DFT, Relation between DTFT, DFS, Z.T and DFT, Problems, computation of DFT using FFT-DIT, Inverse FFT

UNIT IV

IIR Digital Filters: Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from Analog filters- Impulse Invariance and Bilinear Transformation techniques, Design Examples, Realization of IIR filters in Direct, Canonic forms

UNIT V

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency response, Design of FIR Digital Filters - Fourier method, Window Techniques (using rectangular, Hanning and Hamming windows) Frequency Sampling technique, Comparison of IIR & FIR filters, Realization of FIR filters in Direct, Canonic forms

Text books:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2009.
2. Digital Time Signal Processing – A. V. Oppenheim and R. W. Schaffer, J. R. Buck, Pearson Education, 2009
3. Fundaments of Digital Signal Processing – Loney Ludeman, John Wiley, 2010

References:

1. Signals and Systems - A.V. Oppenheim, A.S. Wilsky and S.H. Nawab, PHI, 2nd Edn, 2008
2. Digital Signal Processing – S.Salivahan, A. Vallavaraj and C.GnanaPriya, TMH, 2008
   3. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
3. Digital Signal Processing – Fundaments and Applications – Li Tan, Elsevier, 2008
4. Digital Signal Processing – A Practical Approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education, 2009.

Course Outcomes:

1. Perform Fourier transform and Z transform analysis on signals and systems
2. Understanding the inter-relationship between DFT and various transforms
3. Understand the Discrete Fourier series and various transforms
4. Ability to design various IIR digital filter structures
5. Ability to design a digital FIR filter for a given specification

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	H	M		H				M				
CO2	H	M		H					L			M
CO3	H	H	M		L					H		L
CO4	H	H				M		L				M
CO5	M	M	H	M								

H-HIGH **M-MEDIUM** **L-LOW**

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

EC623PE/EC722OE: NANO MATERIALS AND TECHNOLOGY

(OPEN ELECTIVE- II)

Course Objectives

1. This Course is intended to cover the basics of Nano Materials and Technology.
2. To know the scaling of the devices to smaller and smaller sizes which has provided the basis for growth.
3. To understand the physical and technological processes for Nano devices.
4. Describe tools for properties of nanostructures.
5. To know the knowledge about nanostructure devices.

UNIT I: Nanotechnology Origin of Nanotechnology, Nano Scale, Surface to Volume Ratio, Quantum Confinement, Bottom-up Fabrication: Sol-Gel, Precipitation, Combustion Methods; Top-Down Fabrication: Chemical Vapor Deposition, Physical Vapor Deposition.

UNIT II: Nano Materials Semiconductors, Crystal lattices: bonding in crystals, Electron energy bonds, Semiconductor heterostructures, Lattice-matched and pseudomorphic hetero-structures, Organic semiconductors, Carbon Nano materials: Nano Tubes and fullerenes.

UNIT III: Nanostructures Bulk crystal and hetero-structure growth, Nanolithography, etching and other means for fabrication of Nanostructures and Nano devices, Techniques for characterization of Nanostructures, spontaneous formation and ordering of nanostructures, Clusters and Nano crystals, Methods of Nano tube growth, Chemical and biological methods for Nano scale fabrication, Fabrication of Nano electro-mechanical systems.

UNIT IV: Electron transport in semiconductors and nanostructures Time and length scales of the electrons in solids, Statistics of the electrons in solids and nanostructure, density of states of electrons in nanostructures, Electron transport in nanostructures, Electrons in quantum - wells, wires and dots.

UNIT V: Nanostructure devices Resonant-tunneling diode, Field-effect transistors, Single-electron-transfer devices, Potential-effect transistors, Light-emitting diodes and lasers, Nano-electro-mechanical system devices, Quantum-dot cellular automata.

Text Books:

1. Introduction to Nano electronics: Science, Nanotechnology, Engineering and Applications, Vladimir V, Mitin, Viatcheslav A. Kochelap and Michael A. Stroscio, Cambridge University Press.

References:

1. Fundamentals of Nano electronics by George W Hanson, Pearson Publications, 2008.
2. Introduction to Nanotechnology by Charles P Poole Jr and Frank J Owens Wiley.

Course Outcomes

After completion of the course the student will be able to

1. Understand the basic concepts of Nano technology.
2. Understand the basic concepts of Nano materials
3. Familiar with fabrication process of Nano Technology.
4. Known the scaling and role of electrons in solids and Nanostructures.
5. Understand the structures of Nan devices.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	M		H						M			L
CO2		M				H				H		
CO3	H	M		M			H				L	H
CO4			H						M		M	
CO5	L					M						H

H-HIGH **M-MEDIUM** **L-LOW**

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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(CS603PC/CS721OE) OBJECT ORIENTED ANALYSIS AND DESIGN

(OPEN ELECTIVE-II)

Prerequisites: Software Engineering

Course Objectives:

- Object oriented Analysis and Design using UML present the concepts and techniques necessary to effectively use system requirements to drive the development of a robust design model.
- To acquire UML, a common language for talking about requirements, designs, and component interfaces. Model a real-world application by using a UML class diagram.
- Showing how we apply the process of object oriented analysis and design to software development.
- Pointing out the importance and function of each UML model to the process of object oriented analysis and design, and explaining the notation of various elements in these models.

UNIT-I:

Introduction to UML: Importance of modeling, principles of modeling, object oriented Modeling, conceptual model of the UML, Architecture, Software Development Life Cycle.

Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams.

UNIT– II:

Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages

Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams. Design class diagram for Library information system.

UNIT– III:

Basic Behavioral Modeling-I: Interactions, Interaction diagrams.

Basic Behavioral Modeling-II: Use cases, Use case Diagrams, Activity Diagrams. Design Use cases, Use case diagrams, Interaction diagram and Activity diagram for library system.

UNIT– IV:

Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams. Design State machine for different objects in library system.

UNIT– V:

Architectural Modelling: Component, Deployment, Component diagram and Deployment diagrams. Design and document of library system

Case Study: Online Reservation System using all models of UML.

Text Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, The Unified Modelling Language User Guide, 7th Impression, Pearson Education, 2008.

Reference Books:

1. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, UML2 Toolkit, 2nd Edition, WILEY- DreamTech India Pvt. Ltd.,2012.
2. Meilir Page-Jones, Fundamentals of Object Oriented Design in UML, Illustrated Edition, Pearson Education,2000.
3. Pascal Roques, Modeling Software Systems Using UML2, 1st edition, WILEY-DreamTech India Pvt. Ltd.,2011.
4. Atul Kahate, Object Oriented Analysis & Design, 1st Edition, The McGraw-Hill Companies,2007.
5. Mark Priestley, Practical Object-Oriented Design with UML, 2nd Edition, TATA McGrawHill,2005.

Course Outcomes:

Upon the successful completion of this course, the student will be able to:

1. Demonstrate the concepts and principles of object oriented programming.
2. Understand the purposes, major components and key mechanisms of Class and Object Diagram.
3. Describe the basic resource management responsibilities of Interaction Diagram.
4. Knowledge on State-chart Diagram.
5. Applying the techniques for Component and Deployment Diagrams.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓	✓	✓	✓			✓					
CO 2	✓	✓	✓				✓	✓				
CO 3	✓	✓	✓				✓					✓
CO 4	✓	✓	✓				✓					
CO 5	✓	✓		✓			✓	✓			✓	✓

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(CS722OE/CS862PE) CYBER FORENSICS

(OPEN ELECTIVE-II)

Prerequisites: Computer Networks, Operating Systems

Course Objectives:

- To provide the Fundamentals of Computer Forensic and Types in technology.
- To understand collection of Evidence and data seizure.
- To understand data validation and analytics in network forensics.
- To impart knowledge about current computer forensic tools.
- To Understand whole disk encryption, windows registry and virtual systems.

UNIT- I:

Computer Forensics Fundamentals: What is Computer Forensics? Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists

Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement, Computer Forensic Technology, Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution.

UNIT - II:

Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence General Procedure, Collection and Archiving, Methods of Collection, Artifacts Collection Steps,

Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.

UNIT - III:

Computer Forensics analysis and validation: Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions

Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honey net project.

Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case

UNIT -IV:

Current Computer Forensic tools: evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail

Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.

Cell phone and mobile device forensics: Understanding mobile device forensics, understanding135acquisition procedures for cell phones and mobile devices.

UNIT -V:

Working with Windows and DOS Systems: understanding file systems, exploring Microsoft File Structures, Examining NTFS disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS startup tasks, virtual machines

Text Books:

1. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
2. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning

Reference Books:

1. Real Digital Forensics by Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Addison-Wesley Pearson Education
2. Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brian Jenkinson, Springer International edition.
3. Computer Evidence Collection & Presentation by Christopher L.T. Brown, FirewallMedia.
4. Homeland Security, Techniques & Technologies by Jesus Mena, Firewall Media.
5. Software Forensics Collecting Evidence from the Scene of a Digital Crime by RobertM.Slade, TMH 2005
6. Windows Forensics by Chad Steel, Wiley India Edition.

Course Outcomes:

Upon the successful completion of this course, the student will be able to:

1. Understand the fundamentals of computer forensics and various forensic technologies used for a wide variety of investigations.
2. Apply digital evidence controls.
3. Identify current practices for processing crime and incident scenes.
4. Apply various computer forensics tools to solve the computer forensic cases.
5. Understand whole disk encryption, windows registry and virtual systems.

Co-Po mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1					✓							
CO 2		✓		✓								✓
CO 3										✓		
CO 4		✓		✓	✓							✓
CO 5											✓	

OPEN ELECTIVE III

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B.Tech MECHANICAL ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

CE831OE PROJECT MANAGEMENT
(OPEN ELECTIVE-III)

Course objectives:

1. To understand the concept of construction technology activities & their documents.
2. To study about mechanized constructions &equipments.
3. To know about the quality control, assurance and safety.
4. To know the importance of contract management & project estimations.
5. To understand project scheduling and their relevant documents.

UNIT-I

Fundamentals of construction technology- Construction activities – Process – Construction schedule – Construction records – Documents – Quality – Safety – Codes and regulations. Construction method – Earthwork – Piling – Concrete and concreting – Form work – Fabrication and erection.

UNIT-II

Mechanized construction – Construction equipment – Equipment economics – Excavators – Rollers – Dozers – Scrapers – Handling equipment – Concrete equipment – Handling equipment – Cranes Draglines and Clamshells.

UNIT-III

Quality control – Assurance and safety – ISO-900 Quality systems – Principles on safety – Personnel, Fire and Safety – Environment protection – Concept of green building.

UNIT-IV

Contract management – Project estimation – Project estimation – Contract document – Classification – Bidding – Procurement process. Construction planning – Project planning techniques – Planning of man power – Material, Equipment and Finance.

UNIT-V

Project scheduling – PERT – CPM, Resource leveling, Construction claims, Dispute and Project closure – Source of claim – Claim management – Dispute resolution – Arbitration – Construction closure – Contract closure – Documentation.

Text book:

1. Construction Technology by subir k Sarkar, Subhajit Saraswati-Oxford University Press 2009
2. Construction Project Management – Theory and practice, Nirajjha Pearson Education 2010.

References:

1. Construction planning, Equipment and Methods by Peurifacy. Schexnayder Shapira TMH, 2010.

Course outcomes:
After successfully completion of this course, the student will be able to

CO 1: Handle the Project work with Proper Planning Scheduling including construction methods.

CO 2: Use the mechanized construction equipment at different situations or any huge projects.

CO 3: Have the knowledge of ISC -9000 Quality systems and environmental protection.

CO 4: To classify the contact management, estimation and project planning techniques

CO 5: Use the CPM – PERT Problems in project scheduling

Co-Po mapping:

PM	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	√	√	√	√	√	√		√	√	√	√	√
CO 2	√	√	√	√	√	√		√	√		√	√
CO 3	√	√	√	√	√	√		√	√	√	√	√
CO4	√	√	√	√	√	√		√	√	√	√	√
CO5	√	√	√	√	√	√		√	√		√	√

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

B.Tech IV Year II-Semester

L	T	P	C
3	0	0	3

CE832OE SAFETY ENGINEERING
(OPEN ELECTIVE-III)

Course objectives:

1. To impart the Knowledge of Handling and Protecting the Machine and himself
2. To educate the Knowledge of lifting and carrying the materials and also Maintenance mechanical material handling equipment
3. To provide the knowledge of safety rules and regulations of working at Construction industry
4. To impart the knowledge about working at all stages in different heights at construction site
5. To provide the knowledge of different types of noise and vibration, its causes, Effects and controlling measures.

UNIT-I

MACHINE OPEATION AND GUARDING Principles in machine guarding - Ergonomics of machine guarding - Type of guards, their design and selection - Guarding of different types of machinery including special precautions for wood working, paper, rubber and printing machinery, machine, tools etc. - Built-in safety devices, maintenance and repairs of guard's incidental safety devices and tools

UNIT-II

MATERIAL HANDLING AND STORAGE OF MATERIALS MANUAL: Kinetics of manual material handling, maximum loads that could be carried. Lifting and carrying of objects of different shapes, size and weight. Safe use of accessories for manual handling storage of materials. Safety in stacking and un-stacking, floor loading conditions. Lay-out conditions for safety in storage, Ergonomics of manual handling and storage. Mechanical: Lifting machinery, Lifts and Hoists; Safety aspects in design and construction, testing, use and care, signaling, inspection and maintenance. Safety in design and construction, operation, inspection and maintenance of industrial trucks, lifting tackles and loose gears, conveyors. Safety features, safe locations, testing, inspection and maintenance of lifting tackles, safe working load for all mechanical material handling equipment.

UNIT-III

CONSTRUCTION INDUSTRY Basic Philosophy peculiarities and parameters governing the safety in construction such as site planning and layout, safe access, good housekeeping, safety in the use of construction machinery, signs and indication liaison for safety with local authorities, structural soundness accident and hazards their cause and effects

UNIT IV

WORKING AT HEIGTS: Working at heights: Incidence of accidents. Safety features associated with design construction and use of stairways, ramps, working platforms, gangways, ladders of different types, and scaffolds of different types including Boatswain's chair and safety harness, working on roofs other safety requirements while working at heights. Working in Confined Spaces Working Underground

UNIT V

NOISE AND VIBRATION Continuous and impulse noise - The effect of noise on man - Measurement and evaluation of noise - Noise isolation - Noise absorption techniques, Silencers - Practical aspect of control of noise - Vibration: Effects, measurement and control measures such as vibration damping.

Text books:

1. Industrial safety management By: L.M. Deshmukh Publishers: Tata Megraw Hill ,New Delhi Year: 2006 Edition: First

References:

1. Industrial safety health and environment Management system By: R.K. Jain & Sunil S. Rao Publishers: Khanna Publishers Year: 2008 Edition: Second

Course outcomes:

After successfully completion of this course, the student will be able to

CO 1: Know how to Handle and Protect the Machine and himself while working on it

CO 2: Know the Knowledge of lifting and carrying the materials and also maintenance of mechanical material handling equipment

CO 3: Understand the knowledge of safety rules and regulations of working at construction industry

CO 4: Understand the knowledge about working at all stages in different heights at construction site

CO 5: Know the knowledge of different types of noise and vibration, its causes, effects and controlling measures

Co-Po mapping:

SE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	√		√			√	√	√	√	√	√	
CO 2	√		√	√		√	√	√	√	√	√	
CO 3	√		√	√		√	√	√	√	√	√	√
CO4	√	√	√			√	√	√	√	√	√	√
CO5	√	√	√	√		√	√	√	√	√	√	

ANURAG ENGINEERING COLLEGE

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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(EE831OE) ELECTRICAL ENGINEERING MATERIALS

(Open Elective-III)

Course Objectives:

- To understand the importance of various materials used in electrical engineering.
- To understand the property and importance of insulating and dielectric materials.
- To analyze semiconducting.
- To analyze magnetic materials and their behavior.
- To evaluate semiconductor materials and special purpose materials.

UNIT-I

Introduction to Electrical Engineering Materials

Band theory, classification of electrical materials, characteristics of electrical materials

Conducting Materials

Properties of conducting materials, types of conducting materials- copper, aluminum and silver, material used for special purpose like fuse, filaments, circuit breaker contacts, thermocouples materials, bimetals, soldering materials, materials used for instrumentation system.

UNIT-II

Insulating and Dielectric Materials

General property of insulating materials, polarization, dielectric constant, permittivity, surface resistivity and volume resistivity, dielectric strengths, puncture, flashover, types of insulating materials, classification of insulating material according to operating temperature, piezoelectric materials, ceramics: properties and application.

UNIT-III

Semiconducting Materials

Introduction to semiconductor physics, properties of semiconductor materials, silicon and germanium, intrinsic and extrinsic semiconductor, doping, hall effect, diffusion drift phenomenon, special semiconductors.

UNIT-IV

Magnetic Materials

Classification of magnetic material (Diamagnetic ferromagnetic, ferrite, paramagnetic material), soft and hard magnetic material, characteristics of magnetic material, properties of magnetic material (magnetization, permeability, coercivity, retentivity), B-H curve, Hysteresis phenomenon, iron loss, types, methods for reducing iron loss.

UNIT-V

Super Conducting Materials

Concepts of super conducting materials, types of super conducting materials, application of super conducting materials in electrical machines, power cables, electromagnets and future prospects.

Special Purpose Materials

Introduction and electrical applications of carbon nanotubes, electrical applications of SiC based devices.

Text books:

1. R K Rajput, “A course in Electrical Engineering Materials”, Laxmi Publications, 2009.
2. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009.

Reference books:

1. TTTI Madras, “Electrical Engineering Materials” McGraw Hill Education, First edition, 2004.
2. Adrianus J.Dekker, “Electrical Engineering Materials”, Prentice-Hall Publication, 1959.

Course Outcomes: After completion of this course, student will be able to

CO 1: Understand various types of dielectric materials, their properties in various conditions.
CO 2: Understand the properties and importance of insulating and dielectric medium.
CO 3: Evaluate magnetic materials and their behavior.
CO 4: Evaluate semiconductor materials and technologies.
CO 5: Know the materials used in electrical engineering and applications.

CO-PO Mapping:

PO’S / CO’S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	√			√				√			
CO 2	√			√				√			
CO 3	√	√		√				√	√		
CO 4	√	√	√	√	√				√		√
CO 5	√	√	√	√	√	√			√		√

ANURAG ENGINEERING COLLEGE
(An Autonomous Institution)

B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(EE832OE) FUZZY LOGIC AND ITS APPLICATIONS
(Open Elective-III)

Course Objectives:

- This course introduces the basics of fuzzy logic
- This course deals with classical and fuzzy relations
- This course introduces classical and fuzzy propositional logic
- This course deals with membership functions of fuzzy logic
- This course deals with the fuzzification

UNIT-1

Classical Sets and Fuzzy Sets

Classical Sets - Operations and Properties, function Mapping of Classical Sets.
Fuzzy Sets - Operations and Properties.

UNIT-2

Classical Relations and Fuzzy Relations

Cartesian product. Crisp Relations- Cardinality, Operations, Properties, Composition of relations. Fuzzy Relations - Cardinality, Operations, Properties, Composition of relations. Fuzzy Cartesian product.

UNIT-3

Classical Logic and Fuzzy Logic

Classical Propositions Logic – Tautologies, Laws, inference. Classical Predicate logic-interpretations, inference. Fuzzy Propositional Logic.

UNIT-4

Membership Functions

Features of membership functions, Methods of membership value assignments-Intuition, Inference, Rank ordering, Angular Fuzzy sets. Fuzzification.

UNIT-5

Defuzzification and Applications

Defuzzification: Methods-Max-membership principle, centroid, weighted average, mean-max membership, center of sums, center of largest area. Fuzzy inference system.
Applications: Greg Voit's Fuzzy Cruise Controller, Air Conditioner Controller.

Text books:

1. TimothyJ.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, International edition,1997
2. S.N.Sivanandam and S.N.Deepa, "Principles of soft computing", Wiley ,2nd edition, 2018 reprint.

Reference books:

1. Rajasekharan and G A Vijayalaxmipai Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications",PHI Publication, 2010.
2. Bart Kosko, "Neural Networks and Fuzzy Logic System", PHI Publications, 2003.

Course Outcomes: After going through this course, the student can be able to understand

CO 1: Operation and properties of crisp and fuzzy logic.
CO 2: Operation and properties of crisp relations and fuzzy relations.
CO 3: Laws and inference of classical propositional, predicate and fuzzy propositional logic.
CO 4: Membership value assignment.
CO 5: Methods of defuzzification and fuzzy rule based system.

CO-PO Mapping:

PO'S / CO'S	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	√										
CO 2	√			√							
CO 3	√	√		√	√			√	√	√	
CO 4	√			√	√				√		√
CO 5	√	√		√	√				√		√

ANURAG ENGINEERING COLLEGE

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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(ME731PE/ME831OE) POWER PLANT ENGINEERING

OPEN ELECTIVE III

Pre-requisite: Thermal engineering- I & II.

Course Objectives:

1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle Power plants.
2. Fundamental concepts of diesel power plant and gas turbine power plant.
3. To study hydrological cycle, hydrographs, hydro power plant and projects.
4. A working knowledge of the basic design principles of nuclear, wind, tidal, solar, and alternate Power plants.
5. Awareness of the economic, environmental, and regulatory issues related to power generation.

UNIT – I

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 draught system, cyclone furnace design and construction, Dust collectors, Electrostatic precipitators, cooling towers and heat rejection, corrosion and feed water treatment.

UNIT – II

Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage

Gas Turbine Plant: Introduction – Classification - Construction – Layout with Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

UNIT III

Hydro Electric Power Plant: Water power – Hydrological cycle – Hydrographs – storage and Pondage –construction of Hydrograph, Load duration curves -classification of dams and spill ways.

Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation and pumped storage plants.

UNIT – IV

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, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

Power from Non-Conventional Sources: Utilization of solar – Collectors – Principle of working, Wind energy – Types – HAWT, VAWT – Tidal energy.

UNIT – V

Direct energy conversion: solar energy, Fuel cells, Thermo electric and thermo ionic, MHD generation.

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 numerical exercises, Effluents from power plants and impact on environment – pollutants and pollution standards – Methods of Power plant Pollution control.

Text books:

1. Power Plant Engineering – P.C.Sharma -S.K.Kataria Publications.
2. A Course in Power Plant Engineering: Arora and S.Domkundwar.

References:

1. A Text book of Power Plant Engineering -R.K. Rajput-Laxmi Publications
2. Power plant Engineering-S. Ram lingam-Scietech Publishers.
3. Power Plant Engineering: P.K.Nag -2nd Edition-TMH.
4. An introduction to Power Plant Technology-G.D. Rai.
5. Power plant Engg – Elanchezhian – I.K international Publications.

Course Outcomes:

CO1: Understand the principle of various sources of energy, resources and development of Power.

CO2: To know the concept of internal combustion engine and gas turbine power plant.

CO3: To know the concept of hydroelectric power plant.

CO4: To know the concept of nuclear power stations and non-conventional power sources.

CO5: Understand the power plant economics and environmental considerations.

Co-Po mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√					√			√		
CO 2	√		√					√			
CO 3	√		√					√			
CO 4	√		√						√		
CO 5	√		√					√			

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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(ME622PE/ME832OE) NANO TECHNOLOGY

OPEN ELECTIVE III

Pre-requisites: Engineering physics, chemistry and Material science.

Course Objectives:

1. To understand fundamentals of Nano materials and technologies.
2. To get knowledge about carbon nano tubes and structures.
3. To understand the Characterization Techniques of nano scale.
4. To explore the Nano and Molecular Electronics.
5. To get knowledge on heat transfer in nano fluids.

UNIT – I

Introduction to Nanotechnology: Importance of Nano Scale, Nanostructure Types, Electronic, Magnetic, Optical Properties of Nano Materials, Top-Down and Bottom – Up Approach to Nanostructures.

UNIT – II

Carbon Nano Structures: Carbon Nano Tubes (CNT), Fullerenes, C60, C80 and C240 Nanostructures, Properties (Mechanical, Optical and Electrical) and Applications.

Fabrication Of Nano Materials: Physical Methods; Inert Gas Condensation, Arc Discharge, Rf Plasma, Plasma Arc Technique, Ion Sputtering, Laser Ablation, Laser Pyrolysis, Molecular Beam Epitaxy, Chemical Vapour Deposition Method.

UNIT – III

Nano Scale Characterization Techniques: Scanning Probe Techniques (AFM, MFM, STM, SEM, TEM & XRD).

Nano devices and Nano medicine: Lab On Chip For Bio analysis, Core / Shell Nanoparticles In Drug Delivery Systems (Site Specific And Targeted Drug Delivery), Cancer Treatment, And Bone Tissue Treatment.

UNIT- IV

Nano And Molecular Electronics: Resonant – Tunneling Structures, Single Electron Tunneling, Single Electron Transistors, Coulomb Blockade, Giant Magneto Resistance, Tunneling Magneto Resistance.

UNIT – V

Properties of Nano fluids: Scientific and Engineering Significance - Possible Mechanisms of Thermal Conduction Enhancement. Convective Heat Transfer in Nano fluids - Thermo physical Properties of Nano fluids - Heat Transfer Coefficients in Laminar Flow - Heat Transfer Coefficients in Turbulent Flow.

Text Books:

1. Charles.P.Pode, Introduction To Nanotechnology, Springer Publications.
2. Heat Transfer Enhancement with Nan fluids, Vincenzo Bianco, Oronzio Manca,Sergio Nardini, Kambiz Vafai CRC Press
3. Taylor & Francis Group Springer Handbook Of Nanotechnology – Bharat Bhusan

Reference Books:

4. Phani Kumar, Principles Of Nanotechnology, Scitech Publications.
5. David Ferry " Transport In Nano Structures" Cambridge University Press 2000
6. Nanobiotechnology; Ed. C.M.Niemeyer, C.A. Mirkin.
7. Nanofabrication Towards Biomedical Application, Techniques, Tools, Application And Impact – Ed. Challa S.S.R.Kumar, J.H.Carola.

Course Outcomes:

CO1: Apply engineering and physics concepts to the nano-scale and non-continuum domain.
CO2: Understand Carbon Nano Tubes structures and manufacturing process.
CO3: Understand characterization techniques through various measurements to study electrical, mechanical, thermal properties of nano materials.
CO4: Understand the principles and microelectronics fabrication.
CO5: Understand the concept of Convective Heat Transfer in Nanofluids.

Co-Po mapping:

PO'S / CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	√	√									
CO 2	√		√		√						
CO 3	√	√			√						
CO 4	√	√	√								
CO 5	√	√							√		

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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

EC733PE/EC832OE: BIOMETRIC SYSTEMS

(OPEN ELECTIVE-III)

Course Objectives:

For Biometric system, the course will enable the students:

1. To introduce the principles of biometric authentication
2. To study those biometric characteristics which have commercial implementations, as well as emerging techniques, discussing hopes and fears related to the presented modalities.
3. To show how to apply statistics for biometric reliability evaluation
4. To understand the classification and Methods for assessing progress in Face Recognition.
5. To understand the Features and Models of Biometric System Integration.

UNIT -I:

Biometric Fundamentals: Key Biometric terms and Processes – Definitions-verification and identification – matching, Accuracy in Biometric Systems – False match rate - False non match rate - Failure to enroll rate – Derived metrics - An Introduction to Biometric Authentication Systems- a taxonomy of application environment, a system model, biometrics and privacy.

UNIT -II:

Fingerprint Identification Technology:

History, Components, Application of Fingerprints, The Technology- Finger Scan Strengths and Weaknesses, Criminal Applications, Civil Applications, Commercial Applications, Technology Evaluation of Fingerprint Verification Algorithms.

UNIT -III:

IRIS Recognition:

Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses, System Performance, Future Directions.

UNIT -IV:

Face Recognition:

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition-Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

UNIT -V:

Voice Scan:

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.

Text books:

1. James Wayman & Anil Jain, Biometric Systems – Technology, Design and Performance Evaluation, Springer-verlag London Ltd, USA, 2005

2. Sanir Nanavati, Michael Thieme, Biometrics Identity Verification in a Networked world, Wiley Computer Publishing Ltd, New Delhi, 2003.

Reference books:

1. John D. Woodword Jr., Biometrics, Dreamtech Press, New Delhi, 2003.

Course Outcomes:

At the end of the course students should be able to:

1. Understand differences between a biometric method and a biometric system.
2. Organize and conduct biometric data collection processes.
3. Understand the concepts of IRIS recognition.
4. Understand the concepts of FACE recognition.
5. Understand how to use biometric databases in system evaluation.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	L	H					H			H		L
CO2	M			L	M	L			M		M	
CO3	M		L				M	L		M	M	L
CO4	H		M		M							
CO5		H			L				H			H

H-HIGH **M-MEDIUM** **L-LOW**

ANURAG ENGINEERING COLLEGE
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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(EC831OE) FUNDAMENTALS OF EMBEDDED SYSTEMS
(OPEN ELECTIVE-III)

Course Objectives:

In this course it is aimed to introduce to the students with

1. To understand the basics of an embedded system with its application area for implementation, components required for the development of embedded systems.
2. To have knowledge about the basic working of a microcontroller system and its programming in assembly language
3. To interpret the different development languages for designing an Embedded System application,
4. To understand the RTOS based embedded system design concepts and tools.
5. Ability to understand the role of embedded systems in industry

UNIT-I

Introduction to Embedded Systems: Embedded Systems- Definition- Embedded Systems Vs General Computing-Systems – Evolution – Classification - Application Areas – Purpose – Characteristics - Quality Attributes.

UNIT-II

Typical Embedded System: Core of the Embedded System: General Purpose - Domain Specific Processors – ASICs - PLDs, Commercial Off The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection - Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT-III

Embedded Firmware: Embedded Firmware Design Approaches and Development Languages, Software, Getting Embedded Software into Target System, Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An example System.

UNIT-IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing - Multitasking, Semaphores, Task Scheduling, Choose an RTOS - example RTOS like µC-OS (open source) - Embedded software Development Tools for Host and Target Machines.

UNIT-V

Distributed Embedded System Design: Distributed Embedded system - Embedded networking-RS 232 - RS485 - Inter-Integrated Circuit (I^2C) - Serial Peripheral Interface (SPI) - Universal Serial Bus (USB) - Controller Area Network (CAN)- Ethernet.

Textbooks:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.
2. An Embedded Software Primer - Davia E. Simon, Pearson Education
3. Computer as Components-Principles of Embedded Computing system Design, Wayne Wolf, Elsevier(2nd Edition)

References:

1. Embedded Systems - Raj. Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems - Lyla, Pearson, 2013

Course Outcomes

At the end of the course the student should be able to

1. Summarize the different development tool for embedded system, features of advanced buses for distributed data transfer in system design.
2. Develop the different processors on hardware and software for the development of embedded system design.
3. Contrast the basics of embedded system Firmware.
4. Implement the concepts of RTOS in real time programming
5. Understand the development of distributed embedded system design.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	M	L	L			L						
CO2	M		M	L		L	L					L
CO3	M		H	L	L	M	L				L	L
CO4	L		H	L	L	M	L					L
CO5	L		M	L	L	L						L

H-HIGH **M-MEDIUM** **L-LOW**

ANURAG ENGINEERING COLLEGE
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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(CS853PE/CS831OE) SOFTWARE PROJECT MANAGEMENT
(OPEN ELECTIVE-III)

Prerequisites: Software Engineering.

Course Objectives:

- A basic knowledge of software project management principles.
- The ability to come up with a project schedule and assign resources.
- Choose an appropriate project development methodology (e.g. waterfall, spiral …).
- Identify project risks, monitor and track project deadlines

UNIT- I:

Introduction to software project management: Introduction, importance of software project management, Categorization of software project, problems, setting of objectives, stakeholders, the business case, management control.

Stepwise overview of project planning: Introduction, selection of projects, objectives infrastructure, products and activities, activity risks. Analysis of project characteristics, estimation of effort for each activity, allocation of resources, review/publicize plan/execute plan.

UNIT - II:

Program management and project evaluation: program management, management of allocation of resources within a program, strategic program management, creating a program management, aids to program management, benefits, evaluation of individual project's, technical assessment, cost benefit analysis, evaluation techniques, cash flow forecasting.

Selection of an appropriate project approach: choosing technologies, technical plan content list, and dynamic system development method.

UNIT - III:

Software effort estimation: applications and its problems, the basis of software estimation. Software effort estimation techniques.

Activity Planning: objectives, plan, project schedules, projects and activities (sequencing and scheduling) network planning models, formulating the network models, far ward and backward pass, identifying the critical path, activity float.

UNIT - IV:

Risk Management: framework (identification, assessment, planning, and management), evaluating risks to the schedule, applying the PERT techniques, Monte carol simulation, and critical chain concepts.

Resource Allocation: Nature, identifying requirements, scheduling, creating critical paths, Counting costs, publishing, cost schedule, scheduling sequence.

UNIT - V:

Monitoring and control: creating framework, collecting data, visualizing progress, cost monitoring, earned value analysis, prioritizing monitoring, and change control.

Managing contracts: ISO 12207 approach, supply process, types, stages, typical terms of a contract, contract management, acceptance.

Text Books:

1. Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw- Hill, 4th Edition.
2. Newtown Square A Guide To The Project Management Body Of Knowledge (PMBOKGuide)., Pa. : Project Management Institute, Inc., 2004. Print.

Reference Books:

1. Walker Royce, Software Project Management: Pearson Education, 2005.
2. Joel Henry: Software Project Management, Pearson Education.
3. PankajJalote: Software Project Management in practice, Pearson Education.

Course Outcomes:

Upon the successful completion of this course, the student will be able to:

1. Apply the practice of project management in delivering of projects.
2. Evaluate the project against strategic, technical and economic criteria.
3. Identify effort estimation and activity plan of a project.
4. Categorize and prioritize actions for risk management.
5. Evaluate the characteristics of various team structures

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		✓	✓						✓			✓
CO 2						✓						
CO 3					✓			✓				✓
CO 4		✓	✓	✓				✓	✓			
CO 5						✓			✓			✓

ANURAG ENGINEERING COLLEGE
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B.Tech MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(CS511PE/CS832OE) HUMAN COMPUTER INTERACTION
(OPEN ELECTIVE-III)

Prerequisites: Computer Organization

Course Objectives:

- Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
- Recognizehowacomputersystemmaybemodifiedtoincludehumandiversity.
- Select an effective style for a specific application.
- Design mock ups and carry out user and expert evaluation of interfaces

UNIT – I:
Introduction: Importance of user Interface - definition, importance of good design, Benefits of good design, A brief history of Screen design.
The graphical user interface - popularity of graphics, the concept of direct manipulation, graphical systems, Characteristics of graphical user interface, Web user Interface, popularity of web, characteristics of web interface, Principles of user interface.

UNIT – II:
Design process: - Human interaction with computers, important human characteristics in design, human considerations in design, Human interaction speeds, understanding business functions.

UNIT – III:
Screen Designing: Design goals - Screen meaning and purpose, organizing screen elements clearly and meaningfully: ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis, presenting information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design.

UNIT – IV:
Windows –Navigation schemes, Selection of windows, selection of devices based controls, screen based controls.
Components - Text and messages, Icons, Multimedia, colour, colour uses, possible problems with colour, choosing colours.

UNIT – V:
Software tools - Specification methods, interface Building Tools.
Interaction Devices - Keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays.

Text Books:

1. Wilbert O Galitz, The essential guide to user interface design, Wiley DreamaTech,2007.
2. BenShneidermann,Designingtheuserinterface.3rdEdition,PearsonEducationAsia, 2001.

Reference Books:

1. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, Human Computer Interaction.,Pearson.
2. Rogers,Sharps,InteractionDesignPrece,.WileyDream Tech

Course Outcomes:

Upon the successful completion of this course, the student will be able to:

1. Identifyandformulatecharacteristicsandcomponentsofgraphicaluserinterface.
2. Apply an interactive design process and universal design principles to designing HCI systems
3. Analyze&implementvariousdesignparadigmsforhumancomputerinteraction.
4. Apply the navigation schemes through window, device and screen based controls
5. Use HCI in the software process.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		✓	✓	✓								
CO 2	✓		✓	✓								
CO 3	✓	✓	✓	✓								
CO 4	✓	✓		✓	✓							
CO 5	✓		✓	✓		✓						