Academic Regulations

Course Structure & Detailed Syllabus

CHOICE BASED CREDIT SYSTEM

MLR20

MECHANICAL ENGINEERING

Bachelor of Technology (B.Tech.)

B. Tech. - Regular Four Year Degree Programme
(For batches admitted from the academic year 2020 - 2021)
&
B. Tech. - Lateral Entry Scheme
(For batches admitted from the academic year 2021 - 2022)

MARRI LAXMAN REDDY
GROUP OF INSTITUTIONS

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FOREWORD

The autonomy is conferred on MLR Institute of Technology by UGC, based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system and monitoring mechanism**, independent of the affiliating University but under its observance.

MLR Institute of Technology is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad to frame the regulations, course structure and syllabi under autonomous status.

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

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

PRINCIPAL

B. Tech. - Regular Four Year Degree Programme
(For batches admitted from the academic year 2020-21)
&
B. Tech. - Lateral Entry Scheme
(For batches admitted from the academic year 2021-22)

For pursuing four year Under Graduate Degree Programme of study in Engineering & Technology (UGP in E&T) offered by MLR Institute of Technology under Autonomous status is herein referred to as MLRIT (Autonomous):

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2020-21 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for M L R Institute of Technology (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, M L R Institute of Technology shall be the chairman Academic Council.

1. ADMISSION

1.1. **Admission into first year of four year B. Tech. degree programmes of study in Engineering**

1.1.1. **Eligibility:**

A candidate seeking admission into the first year of four year B. Tech. degree Programmes should have:

(i) Passed either Intermediate Public Examination (I.P.E) conducted by the Board of Intermediate Education, Telangana, with Mathematics, Physics and Chemistry as optional subjects or any equivalent examination recognized by Board of Intermediate Education, Telangana or a Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Telangana or equivalent Diploma recognized by Board of Technical Education for admission as per guidelines defined by the Regulatory bodies of Telangana State Council for Higher Education (TSCHE) and AICTE.

(ii) Secured a rank in the EAMCET examination conducted by TSCHE for allotment of a seat by the Convener, EAMCET, for admission.

1.1.2. **Admission Procedure:**

Admissions are made into the first year of four year B. Tech. Degree Programmes as per the stipulations of the TSCHE.

(a) Category A seats are filled by the Convener, TSEAMCET.

(b) Category B seats are filled by the Management.

1.2. **Admission into the second year of four year B. Tech. degree Program in Engineering**

1.2.1 **Eligibility**:

A candidate seeking admission under lateral entry into the II year I Semester B. Tech. degree Programmes should have passed the qualifying exam (B.Sc. Mathematics or Diploma in concerned course) and based on the rank secured by the candidate at Engineering Common Entrance Test ECET (FDH) in accordance with the instructions received from the Convener, ECET and Government of Telangana.

1.2.2 **Admission Procedure**:

Admissions are made into the II year of four year B. Tech. degree Programmes through Convener, ECET (FDH) against the sanctioned strength in each Programmes of study as lateral entry students.

2. PROGRAMMES OFFERED

MLR Institute of Technology, an autonomous college affiliated to JNTUH, offers the following B.Tech. Programmes of study leading to the award of B. Tech. degree under the autonomous scheme.

1) B.Tech. - Aeronautical Engineering
2) B.Tech. - Computer Science and Engineering
3) B.Tech - CSE (Artificial Intelligence & Machine Learning)
4) B.Tech - CSE(Data Science)
5) B.Tech - CSE (Cyber Security)
6) B.Tech - Computer Science & Information Technology
7) B.Tech. - Electronics and Communication Engineering
8) B.Tech - Electrical & Electronics Engineering
9) B.Tech. - Information Technology
10) B.Tech. - Mechanical Engineering

3. DURATION OF THE PROGRAMMES

3.1 **Normal Duration**

3.1.1 B. Tech. degree programme extends over a period of four academic years leading to the Degree of Bachelor of Technology (B.Tech.) of the Jawaharlal Nehru Technological University Hyderabad.

3.1.2 For students admitted under lateral entry scheme, B. Tech. degree programme extends over a period of three academic years leading to the Degree of Bachelor of Technology (B. Tech.) of the Jawaharlal Nehru Technological University Hyderabad.

3.2 **Maximum Duration**

3.2.1 The maximum period within which a student must complete a full-time academic programme is 8 years for B. Tech. If a student fails to complete the academic programme within the maximum duration as specified above, he shall forfeit the seat in B.Tech. and his admission shall stand cancelled.

3.2.2 For students admitted under lateral entry scheme in B.Tech. degree programme, the maximum period within which a student must complete a full-time academic programme is 6 years. If a student fails to complete the academic programme within the maximum duration as specified above, he shall forfeit the seat in B.Tech. and his admission shall stand cancelled.

3.2.3 The period is reckoned from the academic year in which the student is admitted first time into the degree Programme.

4. AWARD OF B.Tech. DEGREE

A student will be declared eligible for the award of the B.Tech. degree if he/she fulfils the following academic regulations:

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

4.2 The candidate shall register for 160 credits and secure 160 credits.

4.3 The degree will be conferred and awarded by Jawaharlal Nehru Technological University Hyderabad on the recommendations of the Chairman, Academic Council.

5. PROGRAMME STRUCTURE

5.1 UGC/AICTE specified Definitions/ Descriptions are adopted appropriately for various terms and abbreviations used in these Academic Regulations/ Norms, which are listed below.

Semester Scheme:

Each UGP is of 4 Academic Years (8 Semesters), each year divided into two Semesters of 22 weeks (≥90 working days), each Semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'under Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted by UGC, and Curriculum/Course Structure as suggested by AICTE are followed.

5.1.2 The B.Tech. Programme of MLR Institute of Technology are of Semester pattern, with 8 Semesters constituting 4 Academic Years, each Academic Year having TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 15-18 Weeks duration with a minimum of 90 Instructional Days per Semester.

5.1.3 Credit Courses:

a) All Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a L: T: P: C (Lecture Periods: Tutorial Periods: Practical Periods : Credits) Structure, based on the following general pattern ..

- One Credit - for One hour/Week/Semester for Theory/Lecture(L)/Tutorial)T)Courses; and
- One Credit - for Two hours/Week/Semester for Laboratory/Practical (P) Courses, Mini Project...
- Mandatory Courses will not carry any Credits.

5.1.4 **Course Classification:**

All Courses offered for the UGP are broadly classified as:

- **Basic Science Courses (BSC)** include Mathematics, Physics, Chemistry, Biology etc.
- **Engineering Science Courses (ESC)** courses include Materials, Workshop, Basics of Electrical/Electronics/ Mechanical/Computer Science & Engineering, Engineering Graphics, Instrumentation, Engineering Mechanics, Instrumentation etc.
- **Humanities and Social Science including Management Courses (HSMC)**courses include English, Communication skills, Management etc.
- **Professional Core Courses(PCC)** are core courses relevant to the chosen specialization/branch.
- **Professional Elective Courses (PEC)** are courses relevant to the chosen specialization/ branch offered as electives.
- **Open Elective Courses (OEC)** courses from other technical and/or emerging subject areas offered in the College by the Departments of Engineering, Science and Humanities.
- **Mandatory Course:** Course work on peripheral subjects in a programme, wherein familiarity considered mandatory. To be included as non-Credit, Mandatory Courses, with only a pass in each required to qualify for the award of degree from the concerned institution.
- **Project Work** and/or internship in industry or elsewhere, seminar.
- **MOOCS –** Massive Open Online Courses in a variety of disciplines available at both introductory and advanced levels, accessible from e-resources in India and abroad. .

5.1.5 **Course Nomenclature:**

The Curriculum Nomenclature or Course-Structure Grouping for the each of the UGP E&T (B.Tech. Degree Programme), is as listed below (along with AICTE specified Range of Total Credits).

S. No.	***Broad Course Classification***	***Course Group/ Category***	***Course Description***
1)	BSC,ESC & HSMC	BSC – Basic Sciences Courses	Includes - Mathematics, Physics and Chemistry Subjects
2)		ESC - Engineering Sciences Courses	Includes fundamental engineering subjects.
3)		HSMC – Humanities and Social Sciences including Management	Includes subjects related to Humanities, Social Sciences and Management.
4)	PCC	PCC – Professional Core Courses	Includes core subjects related to the Parent Discipline/ Department/ Branch of Engg.
5)	PEC	PEC– Professional Elective Courses	Includes Elective subjects related to the Parent Discipline / Department / Branch of Engg.
6)	OEC	OEC – Open Elective Courses	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the Parent Discipline/ Department / Branch of Engg.
7)	PWC	Project Work	Major Project.
8)		Industrial Training/ Mini- Project	Industrial Training/ Internship/ Mini-Project.
9)		Seminar	Seminar / Colloquium based on core contents related to Parent Discipline/ Department/ Branch of Engg.
10)	MC	Mandatory Courses	Mandatory Courses (non-credit)
Total Credits for UGP (B. Tech.)Programme			

- Minor variations as per AICTE guidelines

6. COURSE REGISTRATION

6.1 A 'Faculty Advisor or Counsellor' shall be assigned to each student, who advises him/her about the UGP, its Course Structure and Curriculum, Choice/Option for Subjects/Courses, based on his/her competence, progress, pre-requisites and interest.

6.2 Academic Section of the College invites 'Registration Forms' from students prior (before the beginning of the Semester), ensuring 'DATE and TIME Stamping'. The Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

6.3 A Student can apply for Registration, which includes approval from his faculty advisor, and then should be submitted to the College Academic Section through the Head of Department

(a copy of the same being retained with Head of Department, Faculty Advisor and the Student).

6.4 A student may be permitted to register for his/her course of CHOICE with a Total of prescribed credits per Semester (permitted deviation being±12%), based on his PROGRESS and SGPA/CGPA, and completion of the 'PRE-REQUISITES' as indicated for various courses in the Department Course Structure and Syllabus contents.

6.5 Choice for 'additional Courses' must be clearly indicated, which needs the specific approval and signature of the Faculty Advisor/Counsellor.

6.6 If the Student submits ambiguous choices or multiple options or erroneous (incorrect) entries during Registration for the Course(s) under a given/specified Course Group/ Category as listed in the Course Structure, only the first mentioned Course in that Category will be taken into consideration.

6.7 Dropping of Courses or changing of options may be permitted, ONLY AFTER obtaining prior approval from the Faculty Advisor, 'within 15 Days of Time' from the commencement of that Semester. Course Options exercised through Registration are final and CAN NOT be changed, and CAN NOT be inter-changed; further, alternate choices will also not be considered. However, if the Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by Head of the Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

7. COURSES TO BE OFFERED

7.1 A typical section (or class) strength for each semester shall be 60.

7.2 courses may be offered to the Students, only if minimum of 20 students (1/3rd of the section strength) opt for it.

7.2 More than ONE TEACHER may offer the SAME SUBJECT (Lab/Practical's may be included with the corresponding Theory Subject in the same Semester) in any Semester. However, selection choice for students will be based on - 'CGPA Basis Criterion' (i.e., the first focus shall be on early Registration in that Semester, and the second focus, if needed, will be on CGPA of the student).

7.3 If more entries for Registration of a Subject come into picture, then the concerned Head of the Department shall take necessary decision, whether to offer such a Subject/Course for TWO (or multiple) SECTIONS or NOT.

7.4 OPEN ELECTIVES will be offered by a department to the students of other departments.

8. B.Tech. (HONOURS) DEGREE

A new academic programme B.Tech. (Hons.) is introduced in order to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area.

8.1. B.Tech. students in regular stream can opt for B.Tech.(Hons.), provided they have a CGPA of 8.0 and above up to the end of IVth semester without any history of arrears and attempting of betterment.

8.2 For B. Tech (Honors), a student needs to earn additional 20 credits (over and above the required 160 credits for B. Tech degree).Student to opt for the courses from NPTEL/ SWAYAM / Coursera /other MOOC platform as recommended by concern BOS relevant to her/his discipline through MOOCs as recommended by the BOS.

8.3 If the credits of NPTEL/ SWAYAM/ Coursera /other MOOC platform courses do not match with the existing subject proper scaling will be done by the college.

8.4After registering for the B.Tech (Honours) programme, if a student fails inany course he/she will not be eligible for B.Tech (Honours).

8.7Students who have obtained "C grade " or "reappear" or "Repeat Course" / "Re Admitted" or "Detained" category in any course, including the MOOCs courses, are not eligible for B.Tech (Honours) degree. Up to 8 semesters without any history of arrears and attempting of betterment is not eligible to get B.Tech (Hons.).

8.8 Those who opted for B. Tech (Honours) but unable to earn the required additional credits in 8 semesters or whose final CGPA is less than 8 shall automatically fall back to the B.Tech. programme. However, additional course credits and the grades thus far earned by them will be shown in the grade card but not included for the CGPA.

8.9The students have to pay the requisite fee for the additional courses.

Table : Assigned Credits

Online Course Duration	Assigned Credits
04 Weeks	01 Credit
08 Weeks	03 Credits
12 Weeks	04 Credits

9. B.Tech. (MINOR) DEGREE

This concept is introduced in the curriculum of all conventional B. Tech. programmes offering a major degree. The main objective of Minor in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B. Tech. programme. In order to earn a Minor in a discipline a student has to earn 20 extra credits by studying any seven theory subjects from the programme core & professional elective courses of the minor discipline or equivalent MOOC courses available under SWAYAM platform. The list of courses to be studied either in MOOCs or conventional type will be decided by the department at the time of registration for Minor degree.

a. B.Tech. students in regular stream can opt for B.Tech.(Minor.), provided they have a CGPA of 8.0 and above up to the end of IVth semester without any history of arrears and attempting of betterment.

b. Students aspiring for a Minor must register from **V** semester onwards and must opt for a Minor in a discipline other than the discipline he/she is registered in. However, Minor discipline registrations are not allowed before V semester and after VI semester.

c. Students will not be allowed to register and pursue more than two subjects in any semester.
d. Completion of a Minor discipline programme requires no addition of time to the regular Four year Bachelors' programme. That is, Minor discipline programme should be completed by the end of final year B. Tech. program along with the major discipline.
e. A student registered for Minor in a discipline shall pass in all subjects that constitute the requirement for the Minor degree programme. No class/division (i.e., second class, fist class and distinction, etc.) shall be awarded for Minor degree programme.

10. ATTENDANCE REQUIREMENTS

a. A student will be eligible to appear for the End Semester Examinations, if he acquires a minimum of 75% of attendance in aggregate of all the Subjects/Courses (excluding Mandatory or Non-Credit Courses) for that Semester.

b. Condoning of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each Semester may be granted by the College Academic Committee on genuine and valid grounds, based on the student's representation with supporting evidence by following the govt. rules in vogue.

c. A stipulated fee shall be payable towards condoning of shortage of attendance.

d. Shortage of Attendance below 65% in aggregate shall in No case be condoned.

e. A student shall not be promoted to the next Semester unless he/she satisfies the attendance requirements of the current Semester. The student may seek readmission for the Semester when offered next. He / She shall not be allowed to register for the subjects of the Semester while he/she is in detention. A student detained due to shortage of attendance, will have to repeat that Semester when offered next. The academic regulations under which the student has been readmitted shall be applicable.

f. A student detained lack of credits, shall be promoted to the next academic year only after acquiring the required academic credits. The academic regulations under which the student has been readmitted shall be applicable.

g. Students whose attendance is less than 75% are not entitled to get the scholarship / fee reimbursement in any case as per the TS Govt. Rules in force.

11. ACADEMIC REQUIREMENTS FOR PROMOTION/COMPLETION OF REGULAR B.TECH PROGRAMME COURSE STUDY.

11.1 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Course, if he secures not less than 35% marks in the End Semester Examination, and a minimum of 40% of marks in the sum Total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing P Grade or above in that Course.

11.2 A Student will not be promoted from I Year to II Year, unless he/she fulfils the Attendance requirements.

11.3 A Student will not be promoted from II Year to III Year, unless he/she fulfils the Attendance and Academic Requirements and (i) secures a Total 50%of Credits up to II Year II Semester from all the relevant regular and supplementary examinations.

11.4 A Student will not be promoted from III Year to IV Year, unless he/she fulfils the attendance and Academic Requirements and (i) secures a Total 50% of Credits up to III Year II Semester, from all the regular and supplementary examinations.

11.5 After securing the necessary 160 Credits as specified for the successful completion of the entire UGP, resulting in 160 Credits for UGP performance evaluation, i.e., the performance of the Student in these 160 Credits shall alone be taken into account for the calculation of the final CGPA.

If a Student registers for some more 'extra courses' (in the parent Department or other Departments/Branches of Engg.) other than those listed courses Totalling to 160 Credits as specified in the Course Structure of his/her Department, the performances in those 'extra courses' (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 courses' registered, % marks and 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 8 and 9.1-9.5.

11.6 Students who fail to earn minimum of 160 Credits as per the Course Structure, and as indicated above, within 8 Academic Years from the Date of Commencement of their I Year shall forfeit their seats in B.Tech Programme and their admissions shall stand cancelled.

When a Student is detained due to shortage of attendance/lack of credits in any Semester, he may be re-admitted into that Semester, as and when offered. However the regulations at the time of admissions hold good.

12. EVALUATION - DISTRIBUTION AND WEIGHTAGE OF MARKS

12.1 The performance of a student in each Semester shall be evaluated Course-wise (irrespective of Credits assigned) with a maximum of 100 marks for Theory. The B.Tech. Project Work (Major Project) will be evaluated for 100 marks in Phase-I and 200 Marks in Phase-II.

12.2 For all Theory Courses as mentioned above, the distribution shall be 30 marks for CIE, and 70 marks for the SEE.

12.3 a) For Theory Subjects (inclusive of Minor Courses), during the semester, there shall be two Continues Internal Evaluations (CIE) examinations for 30 marks each. Each CIE examination consists of one subjective paper for 25 marks, and assignment for 5 marks for each subject. Question paper contains two Parts (Part-A and Part-B.) The distribution of marks for PART-A and PART-B will be 10 marks & 15 marks respectively for UG programme.

Pattern of the question paper is as follows:

PART–A

Consists of ***one compulsory question*** with five sub questions each carrying two mark. For the I-Mid examinations the sub question would be from first 2 ½ units and for the II-Mid examination the sub question would be from the remaining 2 ½ units.

PART-B

Consists of five questions (out of which students have to answer three questions) carrying five marks each. 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). The questions can consist of sub questions also.

b) The first mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus.

c) First Assignment should be submitted before the commencement of the first mid-term examinations, and the Second Assignment should be submitted before the commencement of the second mid-term examinations. The assignments shall be specified/given by the concerned subject teacher.

d)If any candidate is absent for the CIE examinations or those who want to improve their internal marks in any subject can opt for improvement exam as and when offered. The improvement exam is a 45 minutes duration and consisting of 30 objective questions from the entire syllabus of the subject. Best marks is consider as a final marks from the average of two mid examinations or improvement examination marks. The improvement can be taken after the payment of prescribed fee. There is no Internal Improvement for the courses Machine Drawing, Production Drawing, Engineering Drawing, Engineering Graphics and practical, mandatory courses.

12.4 For Practical Courses, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 internal marks, and 70 marks are assigned for Lab/Practical End Semester Examination (SEE). Out of the 30 marks for internals, day-to-day work in the laboratory shall be evaluated for 15 marks; and for the remaining 15 marks - two internal practical tests (each of 15 marks) shall be conducted by the concerned laboratory teacher and the average of the two tests is taken into account. The SEE for Practical's shall be conducted at the end of the Semester by Two Examiners appointed by the Chief Controller of Examinations in consultation with the Head of the Department.

12.5 For the Subjects having Design and/or Drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation), the distribution shall be 30 marks for CIE (10 marks for day-to-day work and 20 marks for internal tests) and 70 marks for SEE. There shall be two internal tests in a semester and the average of the two shall be considered for the award of marks for internal tests.

12.6 Open Elective Course**:** Students can choose one open elective course (OE-I) during III-B.Tech I-semester, one (OE-II) during III-B.Tech II-semester, one (OE-III) in IV-B.Tech I-semester, and one (OE-IV) in IV-B.Tech II-semester from the list of open elective courses given. However, students cannot opt for an open elective courses offered by their own (parent) department, if it is already listed under any category of the subjects offered by parent department in any Semester.

12.7There shall be an mini project to be taken up during the vacation after II-B.Tech. II-Semester examination. However, the mini project and its report shall be evaluated in III-B.TechI-Semester SEE& CIE. The mini project shall be submitted in a report form and presented before the committee. There is an internal marks of 30, the evaluation should be done by the supervisor. The There is an external marks of 70 and the same evaluated by the external examiner appointed by the Chief Controller of Examinations and he secures a minimum of 35% of marks in the Semester End Examination and a minimum aggregate of 40% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.

12.8 There shall be a independent study in III-B.Tech II-Semester and will be conducted SEE by through a test or a committee consisting of One External Examiner, Head of the Department

and two Senior faculty members of the Department. The independent study is intended to assess the student's understanding of the subjects he/she studied during the B.Tech. course of study and evaluated for 100 marks. There shall be no CIE for independent study.

12.9 Each Student shall start the Project Work Phase-I during the IV B.Tech. I Semester(VII Semester), as per the instructions of the Project Guide/Project Supervisor assigned by the Head of Department. Total 100 marks allotted for the Project Work Stage-I. 40% of marks shall be evaluated Project Guide/Project supervisor CIE (Continuous Internal Evaluation) based on the reports submitted and conduct presentations. Remaining 60% of marks shall be evaluated by committee comprising of the Head of the Department, project supervisor and senior faculty member from concerned department based on Viva/Seminar Presentation. He/She must secure the 40% of the marks from CIE. For Project work Phase-II in IV Year II Sem. There is an internal marks of 50, the evaluation should be done by the supervisor. The There is an external marks of 150 and the same evaluated by the external examiner appointed by the Chief Controller of Examinations and he secures a minimum of 35% of marks in the Semester End Examination and a minimum aggregate of 40% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.

12.10. **Semester End Examination:**

a) Question paper contains 2 Parts (Part-A and Part-B) having the questions distributed equally among all units.
b) The distribution of marks for i) PART-A for 20 marks ii) PART-B for 50 marks. Pattern of the question paper is as follows:

PART–A

Consists of one question which are compulsory. The question consists of ten sub-questions one from each unit and carry 2 marks each.

PART-B

Consists of 5 questions carrying 10 marks each. Each of these questions is from one unit and may contain sub questions. 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).

12.11 For Mandatory Non-Credit Courses offered in a Semester, after securing ≥ 65% attendance and has secured not less than 35% marks in the SEE, and a minimum of 40% of marks in the sum Total of the CIE and SEE taken together in such a course, then the student is **PASS** and will be qualified for the award of the degree. No marks or Letter Grade shall be allotted for these courses/activities.However, for non credit courses '**Satisfactory'** or "**Unsatisfactory'** shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

12.12 SWAYAM: College intends to encourage the students to do a minimum of one MOOC in discipline and open elective during third year. The respective departments shall give a list of **s**tandard MOOCs providers including SWAYAM whose credentials are endorsed by the BoS chairperson. In general, MOOCs providers provide the result in percentage. In such case, the college shall follow the grade table mentioned in 14.2. The Credits for MOOC(s) shall be transferred same as given for the respective discipline or open electives. In case a student fails to complete the MOOCs he/she shall re-register for the same with any of the providers from the list provided by the department. Still if a student fails to clear the course/s, or in case a provider fails to offer a MOOC in any semester, then in all such cases the college

shall conduct the end semester examinations for the same as per the college end semester examination pattern. The syllabi for the supplementary examinations shall be same as that of MOOCs. There shall be no internal assessment however the marks obtained out of 70 shall be scaled up to 100 marks and the respective letter grade shall be allotted. The details of MOOC(s) shall be displayed in Memorandum of Grades of a student, provided he/she submits the proof of completion of it or them to the examination branch through the Coordinator/Mentor, before the end semester examination of the particular semester.

13. AWARD OF DEGREE

After a student has satisfied the requirement prescribed for the completion of the Programme and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes Shown in Table.

Table: **Declaration of Class based on CGPA (Cumulative Grade Point Average)**

Class Awarded	Grade to be Secured
First Class with Distinction	CGPA ≥ 8.00
First Class	≥ 6.50 to < 8.00 CGPA
Second Class	≥ 5.50 to < 6.50 CGPA
Pass Class	≥ 5.00 to < 5.50 CGPA
FAIL	CGPA < 5

a) **Improvement of Grades and Completion of the Course**

i) Candidates who have passed in a theory course in a Semester are allowed to appear for improvement of Grade in the next immediate supplementary examination for a maximum of three subjects only. Candidates will not be allowed to improve grade in the Laboratory, Seminars, Internships and Project Work.

ii) Improved grade will not be counted for the award of prizes/medals and Rank. However the previous grade will be considered for the award of prizes/medals and rank in case of toppers.

iii) If the candidate does not show improvement in the grade, his/her previous grade will be taken into consideration.

14. LETTER GRADE AND GRADE POINT

14.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practical's, or Seminar, or Project, or Internship*/Mini-Project, Minor Course etc., based on the %marks obtained in CIE+SEE (Continuous Internal Evaluation + Semester End Examination, both taken together), and a corresponding Letter Grade shall be given.

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

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
90% and above (≥ 90% , ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥ 80% , < 90%)	A^+ (Excellent)	9
Below 80% but not less than 70% (≥ 70% , < 80%)	A (Very Good)	8
Below 70% but not less than 60% (≥ 60% , < 70%)	B^+ (Good)	7
Below 60% but not less than 50% (≥ 50% , < 60%)	B (above Average)	6
Below 50% but not less than 40% (≥ 40% , < 50%)	C (Average)	5
Below 40% (< 40%)	F (FAIL)	0
Absent	AB	0

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

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

14.5 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 is detained.

14.6 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

14.7 The Student passes the Subject/Course only when he gets GP ≥ 4 (P Grade or above).

14.8 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

$$\textbf{SGPA} = \{\textstyle\sum_{i=1}^{N} C_i G_i\} / \{\sum_{i=1}^{N} C_i\}$$ **…. For each Semester**,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to that ix Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i Subject.

Illustration of Computation of SGPA Computation

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course1	3	A	8	3 x 8 = 24
Course2	4	B+	7	4 x 7 = 28
Course3	3	B	6	3 x 6 = 18
Course4	3	O	10	3 x10= 30
Course5	3	C	5	3 x 5 = 15
Course6	4	B	6	4 x 6 = 24

Thus, **SGPA =139/20 =6.95**

14.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards, at the end of each Semester, as per the formula

$$\textbf{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \text{ … for all S Semesters registered}$$

(i.e., up to and inclusive of S Semesters, S ≥ 2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards up to and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the jth Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

For CGPA Computation

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

Thus, **CGPA =** $\dfrac{20 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0}{144} = 6.73$

14.10 For Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs will be used.

14.11 For Calculations listed in Item 12.6–12.10, performance in failed Subjects/Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/Courses will also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

14.12 Conversion formula for the conversion of GPA into indicative percentage is

% of marks scored = (final CGPA -0.50) x 10

15. DECLARATION OF RESULTS

Computation of SGPA and CGPA are done using the procedure listed in 12.6– 2.10.

No SGPA/CGPA is declared, if a candidate is failed in any one of the courses of a given Semester.

16. WITH HOLDING OF RESULTS

If the student has not paid fees to College at any stage, or has pending dues against his name due to any reason what so ever, or if any case of indiscipline is pending against him, the result of the student may be withheld, and he will not be allowed to go into the next higher Semester. The Award or issue of the Degree may also be withheld in such cases.

17. REVALUATION

Students shall be permitted for revaluation after the declaration of end Semester examination results within due dates by paying prescribed fee. After revaluation if there is any betterment in the grade, then improved grade will be considered. Otherwise old grade shall be retained.

18. SUPPLEMENTARY EXAMINATIONS

Supplementary examinations for the odd Semester shall be conducted with the regular examinations of even Semester and vice versa, for those who appeared and failed or absent in regular examinations. Such candidates writing supplementary examinations may have to write more than one examination per day.

ADVANCED SUPPLEMENTARY EXAMINATION

Advanced supplementary examinations will be conducted for IV year II Semester after announcement of regular results.

19. TRANSCRIPTS

After successful completion of prerequisite credits for the award of degree 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 and also as per norms in vogue.

20. RULES OF DISCIPLINE

20.1 Any attempt by any student to influence the teachers, Examiners, faculty and staff of controller of Examination for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.

20.2 When the student absents himself, he is treated as to have appeared and obtained zero marks in that course(s) and grading is done accordingly.

20.3 When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject(s).

20.4 When the student's answer book is confiscated for any kind of attempted or suspected malpractice the decision of the Examiner is final.

21.MALPRACTICE PREVENTION COMMITTEE

A malpractice prevention committee shall be constituted to examine and punish the students who involve in malpractice / indiscipline in examinations. The committee shall consist of:

a) Controller of examinations - Chairman
b) Addl. Controller of examinations.- Member Convenor
c) Subject expert - member
d) Head of the department of which the student belongs to. - Member

e) The invigilator concerned - member

The committee shall conduct the meeting after taking explanation of the student and punishment will be awarded by following the malpractice rules meticulously.

Any action on the part of candidate at the examination like trying to get undue advantage in the performance at examinations or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the Staff who are in charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations, in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and will be recommended for appropriate punishment after thorough enquiry.

22. TRANSITORY REGULATIONS

Student who has discontinued for any reason, or has been detained for want of attendance or lack of required credits as specified, or who has failed after having undergone the Degree Programme, may be considered eligible for readmission to the same Subjects/Courses (or equivalent Subjects/Courses, as the case may be), and same Professional Electives/Open Electives (or from set/category of Electives or equivalents suggested, as the case may be) as and when they are offered (within the time-frame of 8 years from the Date of Commencement of his I Year I Semester).

23. AMENDMENTS TO REGULATIONS

The Academic Council of MLR Institute of Technology reserves the right to revise, amend, or change the regulations, scheme of examinations, and / or syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

24. STUDENT TRANSFERS

There shall be no Branch transfers after the completion of Admission Process. Transfer of students from other colleges or universities are permitted subjected to the rules and regulations of TSCHE (TE Department) and JNTUH in vogue.

25. GRADUATION DAY

The College shall have its own Annual Graduation Day for the award of Degrees issued by the College/University.

26. AWARD OF MEDALS

Institute will award Medals to the outstanding students who complete the entire course in the first attempt within the stipulated time.

27. SCOPE

i) Where the words “he”, “him”, “his”, occur in the write-up of regulations, they include “she”, “her”.

ii) Where the words “Subject” or “Subjects”, occur in these regulations, they also imply “Course” or “Courses”.

iii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.

iv) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

Academic Regulations for B. Tech. (Lateral Entry Scheme)

(Effective for the students getting admitted into II year from the Academic Year 2020-2021 on wards)

1. The Students have to acquire 124 credits from II to IV year of B.Tech. Programme (Regular) for the award of the degree.

2. Students, who fail to fulfil the requirement for the award of the degree in 6 consecutive academic years from the year of admission, shall forfeit their seat.

3. The same attendance regulations are to be adopted as that of B. Tech. (Regular)

Promotion Rule:

A Student will not be promoted from III Year to IV Year, unless he/she fulfils the Attendance and Academic Requirements and secures a Total of 50% Credits up to III Year II Semester, from all the regular and supplementary examinations.

Award of Class:

After the student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of B. Tech. Degree, he/she shall be placed in one of the following four classes: The marks obtained for 124 credits will be considered for the calculation of CGPA and award of class shall be shown separately.

Table: **Declaration of Class based on CGPA (Cumulative Grade Point Average)**

Class Awarded	Grade to be Secured
First Class with Distinction	CGPA ≥ 8.00
First Class	≥ 6.50 to < 8.00 CGPA
Second Class	≥ 5.50 to < 6.50 CGPA
Pass Class	≥ 5.00 to < 5.50 CGPA
FAIL	CGPA < 5

All other regulations as applicable for B. Tech. Four-year degree programme (Regular) will hold good for B.Tech (Lateral Entry Scheme).

MALPRACTICES RULES - DISCIPLINARY ACTION FOR /IMPROPER CONDUCT IN EXAMINATIONS

S. No	Nature of Malpractices / Improper Conduct	Punishment
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 subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Principal.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the Addl. Controller of examinations / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the addl. Controller of examinations or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the addl. Controller of examinations, 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.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work

		and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that Semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the principal for further action to award suitable punishment.	

COURSE STRUCTURE

Department of Mechanical Engineering - MLR 20

I B.Tech.- I-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5BS01	Calculus and Applications	BSC	3	1	0	4	30	70	100
A5BS09	Engineering Physics	BSC	3	1	0	4	30	70	100
A5ME01	Engineering Mechanics	ESC	3	1	0	4	30	70	100
A5ME02	Engineering Graphics	ESC	1	0	4	3	30	70	100
A5ME03	Engineering Workshop and Manufacturing Practices	ESC	1	0	3	2.5	30	70	100
A5BS10	Engineering Physics Lab	BSC	0	0	3	1.5	30	70	100
Total			**11**	**03**	**10**	**19**	**180**	**420**	**600**
Mandatory Course (Non-Credit)									
A5MC01	Seminar-I	MC	0	0	2	0	30	70	100

I B.Tech.- II-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5BS03	Integral Calculus and Numerical Techniques	BSC	3	1	0	4	30	70	100
A5BS13	Engineering Chemistry	BSC	4	0	0	4	30	70	100
A5HS01	English	HSM	2	0	0	2	30	70	100
A5CS01	Programming for Problem Solving	ESC	3	0	0	3	30	70	100
A5CS02	Programming for Problem Solving Lab	ESC	0	0	3	1.5	30	70	100
A5HS02	English Language and Communication skills Lab	HSM	0	0	2	1	30	70	100
A5BS14	Engineering Chemistry Lab	BSC	0	0	3	1.5	30	70	100
Total			**12**	**01**	**08**	**17**	**210**	**490**	**700**
Mandatory Course (Non-Credit)									
A5MC02	Seminar-II	MC	0	0	2	0	30	70	100

II B.Tech.- I-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5BS06	Vector Calculus and Probability Statistics	BSC	3	1	0	4	30	70	100
A5ME06	Strength of Materials	PCC	3	1	0	4	30	70	100
A5ME07	Material Science and Metallurgy	PCC	3	0	0	3	30	70	100
A5ME09	Thermodynamics	PCC	3	0	0	3	30	70	100
A5ME10	Manufacturing Processes	PCC	3	0	0	3	30	70	100
A5ME11	Manufacturing Processes Lab	PCC	0	0	2	1	30	70	100
A5ME12	Machine Drawing and Computer Graphics Lab	PCC	1	0	4	3	30	70	100
A5ME08	Strength of Materials and Metallurgy Lab	PCC	0	0	2	1	30	70	100
Total			**16**	**02**	**08**	**22**	**240**	**560**	**800**
Mandatory Course (Non-Credit)									
A5MC03	Environmental Studies	MC	2	0	0	0	30	70	100

II B.Tech.- II-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5EE70	Basic Electrical and Electronics Engineering	ESC	3	1	0	4	30	70	100
A5ME13	Theory of Machines - I	PCC	3	1	0	4	30	70	100
A5ME14	Thermal Engineering - I	PCC	3	0	0	3	30	70	100
A5ME15	Fluid Mechanics and Hydraulic Machines	PCC	3	1	0	4	30	70	100
A5ME17	Design of Machine Members - I	PCC	3	0	0	3	30	70	100
A5ME16	Fluid Mechanics and Hydraulic Machines Lab	PCC	0	0	2	1	30	70	100
A5EE71	Basic Electrical and Electronics Engineering Lab	ESC	0	0	2	1	30	70	100
A5ME40	Python Lab	ESC	1	0	2	2	30	70	100
Total			**16**	**03**	**06**	**22**	**240**	**560**	**800**
Mandatory Course (Non-Credit)									
A5MC04	Gender Sensitization	MC	1	0	0	0	30	70	100

III B.Tech.- I-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5ME19	Metrology and Machine Tools	PCC	3	0	0	3	30	70	100
A5ME21	Thermal Engineering - II	PCC	3	0	0	3	30	70	100
A5ME23	Theory of Machines - II	PCC	3	1	0	4	30	70	100
A5ME24	Design of Machine Members - II	PCC	3	0	0	3	30	70	100
	OPEN ELECTIVE - I	OEC	3	0	0	3	30	70	100
A5ME20	Metrology and Machine Tools Lab	PCC	0	0	2	1	30	70	100
A5ME22	Thermal Engineering Lab	PCC	0	0	2	1	30	70	100
A5HS04	Advanced English Communication Skills Lab	HSM	0	0	2	1	30	70	100
A5ME25	Mini Project	PWC	0	0	4	2	30	70	100
Total			**15**	**01**	**10**	**21**	**270**	**630**	**900**
Mandatory Course (Non-Credit)									
A5MC05	Human Values and Professional Ethics	MC	2	0	0	0	30	70	100

III B.Tech.- II-Semester

Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5ME26	CAD/CAM	PCC	3	0	0	3	30	70	100
A5ME28	Heat Transfer	PCC	3	0	0	3	30	70	100
A5ME30	Automation in Manufacturing	PCC	3	0	0	3	30	70	100
	OPEN ELECTIVE-II	OEC	3	0	0	3	30	70	100
	PROFESSIONAL ELECTIVE - I	PEC	3	0	0	3	30	70	100
	PROFESSIONALELECTIVE - II	PEC	3	0	0	3	30	70	100
A5ME27	CAD/CAM Lab	PCC	0	0	2	1	30	70	100
A5ME29	Heat Transfer Lab	PCC	0	0	2	1	30	70	100
A5ME31	Independent Study / MOOCs	PWC	0	0	2	1	0	100	100
Total			**18**	**00**	**06**	**21**	**240**	**660**	**900**

IV B.Tech.- I-Semester									
Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
A5ME32	Finite Element Method	PCC	3	0	0	3	30	70	100
A5ME34	Instrumentation and Control Systems	PCC	3	0	0	3	30	70	100
	OPEN ELECTIVE - III	OEC	3	0	0	3	30	70	100
	PROFESSIONAL ELECTIVE - III	PEC	3	0	0	3	30	70	100
	PROFESSIONAL ELECTIVE - IV	PEC	3	0	0	3	30	70	100
A5ME33	Computer Aided Engineering and Production Drawing Practice Lab	PCC	0	0	2	1	30	70	100
A5ME35	Instrumentation and Control Systems Lab	PCC	0	0	2	1	30	70	100
A5ME36	Major Project Phase - I	PWC	0	0	8	4	100	0	100
Total			**15**	**00**	**12**	**21**	**310**	**490**	**800**

IV B.Tech.- II-Semester									
Course Code	Course Title	Course Area	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
	OPEN ELECTIVE - IV	OEC	3	0	0	3	30	70	100
	PROFESSIONAL ELECTIVE - V	PEC	3	0	0	3	30	70	100
	PROFESSIONAL ELECTIVE - VI	PEC	3	0	0	3	30	70	100
A5ME37	Major Project Phase - II	PWC	0	0	16	8	50	150	200
Total			**09**	**00**	**16**	**17**	**140**	**360**	**500**

PROFESSIONAL ELECTIVE COURSES			
PE-I		**PE-II**	
A5ME41	Design for Manufacturing and Assembly	A5ME45	Automobile Engineering
A5ME42	Unconventional Machining Processes	A5ME46	Power Plant Engineering
A5ME43	Additive Manufacturing	A5ME47	Refrigeration and Air Conditioning
A5ME44	Production Planning and Control	A5ME48	Computational Fluid Dynamics
PE-III		**PE-IV**	
A5ME49	Composite Materials	A5ME53	Fracture Mechanics
A5ME50	Tribology	A5ME54	Machine Dynamics & Vibrations
A5ME51	Nanotechnology	A5ME55	Machine Tool Design
A5ME52	Industrial Safety Engineering	A5ME56	Flexible Manufacturing Systems
PE-V		**PE-VI**	
A5ME57	Industry 4.0	A5ME61	Industrial Management
A5ME58	Mechatronics	A5ME62	Operations Research
A5ME59	Industrial Robotics	A5ME63	Total Quality Management
A5ME60	Product Life Cycle Management	A5ME64	Optimization Techniques

OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSE - I			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1.	A5AE62	Fundamentals of Avionics	Aeronautical Engineering
2.	A5AE63	Introduction to Aerospace Technology	
3.	A5CS30	Core Java Programming	Computer Science and Engineering
4.	A5CS22	Introduction to Data Analytics	
5.	A5EC54	Microprocessors and Interfacing	Electronics & Communication Engineering
6.	A5EC55	Principles of Communications	
7.	A5EE52	Electrical Wiring and Safety Measures	Electrical & Electronics Engineering
8.	A5EE53	Electrical Materials	
9.	A5IT21	Fundamentals of Data Structures	Information Technology
10.	A5IT22	Introduction to Machine Learning	
11.	A5ME71	Elements of Mechanical Engineering	Mechanical Engineering
12.	A5ME72	Fundamentals of Engineering Materials	
13.	A5HS06	Business Economics and Financial Analysis	HSM
14.	A5HS07	Basics of Entrepreneurship	
OPEN ELECTIVE COURSE - II			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1.	A5AE64	Introduction to Jets and Rockets	Aeronautical Engineering
2.	A5AE65	Non-Destructive Testing Methods	
3.	A5CS31	Fundamentals of DBMS	Computer Science and Engineering
4.	A5CS07	Introduction to Design and Analysis of Algorithms	
5.	A5EC58	Microcontrollers and Applications	Electronics & Communication Engineering
6.	A5EC61	Fundamentals of Image processing	
7.	A5EE56	Analysis of Linear Systems	Electrical & Electronics Engineering
8.	A5EE57	Neural Networks and Fuzzy Logic	
9.	A5IT23	Basics of Python Programming	Information Technology
10.	A5IT11	Human Computer Interaction	
11.	A5IT31	Software Testing Fundamentals	
12.	A5ME73	Fundamentals of Mechatronics	Mechanical Engineering
13.	A5ME74	Basics of Thermodynamics	
14.	A5HS09	Advanced Entrepreneurship	HSM

OPEN ELECTIVE COURSE - III			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1.	A5AE66	Introduction to Aircraft Industry	Aeronautical Engineering
2.	A5AE67	Unmanned Aerial Vehicles	
3.	A5CS33	Introduction to Cloud Computing	Computer Science and Engineering
4.	A5CS34	Computer Organization and Operating Systems	
5.	A5EC62	Introduction to Sensors and Actuators	Electronics & Communication Engineering
6.	A5EC63	Introduction to Computer Vision	
7.	A5EE60	Solar Energy and Applications	Electrical & Electronics Engineering
8.	A5IT24	Introduction to AI	Information Technology
9.	A5IT25	Software Testing Fundamentals	
10.	A5ME75	Basics of Robotics	Mechanical Engineering
11.	A5ME76	Fundamentals of Operations Research	
OPEN ELECTIVE COURSE - IV			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1.	A5AE68	Fundamentals of Wind Power Technology	Aeronautical Engineering
2.	A5AE69	Guidance and Control of Aerospace Vehicles	
3.	A5HS11	Management Science	HSM
4.	A5HS12	Intellectual Property Rights	
5.	A5CS20	Distributed Databases	Computer Science and Engineering
6.	A5CS29	Software Project Management	
7.	A5EC64	Introduction to Mobile Communications	Electronics & Communication Engineering
8.	A5EC65	Basics of Embedded System Design	
9.	A5EE61	Instrumentation and Control	Electrical & Electronics Engineering
10.	A5EE63	Energy Storage Systems	
11.	A5IT26	Introduction to Mobile Application Development	Information Technology
12.	A5IT27	Big Data	
13.	A5ME77	Introduction to Material Handling	Mechanical Engineering
14.	A5ME78	Renewable Energy Sources	

B.TECH I SEMESTER SYLLABUS

CALCULUS AND APPLICATIONS

I Semester: Common for ECE/EEE/MECH/AERO

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5BS01	BSC	3	1	0	4	30	70	100

Course Objectives

To learn

1. The concept of differential equations and solvethem using appropriate methods
2. Usage of the appropriate test to find the convergence and divergence of the given series
3. Concept of Rank of a matrix, Consistency and solving system of linear equations.
4. Evaluation of differential equation using Laplace Transform techniques.
5. The partial derivatives of several variable functions.

UNIT-I ORDINARY DIFFERENTIAL EQUATIONS

Introduction- Exact and reducible to Exact differential equations-Newton's Law of cooling-Law of Growth and Decay. Linear differential equations of second and higher order with constant coefficients - Non-Homogeneous term of the type Q(x) = e^{ax}, Sin ax, Cosax, $e^{ax}v(x)$, $x^n v(x)$ - Method of variation of parameters.

UNIT-II SEQUENCES AND SERIES

Basic definitions of Sequences and series – Convergence and divergence –Comparison Test- Ratio Test – Raabe's Test-Integral Test – Cauchy's n^{th} root Test –Absolute and Conditional convergence – Power Series.

UNIT-III THEORY OF MATRICES

Finding rank of a matrix by reducing to Echelon form, Consistency of system of linear equations (homogeneous and non-homogeneous) using the rank of a matrix, Eigen values and Eigen vectors and its properties(without proof),Cayley-Hamilton theorem (Statement and verification)-Finding inverse and powers of a matrix by Cayley-Hamilton theorem, Diagonalization of matrices.

UNIT-IV LAPLACE TRANSFORMS

Laplace transforms of elementary functions- First shifting theorem - Change of scale property – Multiplication by t^n- Division by t – Laplace transforms of derivatives and integrals – Unit step function – Second shifting theorem – Periodic function – Evaluation of integrals by Laplace transforms – Inverse Laplace transforms- Method of partial fractions – Other methods of finding inverse transforms – Convolution theorem – Applications of Laplace transforms to ordinary differential equations.

UNIT-V	CALCULUS OF SEVERAL VARIABLES

Limit, Continuity - Partial derivative- Partial derivatives of higher order -Total derivative –

Chain rule, Jacobians-functional dependence & independence.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints)

Text Books:

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

Reference Books:

1. G.B.Thomas, calculus and analytical geometry,9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal, A Text of Engineering Mathematics, Laxmi publications,2008.
3. E.L.Ince, Ordinary differential Equations, Dover publications,1958.

Course Outcomes:

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

1.Identify the different types of differential equations and solve them using appropriate methods.

2. Apply the appropriate test to find the convergence and divergence of the given series.

3. Solve the system of linear equations using rank of the matrices.

4. Solve the differential equations using Laplace transform techniques.

5. Find the Maxima and Minima of several variable functions.

ENGINEERING PHYSICS

I B. Tech: ECE, EEE, CSIT, IT, AERO, MECH

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5BS09	BSC	3	1	0	4	30	70	100

Course Objectives:

1. Describe the chemical reaction and phase transformation in materials by using modern thermodynamic models
2. Learn the fundamentals of transport properties of materials
3. Describe the interactions of light with materials which results in colour and the temperature dependence of magnetic susceptibility
4. Learn the basic principles of optical fiber and its communication system
5. Understand the development of Nano technology and synthesis of Nano materials by using different techniques

Course Outcomes:

The student will able to:

1. **Analyze** the bonding scheme and its physical properties of a given material
2. **Evaluate** the dimensionality, rates of a nucleation and growth process from kinetic data
3. **Evaluate** the curie and Neel temperature of a given substance.
4. **Justify** how the graded index optical fibre is more efficient than step index optical fiber in fiber optic communication system
5. **Recommend** appropriate synthesis method and explain the characterization techniques

UNIT-I The Structure of Materials & Thermodynamics of Condensed Phases

The Structure of Materials: Structure of Metals and Alloys-- Space lattice, unit cell, basis, crystal systems, Bravais lattice, S.C, B.C.C & F.C.C Structures. Structure of Ceramics and Glasses – Rock salt structure, Diamond structure, structure of SiO_4.

Thermodynamics of Condensed Phases: Introduction – Thermodynamics of Metals and Alloys, - Gibbs rule, Cu- Ni phase diagram, Eutectic systems, Iron-Iron carbide (Fe-Fe_3C) equilibrium diagram.

UNIT-II Transport Properties of Materials & Band theory of solids

Transport Properties of Materials: Introduction -Momentum Transport properties of Materials, - The Molecular Origins of Viscosity, Temperature Dependence of Pure Metal Viscosity, Composition Dependence of alloy Viscosity.

Band theory of solids: Free electron theory, Origin of energy band formation in solids, Estimation of Fermi-level, Kronig-Penny model, E-K diagram.

UNIT-III	Properties of materials

Electrical and Optical properties -Conduction, Semi conductivity, Electrical Conduction in Ionic Ceramics**.** Reflection, Refraction, Absorption and transmission. Opacity and Translucency in insulators. Light interaction with solids, EMR, atomic and electronic interaction.

Magnetic properties – Introduction, Types of magnetic materials, influence of temperature on magnetic behaviour, Hysteresis curve, Soft and Hard magnetic materials, Magnetic storage, Ferrite applications.

UNIT-IV	Optoelectronic devices and optical fibers

Optoelectronic devices: Introduction to Semiconductors, PN Junction Diode, V-I characteristics and applications. LED - Construction, working and applications. Solar cells-working and its applications. Efficiency issues of Solar cell, PIN diode characteristics.

Fiber Optics: Structure of fibers, Principle of fiber (TIR), Acceptance angle and NA. Types of fibers - SI and GI fibers - R.I profiles. Single and Multimode fibers - SMSI, MMSI, MMGI. OFC System with block diagram. Fiber optic sensors – Basic principle, working of Pressure and Temperature Sensors. Applications of fibers in different fields.

UNIT-V	Introduction to Engineered materials

Synthesis of Nano materials: Introduction to nano particles, nano scale, Surface to volume ratio and quantum confinement. Techniques for synthesis of nano materials-Top Down and Bottom Up methods– Sol gel, CVD methods and Photolithography.

Characterization of Nanomaterials: Imaging methods – SEM, TEM and STM. Applications of Nano materials in engineering and Biomedical fields and other fields.

Text Books:

1. Engineering Physics, B.K. Pandey, S. Chaturvedi – Cengage Learing
2. Haliday and Resnick, Physics – wiley
3. P.K Palanisamy, Engineering Physics, Sitech Publications, 2013, IVthEdn.
4. Essentials of Nano Tecnology by Jeremy Ramsden.
5. An introduction to materials engineering and science by Brian S. Mitchell

Reference Books:

1. Hecht, “Optics”, Pearson Education, 2008.
2. D. A. Neamen, “Semiconductor Physics and Devices”, Times Mirror High Education Group, Chicago, 1997.
3. Fundamentals of material science and engineering by William D. Callister, Jr. David G. Rethwisch

ENGINEERING MECHANICS

I Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME01	ESC	3	1	0	4	30	70	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Resolve various force systems and calculate reactions of various supports on rigid bodies in equilibrium
2. Analyze the frictional forces of rigid bodies on rough horizontal and inclined planes.
3. Evaluate Geometric properties of composite areas and solids.
4. Analyze rigid bodies in motion, work-energy problems and their relationship to engineering applications
5. Develop mathematical model of dynamic systems subjected to simple harmonic motion.

UNIT-I INTRODUCTION TO ENGINEERING MECHANICS & EQUILIBRIUM OF PLANAR SYSTEM OF FORCES

Introduction to engineering mechanics: Basic concepts, Classification of a force system, Parallelogram law, Resultant of coplanar concurrent force system, Moment of a force, its applications, Varignon's theorem, Resultant of coplanar non-concurrent force systems, Couples.

Equilibrium of Planar System of forces: Equilibrium, Conditions of equilibrium, Lami's theorem, free body diagrams, Types of supports, their reactions, Analysis of beams.

UNIT-II ANALYSIS OF PERFECT FRAMES & FRICTION

Analysis of perfect frames: Types of frames, Method of joints and Method of Sections

Friction: Introduction, types of friction, laws of friction, coefficient of friction, angle of friction, angle of repose, analysis of bodies on rough horizontal, inclined planes, wedge friction, ladder friction and screw friction

UNIT-III CENTROID, CENTRE OF GRAVITY & MOMENT OF INERTIA

Centroid & Centre of gravity: Introduction, centroids & centre of gravity of simple figures (from first principles), centroid of composite sections, centre of gravity of composite solids, theorems of pappus & guldinus.

Moment of Inertia: Area moment of inertia of plane sections (from first principles), Parallel axis theorem, Perpendicular axis theorem, Moment of inertia of standard sections and composite sections.

UNIT-IV	KINEMATICS & KINETICS

Kinematics of a particle: Rectilinear motion, curvilinear motion, direct and oblique impact.

Kinetics of rigid bodies: Analysis of connecting bodies, kinetics of rigid body rotation, D' Alembert's principle, work-energy theorem, impulse-momentum principle, their applications

UNIT-V	VIRTUAL WORK & MECHANICAL VIBRATIONS

Virtual work: Concept of virtual work, Principle of virtual work, its applications.

Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance, simple harmonic motion, simple, compound and torsional pendulums.

Text Books:

1. Reddy Vijay Kumar and K. Suresh Kumar, Singer's Engineering Mechanics
2. Engineering Mechanics/Timoshenko and D.H. Young, Mc Graw Hill Book Company
3. Bansal R.K, A Text book of Engineering Mechanics, Laxmi Publications

Reference Books:

1. Engineering Mechanics/Irving Shames/Prentice Hall
2. Engineering Mechanics/N.H Dubey/Tata Mc Graw Hill
3. A Text book of Engineering Mechanics/ R S Khurmi / S Chand

COURSE OUTCOMES:

At the end of the course the student should be able to:

1. Evaluate magnitude, direction and position of resultant of different system of forces.
2. Analyze of forces in members and concept of friction
3. Calculate centre of gravity and moment of inertia of plane areas and composite bodies.
4. Analyze general plane motion for particle and rigid bodies
5. Assess virtual work and basic mechanical vibrations

ENGINEERING GRAPHICS

I-Semester:

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME02	ESC	1	0	4	3	30	70	100

COURSE OUTCOMES:

At the end of the course the student should be able to:

1. Explain the basic drawing standards, conventions and AutoCAD fundamentals
2. Sketch the various curves used in engineering and their applications
3. Apply the knowledge of quadrant system and draw the projections of points, lines and planes.
4. Evaluate the given object position and draw the projections of solids and development of surfaces.
5. Convert the pictorial views into orthographic view and vice versa.

UNIT- I	INTRODUCTION

INTRODUCTION TO ENGINEERING DRAWING: Principles of Engineering Graphics and their significance.

INTRODUCTION TO COMPUTER AIDED DRAFTING: Initial Setup Commands, Utility commands, Drawing Aids, Saving and Plotting, Entity Draw Commands, Display Commands, Edit Commands, Layers concept, 2D Drawings-Simple Exercises.

UNIT- II	ENGINEERING CURVES

ENGINEERING CURVES: Conics Ellipse, Parabola, and Hyperbola (General Method only).

CYCLOIDS AND INVOLUTES:

UNIT- III	ORTHOGRAPHIC PROJECTION

PRINCIPLES OF ORTHOGRAPHIC PROJECTIONS – conventions – first and third angle projections. Projections of points.

Projection of lines inclined to both the planes (First angle projection only).

PROJECTIONS OF PLANES: Projections of regular planes, inclined to both planes.

UNIT-IV	PROJECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

PROJECTION OF SOLIDS - Solids inclined to both planes.

DEVELOPMENT OF SURFACES/SOLIDS: Theory of development, development of lateral surfaces along with base.

UNIT- V	ISOMETRIC DRAWINGS

ISOMETRIC VIEWS: Divisions of pictorial projection, theory of Isometric Drawing- Isometric view and Isometric projections; Drawing Isometric circles, Dimensioning Isometric Objects.

ORTHOGRAPHIC VIEWS: Conversion of Isometric view to Orthographic views and Orthographic to isometric views. Missing Views.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. D.M. Kulkarni, A.P.Rastogi, A.K. Sarka “Engineering Graphics with AutoCAD” PHI publications,2013
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Computer Aided Engineering Drawing / K Balaveera Reddy et al- C B S publishers

Reference Books:

1. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
2. Sham Tickoo, D. saravanan, “AutoCAD 2017 for engineers and designers”, Dreamtech Press

ENGINEERING WORKSHOP AND MANUFACTURING PRACTICES

I Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME03	ESC	1	0	3	2.5	30	70	100

COURSE OUTCOMES:

Student will be able to:

1. Fabricate components with own hands
2. Get practical knowledge of the dimensional accuracies and tolerances possible with different manufacturing processes
3. Assemble different components
4. Produce useful products using one or more operations
5. Learn the safety precautions for various manufacturing and trade operations

LIST OF EXPERIMENTS

WEEKS	BASIC TRADES	BASIC MANUFACTURING
	Fitting	**Machine Shop**
Week 1	Filing Four Sides of MS Work piece	Facing & Step Turning on Lathe
Week 2	L Fit	Milling and Drilling
	Carpentry	**Black Smithy**
Week 3	Half Lap Joint	Convert round rod to S-hook
Week 4	Dove Tail Joint	Convert round rod to Chisel
	Tin Smithy	**Casting**
Week 5	Prepare a Rectangular Tray	Casting of simple pattern
Week 6	Prepare A Square Tin	Preparation of Mould cavity for Multi Piece Pattern
	Electrical	**Welding Shop**
Week 7	Series and Parallel Connection One Way Switch	Lap/Butt joint Using Arc Welding
Week 8	Two Way Switch Connection Stair Case Wiring	Lap/Butt joint Using Gas Welding
	Electronics	**Plastic Moulding**
Week 9	Soldering - Series Connection & Parallel Connection	Injection moulding of Simple Components
Week 10	Desoldering & Construction of Wheat Stone Bridge	Making useful products using 3 or more operations.
Week 11	Making useful product using 3 or more operations.	

TEXT BOOKS:

1. Workshop Manual by P. Kannaiah and K. L.Narayana.
2. Rao P. N. "Manufacturing Technology",Tata McGraw Hill House, Vol.I and Vol.II.

REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2. Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4th edition,2002.

ENGINEERING PHYSICS LAB

I B. Tech: ECE, EEE, CSIT, IT, AERO, MECH

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5BS10	BSC	0	0	3	1.5	30	70	100

Course Objectives:

The course should enable the students to:

1. To provide an experimental foundation for the theoretical concepts introduced in the lectures
2. To teach how to make careful experimental observations and how to think about and draw conclusions from such data
3. To help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments
4. To introduce the concepts and techniques which have a wide application in experimental science but have not been introduced in the standard courses
5. To teach how to write a technical report this communicates scientific information in a clear and concise manner

Course Outcomes:

By the end of the course students will be able:

1. Analyze the electric properties of semiconductor materials by determining energy gap of semiconductors, threshold voltage of LEDs and efficiency issues of solar cell with careful experimental and draw conclusions from such data

2. Evaluate the mechanical properties of a given material using dynamic method in torsional pendulum and analyze how stationary waves are produced to determine A.C frequency using Melde's experiment

3. Estimate the optical properties of light such as interference and polarization by using Newton's rings, calculation of the wave length of Laser using diffraction phenomenon and to determine acceptance angle, NA of optical fiber.

4. Analyze the electromagnetic properties in a current carrying conductor using Stewart Gee's experiment

LIST OF EXPERIMENTS	
Experiment-1	**Energy gap of P-N junction diode:** To determine the energy gap of a semiconductor diode
Experiment-2	**Solar Cell:** To study the V-I and P-I characteristics of solar cell
Experiment-3	**Light Emitting Diode:** Plot V-I characteristics of light emitting diode Plot V-I characteristics of light emitting diode
Experiment-4	**Plank's Constant:** To determine value of plank's constant using by measuring radiation in fixed spectral range
Experiment-5	**Melde's Experiment:** To determine the frequency of a tuning fork by using Melde's experiment
Experiment-6	**Optical fiber:** To determine the numerical aperture and acceptance angle of an optical fiber
Experiment-7	**LASER:** To determine the wavelength of a given laser source by using diffraction grating method
Experiment-8	**Malus Law:** To Verify the cosine law by using polarization phenomenon of light.
Experiment-9	**Newton's rings:** To determine the radius of curvature of a given Plano convex lens by forming Newton's rings
Experiment-10	**Torsional Pendulum:** To determine the rigidity modulus of a given metal wire by using Torsional pendulum
Experiment-11	**PIN Photo Diode** To study the V-I Characteristics of Photo Diode by calculating the photo current.
Experiment-12	**Stewart Gee's experiment:** To study the variation of magnetic field along the axis of a circular coil

Reference Books:

1. "Semiconductor Physics and Devices: Basic Principles" by Donald A Neamen
2. "Optics, Principles and Applications" by K K Sharma.
3. "Principles of Optics" by M Born and E Wolf.
4. "Oscillations and Waves" by Satya Prakash and Vinay Dua
5. "Waves and Oscillations" by N Subrahmanyam and Brij Lal

B.TECH II SEMESTER SYLLABUS

INTEGRAL CALCULUS AND NUMERICAL TECHNIQUES

II Semester: ECE/EEE/MECH/AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5BS03	BSC	3	1	0	4	30	70	100

COURSE OBJECTIVES

To learn

1. The concepts of finite differences, operators and relations between them.
2. Evaluation of integrals by using numerical methods.
3. Evaluation of the multiple integrals.
4. Fourier series for periodic functions.
5. Fourier transform and inverse transform of common functions.

UNIT-I **INTERPOLATION AND CURVE FITTING**

INTERPOLATION: Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Difference of a polynomial – Missing terms - Newton's forward interpolation, Newton's backward interpolation, Gauss's forward and backward interpolation formulae. Interpolation with unequal intervals – Lagrange's interpolation.

CURVE FITTING: Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of theform $y= a e^{bx}$, $y= a x^{b}$, $y = a b^{x}$ by the method of least squares.

UNIT-II **NUMERICAL TECHNIQUES**

ROOT FINDING TECHNIQUES :

Bisection method-Regula Falsi method and Newton Raphson method.

NUMERICAL INTEGRATION :

Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Taylor's series method – Euler's – modified, Euler's Method – Runge-Kutta method.

UNIT-III **MULTIPLE INTEGRALS**

Double and triple integrals (Cartesian and polar), Change of order of integration in double integrals, Change of variables (Cartesian to polar) in double integrals. Finding the area and volume of a region using double and triple integral.

UNIT-IV **FOURIER SERIES**

Periodic function-Determination of Fourier Coefficients-Fourier Series-Even and Odd functions-Fourier series in arbitrary interval-Even Odd periodic continuation-Half range Fourier sine and cosine expansions.

UNIT-V	FOURIER TRANSFORMS

Fourier integral theorem (statement)-Fourier sine and cosine integrals –Fourier transforms –Fourier sine and cosine transforms-properties- Inverse transforms-Finite Fourier transforms.

Text Books:

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

Reference Books:

1. G.B.Thomas, calculus and analytical geometry,9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal ,A Text of Engineering Mathematics, Laxmi publications,2008.
3. E.L.Ince, Ordinary differential Equations,Dover publications,1958.

COURSE OUTCOMES

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

1. Find Interpolating polynomial for the given tabular data.
2. Solve the first order ordinary differential equations using numerical techniques.
3. Evaluate multiple integrals.
4. Find the Fourier series of the given functions.
5. Find the Fourier transforms of the given functions.

ENGINEERING CHEMISTRY

II Semester

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5BS13	BSC	4	0	0	4	30	70	100

Course Objectives:

The course should enable the students to:

1. Impart knowledge on soft and hard water types and softening methods.
2. Introduce the basic concepts to develop electrochemical cells.
3. enhance knowledge on corrosion and its significance
4. Analyze the types of fuel based on calorific value for selected applications.
5. Interpret the properties and applications of lubricants.

Course Outcomes:

At the end of the course students will be able to:

1. **Illustrate** the types of hard and soft water, treatment of drinking and industrial water.
2. **Demonstrate** the basic principles of Electrochemistry in electrochemical cells.
3. **Apply** the methods of metal finishing in solving corrosion related problems.
4. **Explain** the chemistry of various fuels and their combustion.
5. **Identify** the properties, application of lubricants and mechanism of lubrication.

UNIT-I	WATER AND ITS TREATMENT

Introduction - Hardness of water- Causes and effects of hardness - Expression and Units of Hardness - Determination of hardness by complexometric method- Numerical problems – Treatment of water by Ion exchange process - Potable water and its specifications – steps involved in treatment of potable water: screening, aeration, sedimentation, coagulation, filtration and sterilisation of water by Chlorination. Desalination of water by Reverse Osmosis.

UNIT-II	ELECTRO CHEMISTRY AND ITS APPLICATIONS

Electro chemical cells – electrode potential - standard electrode potential - Nernst Equation -Types of electrodes - SHE, Calomel, Quinhydrone and Glass electrode -Electrochemical series, and its application- Numerical Problems. Potentiometric: acid- base and redox titration.

UNIT-III	CORROSION AND ITS CONTROL

Introduction-causes and effects-Chemical and Electrochemical corrosion – Mechanism of electrochemical corrosion- factors affecting rate of corrosion- corrosion control methods - cathodic protection and Protective coatings – Metallic coatings- Methods of metallic coatings – Hot dipping methods: Galvanizing, Tinning, cementation (sherardizing) - electroplating (Copper), electroless plating (nickel). Organic coating - Paints (constituents and functions).

UNIT-IV	FUELS AND COMBUSTION

Fuels- Characteristics of good fuels - Classification of fuels with examples – Composition, Characteristics and uses of gasoline, diesel, kerosene oils - Knocking- octane and cetane rating – Aviation fuel: Composition and Characteristics- LPG and CNG: Composition, Characteristics and Uses. Combustion - Calorific value – Gross Calorific Value and Net Calorific Value. Calculation of air quantities required for combustion of a fuel – Numerical problems.

UNIT-V	LUBRICANTS

Lubricant: Definition – Classification with examples: Solid, gas and semisolid lubricants – Mechanism of Lubrication – Characteristics of good lubricant – Important properties of lubricant: viscosity, pour point, flash Point, demulsibility, volatility - Lubricant Additives – Advantages - Grading of lubricants

TEXT BOOKS:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi, 2014.

2. O G Palanna, Engineering Chemistry, Tata McGraw Hill, 2009.

REFERENCE BOOKS:

1. Sashichawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, 2003.
2. Engineering Chemistry (NPTEL Web-book), 11th edition by B.L. Tembe, Kamaluddin and M.S. Krishnan.
3. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press, 2013

ENGLISH

II Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5HS01	HSMC	2	0	0	2	30	70	100

OBJECTIVES:

Student will be able to:

1- Develop language proficiency with emphasis on Vocabulary, Grammar, Reading and Writing skills.

2- Apply the theoretical and practical components of English syllabus to study academic subjects more effectively and critically.

3- Analyze a variety of texts and interpret them to demonstrate in writing or speech.

4- Write/ compose clearly and creatively, and adjust writing style appropriately to the content, the context, and nature of the subject.

5- Develop language components to communicate effectively in formal and informal situations.

UNIT-I	**Of Studies by Francis Bacon**

Vocabulary: The concept of Word Formation, Prefixes and Suffixes
Grammar: Word Families- Nouns, Pronouns, Verbs, Adjectives, Adverbs
Reading Skills:Reading for General Details
Writing Skills: Punctuation, Writing Paragraphs

UNIT-II	**Scientist in Training: The Oxford Years Stephen Hawking's Biography by Kristine Larsen**

Vocabulary: Synonyms and Antonyms, Standard Abbreviations
Grammar: Preposition, Conjunctions, Articles
Reading Skills: Reading for Specific Details, Making Inferences
Writing Skills: Letter Writing- Letters of Request, Apology and Complaint- Letter of Application with Resume

UNIT-III	**The Teenage Years by Sarah Gray**

Vocabulary: Idioms and Phrasal verbs, Technical Vocabulary
Grammar: Sentence Structures, Tenses
Reading Skills: Reading between the Lines
Writing Skills: Essay writing andDescribing Objects, Places and Events

UNIT-IV	**Unlock Your Own Creativity by Robert Von Oech**

Vocabulary: One word Substitutes, Words often confused
Grammar: Direct and Indirect Speech, Active and Passive Voice
Reading Skills: Reading Techniques- Skimming and Scanning of the Text
Writing Skills: Technical Report Writing, E-mail writing, Picture Essay

UNIT-V	**A Talk on Advertising by Herman Wouk**

Vocabulary: Misplaced Modifiers, Redundancies
Grammar: Subject Verb Agreement (Concord), Common Errors in English
Reading Skills:Reading Techniques- Intensive and Extensive Reading
Writing Skills: Memo, Précis and Resume Writing

Text Books:

1. Green, David. Contemporary English Grammar Structures and Composition. Second Edition. Trinity Press. 2016.
2. Michael Swan. Practical English Usage. Oxford University Press. 2017.

Reference Books:

1. Murphy, R. Essential Grammar in Use. Cambridge University Press. 2015.
2. Wood, F.T. Remedial English Grammar. Macmillan. 2007.
3. Krishnamurthy. N, Modern English: A Book of Grammar Usage and Composition. Third Edition. Trinity Press. 2016.
4. Zinsser, William. On Writing Well. Harper Resource Book. 2001.
5. Hamp-Lyons, L. Study Writing. Cambridge University Press.2006.

COURSE OUTCOMES:

By the end of this course, students will be able to:

1- Construct sentences by using appropriate parts of speech.

2- Write letters/paragraphs/reports etc. for meaningful professional communication.

3- Make use of appropriate vocabulary in both written and spoken contexts.

4- Comprehend and analyse different levels of written documents.

5-Analyse and correct common errors in spoken and written forms.

PROGRAMMING FOR PROBLEM SOLVING

II Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5CS01	ESC	3	0	0	3	30	70	100

COURSE OBJECTIVES

1. To impart knowledge about problem solving and algorithmic thinking.
2. To familiarize with the syntax and semantics of C programming language.
3. To learn the usage of structured programming approach in solving problems.
4. To use arrays, pointers, strings and structures in solving problems.
5. To understand how to solve problems related to matrices, Searching and sorting.

COURSE OUTCOMES

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

1. Apply algorithmic thinking to understand, define and solve problems
2. Develop computer programs using programing constructs and control structures
3. Decompose a problem into functions to develop modular reusable code.
4. Use arrays, pointers, strings and structures to formulate algorithms and programs.
5. Use files to perform read and write operations

UNIT-I INTRODUCTION - PROBLEM SOLVING AND ALGORITHMIC THINKING

Problem Solving and Algorithmic Thinking Overview – Problem Definition, logical reasoning, Algorithm definition, practical examples, properties, representation, flowchart, algorithms vs programs.

Algorithmic Thinking – Constituents of algorithms - Sequence, Selection and Repetition, input-output; Computation – expressions, logic; Problem Understanding and Analysis – problem definition, variables, name binding, data organization: lists, arrays etc. algorithms to programs.

UNIT-II OPERATORS, EXPRESSIONS AND CONTROL STRUCTURES

Introduction to C language: Structure of C programs, data types, data inputs, output statements, Operators, precedence and associativity, evaluation of expressions, type conversions in expressions.

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

UNIT-III ARRAYS AND FUNCTIONS

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays, Basic Searching Algorithms: Linear and Binary search

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, call by reference, Passing arrays to functions, Recursionas a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Towers of Hanoi etc.

UNIT-IV	STRINGS AND POINTERS

Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions.

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation.

UNIT-V	STRUCTURES AND FILE HANDLING

Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self-referential structures, unions, typedef, enumerations.

File handling: command line arguments, File modes, basic file operations read, write and append, example programs

Text Books:

1. Riley DD, Hunt K.A. Computational Thinking for the Modern Problem Solver. CRC press, 2014 Mar 27.
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
3. Byron Gottfried, “Programming with C”, Schaum's Outlines Series, McGraw Hill Education, 3rd edition, 2017.

Reference Books:

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

PROGRAMMING FOR PROBLEM SOLVING LAB

II Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5CS02	ESC	0	0	3	1.5	30	70	100

COURSE OBJECTIVES:

1. To be familiarize with flowgorithm to solve simple problems
2. To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
3. To develop modular, reusable and readable C Programs using the concepts like functions, arrays, strings, pointers and structures.

COURSE OUTCOMES

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

1. Solve simple mathematical problems using Flowgorithm.
2. Correct syntax errors as reported by the compilers and logical errors encountered at run time
3. Develop programs by using decision making and looping constructs.
4. Implement real time applications using the concept of array, pointers, functions and structures.
5. Solve real world problems using matrices, searching and sortingTo enable them to represent data in arrays, strings and structures

LIST OF EXPERIMENTS

Week-1 **INTRODUCTION TO FLOGORITHM**

a. Installation and working of Flowgorithm Software.
b. Write and implement basic arithmetic operations using Flowgorithm – sum, average, product, difference, quotient and remainder of given numbers etc.

Week-2 **FLOGORITHM- OPERATORS AND EVALUATION OF EXPRESSIONS**

a. Draw a flowchart to calculate area of Shapes (Square, Rectangle, Circle and Triangle).
b. Draw a flowchart to find the sum of individual digits of a 3 digit number.
c. Draw a flowchart to convert days into years, weeks and days.
d. Draw a flowchart to read input name, marks of 5 subjects of a student and display the name of the student, the total marks scored, percentage scored.

Week-3 **FLOGORITHM- CONDITIONAL STATEMENTS**

a. Draw a flowchart to find roots of a quadratic equation.
b. Draw a flowchart to find the largest and smallest among three entered numbers and also display whether the identified largest/smallest number is even or odd
c. Draw a flowchart to check whether the triangle is equilateral, isosceles or scalene triangle

Week-4	OPERATORS

a. Write a C program to swap values of two variables with and without using third variable.
b. Write a C program to enter temperature in Celsius and convert it into Fahrenheit.
c. Write a C program to calculate Simple and Compound Interest.
d. Write a C program to calculate s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).

Week-5	CONDITIONAL STATEMENTS

a. Write a C program to find largest and smallest of given numbers.
b. Write a C program which takes two integer operands and one operator form the user(+,-,*,/,% use switch)
c. Write a program to compute grade of students using if else adder. The grades are assigned as followed:

marks<50	F
50≤marks< 60	C
60≤marks<70	B
70≤marks	B+
80≤marks<90	A
90≤mars≤ 100	A+

Week-6	LOOPING STATEMENTS

a. Write a C program to find Sum of individual digits of given integer
b. Write a C program to generate first n terms of Fibonacci series
c. Write a C program to generate prime numbers between 1 and n
d. Write a C Program to find the Sum of Series SUM=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!
e. Write a C program to generate Pascal's triangle.
f. Write a C program to generate pyramid of numbers.

```
            1
        1   3   1
    1   3   5   3   1
```

Week-7	ARRAYS

a. Write a C Program to implement following searching methods
   i. Binary Search
   ii. Linear Search
b. Write a C program to find largest and smallest number in a list of integers
c. Write a C program
   i. To add two matrices
   ii. To multiply two matrices
d. Write a C program to find Transpose of a given matrix

Week-8	FUNCTIONS

a. Write a C program to find the factorial of a given integer using functions
b. Write a C program to find GCD of given integers using functions
c. Write a C Program to find the power of a given number using functions

Week-9	RECURSION

a. Write a C Program to find binary equivalent of a given decimal number using recursive functions.
b. Write a C Program to print Fibonacci sequence using recursive functions.
c. Write a C Program to find LCM of 3 given numbers using recursive functions

Week-10	STRINGS

a. Write a C program using functions to
    a. Insert a sub string into a given main string from a given position
    b. Delete n characters from a given position in a string
b. Write a C program to determine if given string is palindrome or not

Week-11	POINTERS

a. Write a C program to print 2-D array using pointers
b. Write a C program to allocate memory dynamically using memory allocation functions (malloc, calloc, realloc, free)

Week-12	STRUCTURES

a. Write a C Program using functions to
    i. Reading a complex number
    ii. Writing a complex number
    iii. Add two complex numbers
    iv. Multiply two complex numbers
    Note: represent complex number using structure
b. Write a C program to read employee details employee number, employee name, basic salary, hra and da of n employees using structures and print employee number, employee name and gross salary of n employees.

Text Books:

1. Riley DD, Hunt K.A. Computational Thinking for the Modern Problem Solver. CRC press, 2014 Mar 27.
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
3. YashavantKanetkar, “Let Us C”, BPB Publications, New Delhi, 13th Edition, 2012.

Reference Books:

1. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018
2. King KN, "C Programming: A Modern Approach", Atlantic Publishers, 2nd Edition, 2015.
3. Kochan Stephen G, "Programming in C: A Complete Introduction to the C Programming Language", Sam's Publishers, 3rd Edition, 2004.
4. Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994.Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994.

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

II Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5HS02	HSMC	0	0	2	1	30	70	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. Enhance English language skills, communication skills and to practice soft skills.
3. Improve fluency and pronunciation intelligibility by providing an opportunity for practice in speaking.
4. Get trained in different interview and public speaking skills such as JAM, debate, role play, group discussion etc.
5. Instill confidence and make them competent enough to express fluently and neutralize their mother tongue influence.

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

a. Computer Assisted Language Learning (CALL) Lab

b. Interactive Communication Skills (ICS) Lab

Listening Skills

Objectives

1. To enable students develop their listening skills to appreciate its role in the LSRW skills approach to language and improve their pronunciation.
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions.

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions
- Describing objects/situations/people
- Role play – Individual/Group activities
- Group Discussions
- Debate

Exercise-I

CALL Lab:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening. *Practice*: Introduction to Phonetics – Speech Sounds – Word Stress and Rhythm

ICS Lab:

Understand: Communication at Work Place- Spoken vs. Written language.

Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Introductions- Greetings – Taking Leave.

Exercise-II	

CALL Lab:
Understand: Structure of Syllables — Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions- Telephone Etiquette.

Exercise-III	

CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Interference of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations- Extempore

Exercise-IV	

CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: Group Discussions, Debate

Exercise-V	

CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Introduction to Interview Skills.
Practice: Mock Interviews.

Reference Books:

1. Whitby, N. Business Benchmark. Cambridge University Press (with CD) 2nd Edition.
2. Kumar, S. &Lata, P. (2011). Communication Skills. Oxford University Press.
3. Balasubramanian, T. (2008). A Text book of English Phonetics for Indian Students, Macmillan.
4. Thorpe, E. (2006). Winning at Interviews, Pearson Education.
5. Sethi, J. et al. (2005). A Practical Course in English Pronunciation (with CD), Prentice Hall of India.

COURSE OUTCOMES:

By the end of the course students will be able to

a) Develop better perception of nuances of English language through audio- visual experience.
b) Acquire Neutralization of accent for intelligibility.
c) Participate in group activities.
d) Employ speaking skills with clarity and confidence which in turn enhances their employability.

ENGINEERING CHEMISTRY LAB

II Semester: AERO, MECH

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5BS14	BSC	0	0	3	1.5	30	70	100

Course Outcomes:

At the end of the course students will be able to:

1. **Estimate** hardness, alkalinity and chloride content in water to check its suitability for drinking.
2. **Estimate** the percentage content of metal oxide in construction material.
3. The measurement of physical properties like adsorption and viscosity.
4. **Demonstrate** the digital and instrumental methods of analysis
5. **Synthesize** various organic compounds.

LIST OF EXPERIMENTS

Experiment-1	Determination of total hardness of water by complexometric method using EDT
Experiment-2	Determination of Alkalinity of given water sample
Experiment-3	Estimation of Chloride content of water by Argentometry.
Experiment-4	Estimation of amount of HCl by Conductometry.
Experiment-5	Estimation of amount of Acetic acid by Conductometry..
Experiment-6	Estimation of amount of ferrous ion by potentiometry using potassium
Experiment-7	Estimation of HCl by potentiometry
Experiment-8	Determination of Viscosity of a given liquid using Ostwald's Viscometer
Experiment-9	Determination of surface tension of a given liquid using Stalagmo meter
Experiment-10	Synthesis of Aspirin
Experiment-11	Synthesis of Thiokol Rubber
Experiment-12	Separation of organic mixture by Thin layer Chromatography and calculation of RF values.
Experiment-13	Determination of percentage of Calcium Oxide in Cement
Experiment-14	Estimation of Manganese Dioxide in Pyrolusite

Reference Books:

1. Senior practical physical chemistry, B. D. Khosla, A. Gulati and V. Garg (R. Chand and amp; Co., Delhi)
2. An introduction to practical chemistry, K. K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi)
3. Vogel's textbook of practical organic chemistry 5th edition.
4. Text book on Experiments and calculations in Engineering chemistry- S. S. Dara

B.TECH III SEMESTER SYLLABUS

VECTOR CALCULUS AND PROBABILITY STATISTICS

III Semester: **MECHANICAL ENGINEERING**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5BS06	BSC	3	1	0	4	30	70	100

Course Objectives

1. Evaluation of definite integrals using Beta and Gamma functions.
2. Verification of vector integral theorems.
3. The concepts of discrete and continuous random variables, probability distribution and density function.
4. The concept of correlation and regression to find covariance.
5. Evaluation of the given data for appropriate test of hypothesis and finding the variance.

UNIT-I	BETA GAMMA FUNCTIONS AND VECTOR DIFFERENTIATION

Beta- Gamma Functions and their Properties-Relation between them- Evaluation of improper integrals using Gamma and Beta functions.
Scalar and vector point functions - Gradient, divergence, curl and their related properties -Solenoidal and irrotational vector point functions - Scalar potential function - Laplacian operator

UNIT-II	VECTOR INTEGRATION AND VECTOR INTEGRAL THEOREMS

Line integral - work done - surface integrals - volume integral - Vector integral theorems - Green's theorem in a plane - Stoke's theorem - Gauss divergence theorem (all theorem statements and their verification).

UNIT-III	SINGLE RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS

Basic definitions of probability, Random Variables – Discrete and Continuous. Probability distributions, mass function/ density function of a probability distribution- mathematical expectation, Mean, Variance.
Binomial, Poisson & Normal distributions and their Properties.

UNIT-IV	CORRELATION & REGRESSION AND SAMPLING DISTRIBUTIONS

Coefficient of correlation, the rank correlation, Covariance of two random variables. Regression- Regression Coefficient, The lines of regression.
Sampling: Definitions of population, sampling, statistic, parameter. Types of sampling, Expected values of Sample mean and variance, sampling distribution, Standard error, Sampling distribution of means and sampling distribution of variance.
Parameter estimation- Point estimation and interval estimation.

UNIT-V	TESTING OF HYPOTHESIS

Testing of hypothesis: Null hypothesis, Alternate hypothesis, type I & type II errors – critical region, confidence interval, Level of significance. One sided test, two sided test,
Large sample tests:(i) Test of Equality of means of two samples equality of sample mean and population mean (cases of known variance & unknown variance, equal and unequal variances)
(ii) Tests of significance of difference between sample S.D and population S.D.
(iii) Tests of significance difference between sample proportion and population proportion &difference between two sample proportions.

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

Text Books:

2. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.
3. Probability and Statistics for Engineers and Sciences by Jay L. Devore, Cengage Learning

Reference Books:

1. Fundamentals of Mathematical Statistics by S.C. Guptha &V.K. Kapoor, S. Chand
2. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, Academic Press

Course Outcomes;

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

1. Evaluate of definite integrals using Beta and Gamma functions
2. Verify vector integral theorems.
3. Evaluate the discrete and continuous random variables, mathematical expectation of mean and variance.
4. Apply the concepts of correlation and regression to find covariance and sampling distribution of mean and Variance.
5. Evaluate the given data for appropriate test of hypothesis.

STRENGTH OF MATERIALS

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME06	PCC	3	1	0	4	30	70	100

COURSE OVERVIEW:

Mechanics of solids is the branch of continuum mechanics which deals with behaviour of solids under different loading conditions. This course will help students to acquire knowledge on the concepts needed for the design of various machine elements.

COURSE OUTCOMES:

The course should enable the students to

1. Explain concepts of simple stresses and strains, calculate deformations, strains and stresses in axial bar elements subjected to different load conditions.
2. Draw and analyze shear force and bending moment diagrams of various beams.
3. Analyze the members subjected to bending and shear loads.
4. Explain principal stresses, principal strains and derive slope and deflection equations for various beams for different loading conditions.
5. Analyze shafts subjected to torsion and thin cylindrical and spherical shells.

UNIT-I SIMPLE STRESSES AND STRAINS

Elasticity and plasticity, Types of stresses and strains, Hooke's law stress, straindiagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic module and the relationship between them, Bars of varying section, composite bars, Temperature stresses. Strain energy, Resilience - Gradual, Sudden, Impact, and Shock loadings

UNIT-II SHEAR FORCE AND BENDING MOMENT

Definition of beam, Types of beams, Concept of shear force and bendingmoment, Relation between Shear Force and Bending Moment. and rate of loading at a section of a beam. Shear Force and Bending Moment diagrams for cantilever simply supported and overhanging beams subjected to point loads, U.D.L., uniformly varying loads and combination of these loads, Point of contra flexure.

UNIT-III FLEXURAL STRESSES & SHEAR STRESSES

FLEXURAL STRESSES: Theory of simple bending, Assumptions, Derivation of bending equation: M/ I = f/y = E/R, Neutral axis, Determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections.

SHEAR STRESSES: Derivation of formula, Shear stress distribution across various beams sections like rectangular,circular, I, T, angle sections.

UNIT-IV PRINCIPAL STRESSES AND STRAINS & DEFLECTION OF BEAMS

PRINCIPAL STRESSES AND STRAINS: Introduction - Stresses on an inclined section of a bar under axial loading - compound stresses - Normal and tangential stresses on an inclined plane for biaxial stresses - Two perpendicular normal stresses accompanied by a state of simple shear - Mohr's circle of stresses - Principle stresses and strains - Analytical and graphical solutions.

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.

UNIT-V	TORSION OF CIRCULAR SHAFTS & THIN CYLINDERS

TORSION OF CIRCULAR SHAFTS: Theory of pure torsion - derivation of Torsion eqautions: T/J = Ƭ/R = Gϴ/L - Assumptions made in the theory of pure torsion - Torsional moment of resistence - Polar section modulus - Power transmitted by shafts

THIN CYLINDERS: Thin seamless cylindrical shells, Derivation of formula for longitudinal and circumferential stresseshoop, longitudinal and volumetric strains, changes in dia, and volume of thin cylinders, Riveted boiler shells, Thin spherical shells.

Text Books:

1. Dr.S.Sadhu Singh, Strength of materials, Khanna publishers.
2. Ramamrutham S, Strength of materials, Danpath rai publishing company.

Reference Books:

1. Strength of materials by R.K.Bansal, Laxmi Publications (P) Ltd.
2. Engineering mechanics of solids by EGOR P. Popov, Pearson publishers
3. Timoshenko and Gere, Mechanics of Materials, CBS Publishers, 2011
4. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman

MATERIAL SCIENCE AND METALLURGY

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME07	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course is intended to provide basic knowledge on the metallurgical aspects of metals that are being used in our homes to various engineering applications. It covers the fundamental aspects of materials, crystal structures and their representation, and various defects that are present in the materials. Then, the necessity of alloying and the corresponding changes occurring in their phase diagrams are discussed. A special focus is given on the important ferrous and non-ferrous alloys which are extensively used in the industries. Tailoring of material properties through different heat treatment processes with their microstructural changes are included. And, finally the course concludes with discussion on materials other than metals that includes polymers, ceramics and advanced materials such as composites.

COURSE OUTCOMES:

At the end of course, students will be able to

1. Explain basic concepts of crystal structures and their imperfections.
2. Interpret various phases present in the binary phase diagrams of alloys and comment on the microstructural development
3. Recommend a heat treatment processes for the desired changes in properties.
4. Differentiate ferrous and non-ferrous alloys.
5. Classify and explain polymers, ceramics and composites.

UNIT-I CRYSTAL STRUCTURE

Metallic crystal structures: Unit cells, crystal systems, crystal points, directions and planes,
Imperfections in solids: point defects, dislocations, surface and volume defects, dislocation strengthening mechanisms, slip systems, strengthening mechanisms for single phase metals: grain size reduction, Hall - Petchequation and determination of grain size.

UNIT-II ALLOYS & PHASE DIAGRAMS

Alloys: Definition, necessity of alloying; Solid solutions: substitutional and interstitial, Hume-Rothery rules. Phase diagrams: Gibbs phase rule, unary phase diagram, cooling curves of pure metals, construction of phase diagram,
Interpretation of binary phase diagrams: Tie line, Lever rule, various invariant reactions, Microstructure development upon cooling, Iron Carbon phase diagram: Phases, Invariant reactions involved.

UNIT-III HEAT TREATMENT OF STEEL

Heat treatment processes: Annealing & their types, normalizing, spheroidizing, hardening and tempering, Surface hardening: flame and induction hardening, Case hardening: carburizing, nitriding, carburising and cyaniding,

Transformation Diagrams: Time-Temperature-Transformation (TTT) diagrams Fe-C alloys, bainite and martensite, continuous cooling curves and interpretation of final microstructures and properties.

Special heat treatment processes: austempering& its limitations, martempering.

UNIT-IV	FERROUS AND NON-FERROUS ALLOYS

Ferrous alloys: Introduction, Classification, Plain carbon steels: high, medium and low carbon steels, alloying of steels: stainless steels, tool steels and maraging steels; Cast irons: grey, white, malleable and spheroidal cast irons.
Non-ferrous alloys: Copper alloys- brass, bronze and cupro-nickel; Aluminium and Aluminium alloys.

UNIT-V	POLYMERS, CERAMICS AND COMPOSITES

Polymers and Ceramics: Introduction, classification, general characteristics, and potential applications.
Composites: Introduction, classification, general characteristics, and potential applications.

Text Books:

1. W. D. Callister, Materials Science and Engineering-An Introduction, Wiley India, 6th Edition, 2006.
2. V. Raghavan, Material Science and Engineering, Prentice Hall of India Private Limited, 1999.
3. Sidney H. Avener, Introduction to Physical Metallurgy, Tata McGraw hill education (P) Ltd, 2nd Edition, 2007.

Reference Books:

1. U. C. Jindal, Engineering Materials and Metallurgy, Pearson, 2011.
2. Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. D. Kodgire, Material Science and Metallurgy for Engineers, Everest, 1st Edition, 2006.

THERMODYNAMICS

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME09	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW :

This course intended to introduce thermodynamic laws and their application to analyse boilers, heat pumps, heat engines etc., properties of mixture of gases and pure substances, Psychrometry.

COURSE OBJECTIVES:

The course should enable the students to:

- To understand the basic concepts of thermodynamics.
- To comprehend laws of thermodynamics and apply it to the related processes.
- Perform thermal analysis on behaviour and performance of systems.

COURSE OUTCOMES:

- CO1 - Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.
- CO2 – Analyse the second law of thermodynamics to open and closed systems and calculate entropy.
- CO3 - Summarize the thermodynamic properties of gases and steam and apply it to related system analysis.
- CO4 - Calculate the properties of gas mixtures and apply it to related system analysis.
- CO5 - Evaluate the properties of moist air and its use in psychometric processes.

UNIT-I **Basic Concepts and First Law**

Basic concepts – concept of continuum, microscopic and macroscopic approach. Path and point functions. System and their types. Thermodynamic Equilibrium State, Quasi-static, reversible and irreversible processes. Heat and work transfer.

Zeroth law of thermodynamics –First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

UNIT-II **Second Law and Entropy**

Second law of thermodynamics – Kelvin-Plank's and Clausius statements. Reversibility and irreversibility. Heat Engine, Refrigerator, Heat pump, Carnot theorem, efficiency, COP.
Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

UNIT-III **Properties of Pure Substances**

Properties of pure substances - solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces.
Thermodynamic properties of steam, Dryness fraction and its determination by separating and throttling calorimeter.

UNIT-IV	Ideal and Real Gases, Gas Mixtures and Thermodynamic Relations
Properties of ideal and real gases - Equations of state - compressibility factor - compressibility chart. Properties of gas mixture. Exact differentials – Difference and ratio of heat capacities - Clausius Clapeyron equations - Joule Thomson effect.	
UNIT-V	**Psychrometry**
Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications.	
Text Books:	
1.Nag.P.K, Engineering Thermodynamics, 6th Edition, Tata McGraw-Hill, 2017. 2. R.K.Rajput, A Textbook of Engineering Thermodynamics, 5 th Edition, Laxmi Publications, 2016. 3. Onkar Singh, Applied Thermodynamics, 4 th Edition, New Age International Private Limited, 2018. 4. Chattopadhyay, P, “Engineering Thermodynamics”, Oxford University Press, 2016.	
Reference Books:	
1. Yunus A Cengel and Michael A Boles, Thermodynamics: An Engineering Approach, 8th Edition, McGraw Hill, 2017. 2. Claus Borgnakke, Richard E. Sonntag, Fundamentals of Thermodynamics, 8th Edition, Wiley, 2016. 3. Lynn D. Russell, George A. Adebiyi, Engineering Thermodynamics, 6th Edition, Oxford University Press, New Delhi, 2008.	

MANUFACTURING PROCESSES

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME10	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW :

This course is intended to introduce various manufacturing processes such as casting, joining, forming and their relevance in current manufacturing industry. Also focus to explore processing methods of plastics.

COURSE OUTCOMES:

The course should enable the students to

1. Explain casting, casting methods, preparation of patterns and castings.
2. Enumerate various welding & cutting techniques.
3. Explain hot working, cold working, extrusion, rolling and forging processes.
4. Select equipment for various deformation processes.
5. Demonstrate various methods used for producing plastic shapes.

UNIT-I CASTINGS & METHODS OF MELTING

CASTING: Steps involved in making a casting, Advantage of casting and its applications. 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 Solidification of casting, Concept, Solidification of pure metal and alloys, short and long freezing range alloys. Risers Types function and design, special casting processes 1) Centrifugal 2) Die 3) Investment.

METHODS OF MELTING: Crucible melting and cupola operation, steel making processes

UNIT-II WELDING & CUTTING OF METALS

WELDING: Classification of welding process types of welds and welded joints and their characteristics, design of welded joints, Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding. TIG and MIG, welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering and Brazing. Heat affected zones in welding; welding defects, causes and remedies, destructive, non-destructive testing of welds.

CUTTING OF METALS: Oxy Acetylene Gas cutting, water plasma, cutting of ferrous, non-ferrous metals.

UNIT-III HOT AND COLD WORKING, EXTRUSION

HOT WORKING AND COLD WORKING: Strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of cold and hot worked parts.

EXTRUSION OF METALS: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion, Forward extrusion and backward extrusion, Impact extrusion, Hydrostatic extrusion.

UNIT-IV ROLLING

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: Drawing and its types, wire drawing and Tube drawing, coining, Hot and cold spinning Forces and power requirement in the above operations.

UNIT-V	FORGING & PROCESSING OF PLASTICS

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

PROCESSING OF PLASTICS: Types of Plastics, Properties, applications and their Processing methods and Equipment (blow and injection modelling).

Text Books:

1. P. N. Rao (2011), Manufacturing Technology, Vol -1, 3rd edition, Tata McGraw- Hill education (P) Ltd, New Delhi
2. S. Kalpakjain (2005), Manufacturing Engineering and Technology, 4th edition, Pearson Education, New Jersey.

Reference Books:

1. R. K. Jain (2010), Production Technology, 16th edition, Khanna publishers, New Delhi, India.
2. B.S. Raghuwanshi (2011), A course in workshop Technology, Vol - II, 3rd Edition, DhanpatRai& Co, New Delhi, India
3. Gosh (2004), Manufacturing science, Affiliated East-west press (p) Ltd, New Delhi, India

MANUFACTURING PROCESSES LAB

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME11	PCC	0	0	2	1	30	70	100

COURSE OVERVIEW :

This course is designed to impart hands-on practical exposure on manufacturing processes and equipment.

COURSE OUTCOMES:

The student will be able to:

1. Design and manufacture different patterns
2. Prepare various castings.
3. Operate arc welding, gas welding and resistance welding equipment
4. Perform operations such as blanking, piercing, deep drawing, extrusion, bending and other operations.
5. Use injection moulding and blow moulding equipment to produce plastic products such as water bootle, water bottle caps etc.

LIST OF EXPERIMENTS:

METAL CASTING

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

II.WELDING

1. ARC Welding Lap & Butt Joint - 2 Exercises
2. 2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

III. MECHANICAL PRESS WORKING

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

IV. PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

MACHINE DRAWING AND COMPUTER GRAPHICS LAB

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME12	PCC	1	0	4	3	30	70	100

COURSE OBJECTIVES:

The objective of this course is to make the students to become familiar with drawing conventions, external and internal details of the machine components needed for manufacturing and assembling.

COURSE OUTCOMES:

The course should enable the students to:

1. Understand and apply Indian and international standards while drawing machine components
2. Illustrate various machine elements and simple parts in drawings.
3. Perform the drawing of riveted joints, couplings and bearings.
4. Recognize the assembled views of engine parts.
5. Relate the machine parts for assembled views.

UNIT-I MACHINE DRAWING CONVENTIONS

Need for drawing conventions – Introduction to ISI conventions:
1. Types of Drawings – Introduction, Drawing area, Title box size, location and details.
2. Conventional representation of materials, common machine elements such as screws, nuts, bolts, keys, gears.
3. Methods of dimensioning, placement of dimensions for holes, centers,curved and tapered features.
4. Types of sections – drawing of sectional views.

UNIT-II DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS

Selection of Views, additional views for the following machine elements and parts with every drawing proportions. Popular forms of Screw threads, bolts, nuts, stud bolts, keys, cotter joint and knuckle joint.

UNIT-III RIVTED JOINTS, COUPLINGS AND BEARINGS

Riveted joints for plates, flanged coupling, socket and spigotjoint.
Journal, pivot, collar and foot step bearings.

UNIT-IV ASSEMBLED VIEWS OF ENGINE PARTS

Drawing of assembled views for the part drawings of the following using conventions.
Engine parts – Cross head, Eccentric, connecting rod, piston assembly.

UNIT-V ASSEMBLED VIEWS OF MACHINE PARTS

Drawing of assembled views for the part drawings of the following using conventions.
Machine parts - Screws jack, Machine Vice, Plummer block, Tailstock.

Text Books:

1. Machine Drawing –K.L.Narayana, P.Kannaiah&K.Venkata Reddy / New Age/Publishers.
2. Machine Drawing – Dhawan, S.Chand Publications.
3. Machine Drawing- Siddheswar.

Reference Books:

1. Machine Drawing – N.D.Bhatt, Charotar Publishing House.
2. Machine Drawing – P.S.Gill.
3. Machine Drawing – Luzzader.

STRENGTH OF MATERIALS AND METALLURGY LAB

III Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME08	PCC	0	0	2	1	30	70	100

COURSE OUTCOMES:

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

1. Analyze mechanical behaviour of test sample under tensile, compressive, torsion and impact load conditions.
2. Find deflection of simply supported and cantilever beams with different cross sections/materials.
3. Calculate stiffness and modulus of rigidity of helical coil spring.
4. Identify the various phases depicted in the microstructure of pure metals, ferrous and non-ferrous alloys.
5. Analyze the significance of cooling rate in the formation of fine grains using Jominy end quench test.

SYLLABUS:

LIST OF EXPERIMENTS: Strength of Materials Lab

1. Direct tension test.
2. Deflection test on simply supported beam and Cantilever beam.
3. Torsion test.
4. Hardness test
    a. Brinell's hardness test
    b. Rockwell hardness test
5. Test on springs.
6. Charpy and Izod Impact test.

LIST OF EXPERIMENTS: Metallurgy Lab

7. Study of microstructures of pure metals such as Iron, Cu, Al, etc.
8. Study of microstructures of plain carbon steels.
9. Study of microstructure of cast irons.
10. Study of microstructure of alloy steels.
11. Study of microstructures of non-ferrous alloys.
12. Determination of hardenability of steels by Jominy end quench test.

ENVIRONMENTAL STUDIES

III Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5MC03	MC	2	0	0	0	30	70	100

COURSE OVERVIEW :

This course is introduced to create the awareness about environmental problems among students, to Impart basic knowledge about the environment and its allied problems. Also focus on developing an attitude of concern for the environment, motivating students to participate in environment protection and environment improvement.

COURSE OUTCOMES:

Upon successful completion of the course, the student should be able to

1. Explain the natural resources and their management.
2. Understanding the Classification and functioning of Ecosystems.
3. Remembering the Importance of biodiversity and its conservation.
4. Understanding the problems related to environmental pollution and management.
5. Apply the role of information technology, Analyze social issues and Acts associated with Environment.

UNIT-I	ECOSYSTEM

Introduction, definition, scope and Importance of environmental studies. Classification, structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Biogeochemical cycles, Bioaccumulation, Biomagnifications.

UNIT-II	NATURAL RESOURCES

Classification of Resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Forest resources, Energy resources: renewable and non renewable energy sources.

UNIT-III	BIODIVERSITY

Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife: co-existence and conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation.

UNIT-IV	ENVIRONMENTAL POLLUTION

Environmental Pollution: Air Pollution: types of pollutants. Water pollution: Sources and types of pollution, Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, composition and characteristics of e-Waste and its management. Global Environmental Problems: Ozone depletion and Ozone depleting substances (ODS).

UNIT-V	ENVIRONMENTAL POLICY & LEGISLATION

International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Towards Sustainable Future: Concept of Sustainable Development, Environmental Education, urbanization, Urban Sprawl. Concept of Green Building.

Text Books:

1. Erach Bharucha (2005)., Textbook of Environmental Studies for Undergraduate Courses, Hyderabad, Universities Press.

Reference Books:

2. Anubha Kaushik(2006).,Perspectives in Environmental Science, 3rd Edition, New Delhi, New age international.
3. Textbook of Environmental Studies by OVK Reddy

B.TECH IV SEMESTER SYLLABUS

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5EE70	ESC	3	1	0	4	30	70	100

COURSE OBJECTIVE :

1. Develop fundamentals, including Ohm's law, Kirchoff's laws and be able to solve for currents, voltages and power in electrical circuits.
2. Develop EMF equation and analyze the operation of DC Machines.
3. Analyze the working principle of Transformer.
4. Discuss the operation of AC Machines and Electrical Instruments.
5. Analyze the operation of PN junction diode and rectifiers.
6. Discuss the operation and characteristics of Transistors.

COURSE OUTCOMES:

The course should enable the students to

1. Understand basic electrical concepts, including electric charge, current, electrical potential, electrical Power and energy.
2. Differentiate circuits with ideal, independent, and controlled voltage and current sources and able to apply Kirchhoff's voltage and current laws to the analysis of electric circuits.
3. Calculate the losses of DC machine and elucidate the working principle of Transformer.
4. Obtain the slip and torque characteristics of Induction motor and describe the types of electrical instruments.
5. Obtain the V-I characteristics of PN–junction diode and describe the operation of rectifiers.
6. Analyze the different configurations of Transistors and obtain its characteristics.

UNIT-I	ELECTRICAL CIRCUITS

Basic definitions-Ohm's Law – Kirchhoff's Laws – simple problems. types of elements, types of sources, series & parallel resistive networks with DC excitation, star to delta and delta to star transformations.

UNIT-II	DC MACHINES & TRANSFORMERS

Principle of Operation of DC Motor, types of DC motor, Losses and Torque equation, DC Generator construction and working Principle, EMF Equation, working principle and Construction of transformer.

UNIT-III	AC MACHINES &INSTRUMENTS

Principle of operation of 3-phase induction motor, slip and torque Equation, principle of operation of 3-phase Alternator. Basic principle of indicating instruments, permanent magnet moving coil and moving iron instruments.

UNIT-IV	DIODE AND ITS CHARACTERISTICS
PN JUNCTION DIODE: Operation of PN junction Diode: forward bias and reverse bias, Characteristics of PN Junction Diode –Zener Effect –Zener Diode and its Characteristics. Rectifiers, Half wave, Full wave and bridge Rectifiers– filters capacitor, inductor-Voltage Regulation.	
UNIT-V	**TRANSISTORS**
Bipolar Junction Transistor –CB,CE,CCC on figurations and Characteristics–Transistor Amplifier. TRANSISTOR BIASING AND STABILIZATION: Need for biasing, operating point, DC and AC load lines, stability factor, fixed bias circuit, collector to base bias circuit, self bias circuit.	
Text Books:	
1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshaiah TMH 2. ElectronicDevicesandcircuitsbyJ.Millman,C.C.HalkiasandSatyabrataJit2ed.,	
Reference Books:	
1. MuthusubramanianR,SalivahananSandMuraleedharanKA,"BasicElectrical,ElectronicsandComputer Engineering", Tata McGraw Hill, Second Edition,(2006). 2. NagsarkarTKandSukhijaMS,"BasicsofElectricalEngineering",Oxfordpress(2005). 3. Mehta V K, "Principles of Electronics", S.Chand& Company Ltd,(1994).	

THEORY OF MACHINES - I

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME13	PCC	3	1	0	4	30	70	100

COURSE OVER VIEW:

This course will deal with kinematic analysis of mechanisms and machines. It covers basic concepts and principles of various mechanisms, analysis of velocity and acceleration of different mechanisms, study of steering gear mechanisms, gears, gear trains, cams and followers.

COURSE OUTCOMES:

The course should enable the students to:
1. Synthesis basic concepts and principles of mechanisms for doing useful work.
2. Compute velocity and acceleration in different mechanisms.
3. Analyse straight line and steering gear mechanisms.
4. Design the gears and gear trains for transmission of motion.
5. Design cam profile for different follower motions.

UNIT-I INTRODUCTION

Introduction: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – Types of constrained motion – kinematic chain – Mechanism-Machine-Structure – Kleins criteria,

Degrees of freedom, Grubler's Criterion, Grashof's law – inversion of mechanism – inversions of four bar chain, single and double slider crank chains.

UNIT-II VELOCITY & ACCELERATION ANALYSIS

Velocity in Mechanisms: Relative Velocity Method- Relative velocities of two bodies moving in straight line, velocity of a point on a link by relative velocity method, Velocities in four bar and single slider crank mechanisms – Problems.
Instantaneous Centre Method: Introduction, Velocity of a point on a link, Types of instantaneous centres, Kennedy's theorem,Methodoflocatinginstantaneouscentres,Velocitiesinfourbarandsingleslidercrankmechanisms–Problems.

Acceleration in Mechanisms: Acceleration of a point on a link, Acceleration in four bar and single slidercrank mechanisms – Problems.

UNIT-III STRAIGHT LINE MOTION & STEERING GEAR MECHANISMS

Straight line motion mechanisms: Types, Peaucellier, Hart's, Scott Russel, Tchebichef's, Watt's, Grasshopper and Robert Mechanisms - Pantograph.
Steering gear mechanisms: Introduction, Condition for correct steering, Davis Steering gear mechanism, Ackerman's steering gear mechanism. Hooke's joint: Single and double Hooke's joint –velocity ratio – application – Problems.

UNIT-IV	GEARS & GEAR TRAINS
Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, phenomena of interference, condition for minimum number of teeth to avoid interference, expressions for arc of contact, path of contact and contact ratio of pinion and gear. Gear trains: Introduction – Types – Simple, compound and reverted gear trains, Epicyclic gear train –Methods of finding train value or velocity ratio – Problems.	
UNIT-V	**CAMS**
Cams: Introduction, classification of followers and cams; Displacement, velocity and acceleration analysis. Construction of motion of the follower for uniform velocity, simple harmonic motion, uniform acceleration and retardation, cycloidal motion.	

Text Books:

1. Theory of Machines / S.S. Rattan /Tata McGraw-Hill Education
2. Theory of Machines/Thomas Bevan/Pearson/ 3rdEdition

Reference Books:

1 Kinematics and Dynamics of machinery/Robert L. Norton/Tata Mc Graw Hill
2 Mechanisms of machines / Cleghorn W.L. / Oxford University Press
3 TheoryofMechanismandMachines/GhoshandMallik/AffiliatedEast-WestPvt.Ltd.
4 Theory of Machines by R.S Khurmi& J.K Gupta, S.Chand Publications.

THERMAL ENGINEERING -I

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME14	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW :

This course will make students to understand principles of Internal combustion engines, study testing and performance of compressors.

COURSE OUTCOMES:

The course should enable the students to:

1. Demonstrate the basic Cycles and operation of IC engines.
2. Analyse the combustion process and also how it does affect the performance of the IC engines.
3. Describe procedures of testing and analyses the emission of IC engines.
4. Apply the modern developments and alternate fuels on IC engines.
5. Formulate and perform the maintenance and operation of Air compressors.

UNIT-I	AIR STANDARD CYCLES AND IC ENGINES

Air standard Cycles- Otto, Diesel and Dual cycle.

IC Engine- Classification, Working principle, Valve and Port Timing Diagrams. Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Loss due to Rubbing Friction.

UNIT-II	COMBUSTION IN IC ENGINES

Combustion in S.I. Engines: Normal Combustion and abnormal combustion, Importance of flame speed and effect of engine variables, Type of Abnormal combustion, pre-ignition and knocking.

Combustion in C.I. Engines: Four stages of combustion, Delay period and its importance, Effect of engine variables, Diesel Knock, Need for air movement.

UNIT-III	IC ENGINE TESTING AND EMISSION

Performance of IC Engines: Measurement and analysis of engine performance. Factors effecting efficiency. Variable speed, Air/Fuel ratio. Heat balance test.

Engine Emissions: SI and CI engine emissions, Harmful effects, Emissions measurement methods, methods for controlling engine emissions.

UNIT-IV	MODERN DEVELOPMENTS AND ALTERNATE FUELS

Super Charging, Stratified charge engine, Dual-fuel engines, CRDI and HCCI concept, Hybrid and Electrical vehicle.

Alternate Fuels for IC Engines: Need for use of alternate fuels, Use of alcohol fuels, Biodiesel, Introduction to Battery system in electrical vehicle.

UNIT-V	AIR COMPRESSORS

Compressors: Classification, positive displacement and roto dynamic machinery, Rotary blower, vane sealed compressor, principle of working, efficiency considerations.

Reciprocating Air Compressors: Principle of operation, work required, Isothermal efficiency, volumetric efficiency, clearance, multi stage compression, under cooling, saving of work, minimum work condition for stage compression.

Text Books:

1. V. Ganesan (2011), I.C. Engines, 3rd edition, Tata McGraw-Hill, New Delhi, India.

2. R. K. Rajput (2011), Thermal Engineering, 18th edition, Lakshmi Publications, New Delhi, India.

Reference Books:

1. Mathur, Sharma (2008), IC Engines, 3 rd edition, Dhanpat Rai & Sons, New Delhi, India.
2. PulkrabekPulkrabek(2008),EngineeringfundamentalsofICEngines,2ndedition,PearsonEducation,NewJersey
3. Rudramoorthy(2003), Thermal Engineering, 5th edition, Tata McGraw-Hill, New Delhi, India.

FLUID MECHANICS AND HYDRAULIC MACHINES

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME15	PCC	3	1	0	4	30	70	100

COURSE OVERVIEW:

This course is introduced with the fundamentals of fluid mechanics such as fluid and fluid flow properties followed by the discussion on the behaviour of fluid at rest and in motion. Then, the basic principles of mass, momentum and energy are emphasized. The differential equations of continuity and momentum are developed and their applications are highlighted in flow measurements. At the end, the basics of turbo machinery are also covered to provide glimps on hydraulic machines which plays an important role in the conversion of hydraulic energy to mechanical energy and vice-versa.

COURSE OUTCOMES:

The course should enable the students to

1. Describe the basic principles of fluid mechanics.
2. Identify various types of flows and formulate their governing equations.
3. Analyze the losses in pipe flows with the concepts of flow through pipes.
4. Evaluate hydrodynamic forces of jet striking different vanes from various angles.
5. Design the working proportions of hydraulic turbines and pumps.

UNIT-I FLUID STATICS

Fluid Statics: Units and Dimensions, Properties of fluids: Mass Density,Specific weight, Specific Volume,Specific gravity, Viscosity, Surface tension and Capillarity, Vapour pressure and Cavitation.

Pressure, Buoyancy and Floatation: Pressure and its Measurements (Manometers).Buoyancy Forces, Buoyancy forces on submerged bodies. Floatation and stability of floating bodies.

UNIT-II FLUID KINEMATICS

Fluid Kinematics: Methods to describe fluid motions, Types of fluid flow- steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational, One dimensional, Two dimensional and Three Dimensional.

Discharge and Continuity Equation: Rate of Flow or Discharge. Stream line, path line, streak line and stream tube, basic principles of mass, momentum and energy, continuity equation for one, two and three dimensional flow, fluid acceleration.

UNIT-III FLUID DYNAMICS AND FLOW THROUGH PIPES

Fluid Dynamics: Surface and body forces, equations of motion: Euler's and Bernoulli's equations, Dimensional analysis, Bernoulli's equation for incompressible fluids and its practical applications: Venturimeter, Orificemeter, Pitot tube, Momentum equation.

Flow through Pipes: Elementary turbulent flow (Reynolds's experiment), flow through pipes: head loses in pipes (Major losses & Minor losses). Head loss due to friction: Darcy Weisbach equation, Total Energy Line (TEL), Hydraulic Gradient Line (HGL), Pipes in series and parallel; Basic concepts of boundary layer and its Separation.

UNIT-IV BASICS OF TURBO MACHINERY

Basics of Turbo machinery: Introduction, classification, hydrodynamic force of jets on stationary and moving plates, flat, inclined and curved vanes.

Workdone and Efficiency: Jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

UNIT-V	HYDRAULIC TURBINES AND PUMPS

Hydraulic turbines: Classification ofTurbines, Heads and efficiencies, Impulse and Reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine: working proportions, work done, efficiencies, draft tube theory, cavitation, surge tank, water hammer.

Hydraulic pumps: Classification, centrifugal and reciprocating pumps: working, work done,heads and efficiencies.

Text Books:

1. Modi and Seth, Hydraulics, Fluid Mechanics and Hydraulic Machinery, Rajsons Publications, 20th Edition, 2013.
2. YunusCengel, John Cimbala, Fluid Mechanics, McGraw Hill Education.
3. S K Som, GautamBiswas and SumanChakraborty, Introduction to Fluid Mechanics and Fluid Machines, 3rd Edition, McGraw Hill Education.

Reference Books:

1. Rajput, Fluid Mechanics and Hydraulic Machines, S.Chand& Co, 6th Edition, 1998.
2. Banga, Sharma, Hydraulic Machines, Khanna Publishers, 6th Edition, 2001.
3. Dr. R. K. Bansal, A Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd, 10th Edition, 2015.

DESIGN OF MACHINE MEMBERS-I

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME17	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW :

This course deals the systematic approach to design, standardization, design and manufacturing considerations, engineering materials properties and their selection, simple and compound stresses in machine elements, theories of failure under static and dynamic loading situations, Design of riveted joints, welded joints, bolted joints, keys and cotter joints, shafts, shaft couplings and springs.

COURSE OUTCOMES:

The course should enable the students to

1. Explain various types of design, various considerations for design and theories of failure.
2. Design riveted, welded and bolted joints.
3. Design keys, cotter and knuckle joints.
4. Design shafts and shaft couplings.
5. Design Mechanical Springs.

UNIT-I INTRODUCTION & FATIGUE

Introduction: General considerations & Manufacturing considerations for design of machine elements, Mechanical properties of materials, Static theories of failure and preferred numbers.
Fatigue: Types of Fatigue loading, S-N Curve – Endurance Limit, Factors effecting Endurance Limit, Stress Concentration - Theoretical stress concentration factor - Fatigue stress concentration factor - Notch sensitivity- Design for fluctuating stresses-endurance limit-Goodman line, Soderberg line and Gerber's Parabola.

UNIT-II DESIGN OF RIVTED , WELDED & BOLTED JOINTS

Riveted Joints: Cold riveting and hot riveting, types of riveted joints, terminology, methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints
Welded Joints: Types, Advantages, Dis advantages, Design of fillet welds-axial loads-circular fillet welds subjected to torsion and bending.
Design of bolts: Design of bolts with pre-stresses, bolts of uniform strength, bolted joints under eccentric loading.

UNIT-III DESIGN OF KEYS, COTTER& KNUCKLE JOINTS

Keys, Cotter& Knuckle Joints: Design of key-stresses in keys-cotter joints-spigot &socket, sleeve & cotter, Gib & cotter joints & Knuckle Joints.

UNIT-IV DESIGN OF SHAFTS & SHAFT COUPLINGS

Design of shafts: Design of solid & hollow shafts for strength & rigidity- Design of shafts for complex loads-shaft sizes-Design of shaft for Belt drives.

Shaft couplings: Rigid couplings-Muff, split muff and flange couplings-Flexible couplings-PIN Bush couplings

UNIT-V	DESIGN OF MECHANICAL SPRINGS

Mechanical Springs: Stresses & Deflection of helical springs-extension of compression springs- springs for static & fatigue loading-natural frequency of helical springs- energy storage capacity-helical torsion springs

Text Books:

1. V. Bandari (2011), *A Text Book of Design of Machine Elements*, 3rd edition, Tata McGraw hill education (P) ltd, New Delhi, India.
2. R. L. Norton (2006), *Machine Design (An Integrated approach*), 2nd edition, Pearson Publishers, Chennai, India.

Reference Books:

1. Shigley, J.E, (2011), *Mechanical Engineering Design*, 9th Edition, Tata McGraw-Hill, New Delhi, India.
2. Dr.P.C Sharma, D.K Agarwal, Machine Design, S.K Kataria& Sons

FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME16	PCC	0	0	2	1	30	70	100

COURSE OVERVIEW :

This course will provide a basic understanding of calibration of flow measuring devices such as venturi meter, orifice meter, notches, water meter, rotameter etc used in channels and pipes and Losses in pipes by major and minor loss apparatus. Measurements of critical Performance parameters like efficiency, flow rate etc of various hydraulic machines such as turbines, pumps are also measured in this lab. Students can perform tests and find the flow rate of equipment like venturimeter, orifice meter, and notches and can calibrate them. Darcy's as well as Chezy's coefficient of friction for different pipes can be found out in pipe friction apparatus. Also students can find out the performance of centrifugal and reciprocating pumps.

COURSE OUTCOMES:

At the end of course students are able to

1. Develop procedure for standardization of experiments.
2. Calibrate flow discharge measuring devices used in pipes.
3. Determine the major and minor losses in a given pipe.
4. Prove that the total head at any point along the fluid flow is same.
5. Test the performance of pumps and turbines.

LIST OF EXPERIMENTS:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5EE71	ESC	0	0	2	1	30	70	100

COURSE OUTCOMES:

At the end of course, students can able to

1. To analyze basic concepts to electric circuits
2. To apply electrical fundamentals to real time applications.
3. To apply electronics components to electronics circuits.
4. To create circuits containing basic electrical elements.
5. To apply electrical and electronics engineering concepts to real time applications

LIST OF EXPERIMENTS:

Section-A

1. Verification of KCL and KVL.
2. Magnetization characteristics of D.C. Shunt generator.
3. Speed control of DC motor.
4. Swinburne's Test on DC shunt machine.
5. Brake test on DC shunt motor.
6. OC and SC tests on Single-phase transformer.
7. Brake test on 3-phase Induction motor.
8. Regulation by an alternator by synchronous impedance method.

Section-B

1. PN Junction Diode Characteristics (Forward bias, Reverse bias)
2. Transistor CE Characteristics (Input and Output)
3. Study of CRO.
4. Class A Power Amplifier
5. Zener Diode Characteristics
6. Transistor CE Characteristics
7. Rectifier without Filters (Full wave &Half wave)
8. Rectifier with Filters (Full wave & half wave).

Note: Total 12 experiments are to be conducted.
(Six experiments from PART-A, Six experiments from PART-B)

Reference Books:

1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshaiah TMH
Electronic Devices and circuits by J.Millman, C.C.Halkias and SatyabrataJit 2ed.,

PYTHON LAB

IV Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME40	PCC	1	0	2	2	30	70	100

COURSE OVERVIEW :

1. Understand the basics and function of Python Programming Language.
2. Understand the string operation and sequences used in Python Programming Languages.
3. Understand the data structures used in Python Programming Languages.
4. Know the classes and objects in Python Programming Language.
5. Use the reusability concepts in Python Programming Language.

COURSE OUTCOMES:

The course should enable the students to

1. Apply conditional statement, loops condition and functions in python program
2. Solve mathematical and mechanical problems using python program
3. Plot various type of chart using python program
4. Analyze the mechanical problem using python program
5. Illustrate programs on various python libraries such asnumpy, pandas and matplotlib

List of Python Programs

1. Write a program to find root of quadratic equation.
2. Write a program to find and delete repeating number in Given List.
3. Write a program to perform equations of uniform motion of kinematics :
   i. $v = u + at$
   ii. $s = ut + \frac{1}{2}(at^2)$
   iii. $v^2 = u^2 - 2as$
4. Write a menu driven program to perform following properties of thermodynamics as given below:
   i. First Law of thermodynamics ($U = Q - W$), where ΔU is the change in the internal energy. Q is the heat added to the system, and W is the work done by the system.
   ii. Efficiency of Heat Engine = (TH – TC) / TH where TH & TC is the temperature of HOT and COLD Reservoirs.
5. Write the menu program to find the relationship between stress and strain curve as given below:
   i. Young's Modulus
   ii. Shear Modulus
   iii. Poisson Ratio
6. Write the program to determine the shear force and bending moment in beams.
7. Write a program to find maxima/minima of functions of two variables and evaluate some real

definite and finite integrals.

8. Write a Program to find out unknown magnitude of T_B and T_D of unknown tensions can be obtained from two scalar equations of equilibrium i.e. ΣFx = 0 and ΣFy =0.
9. Write a program to perform interpolation of equally and unequally spaced data.
10. Write a program to calculate total pressure exerted in ideal fluid as equation is given below:
    $P+1/2(\rho v_2) + \rho gh = constant$
    Where P is Pressure, V is Velocity of fluid, ρ is density and h is the height of the container.
11. Write a program to input and print the element sum of user defined matrix.
12. Write a program to input and multiply two different matrices.
13. Write a program to compute eigen value and vector of a given 3*3 matrix using NumPy.
14. Write a program to find a solution of linear equations in y=mx+c
15. Write a program to draw line using equation y=mx+c
16. Write the program to determine the intersection point of two lines.
17. Draw various types of charts using matplotlib.
18. Write a program to find numerical differentiation using Finite differences Method by Importing NumPy and plot the numerical values using matplotlib libraries of python.
19. Write a program for bresenham's line drawing algorithm.
20. Write a program for geometric transformation of a given object.

III B.TECH I SEMESTER SYLLABUS

METROLOGY AND MACHINE TOOLS

III B. TECH I Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME19	PCC	3	0	0	3	30	70	100

COURSEOVERVIEW:

Thiscourseisintroducedtoimpartknowledgeofmetalcuttingprinciplesandtheirapplicationtovariousmachiningprocesses,conceptsof limits, fits and tolerances, measurement and control.

COURSEOUTCOMES:

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

1. Identify techniques to minimize the errors in measurement.
2. Demonstrate methods and devices for measurement of length, angle, gear & thread parameters, surface roughness and geometric features of parts.
3. Explain working of lathe, shaper, planer, drilling, milling and grinding machines.
4. Comprehend speed and feed mechanisms of machine tools.
5. Estimate machining times for machining operations on machine tools.

UNIT-I LINEAR AND ANGULAR MEASUREMENTS

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, and Sine bar. Measurements by using auto collimator.

UNIT-II 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.

UNIT-III METAL CUTTING & LATHE MACHINES

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Merchants Circle Diagram and cutting forces, Chip formation and types of chips. Engine lathe – Principle of working, types of lathes, specifications. Taper turning, – Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes

UNIT-IV DRILLING AND BORING MACHINES

Drilling and Boring Machines – Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines – Principles of working – machining time calculations; Work Holding Devices-Jigs and Fixtures, Types and applications.

UNIT-V	MILLING &GRINDING MACHINES
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	
Text Books:	
1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson 2. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill. 3. A Text Book of Metrology/M.Mahajan/Danpat Rai	
Reference Books:	
1. Principles of Machine Tools, Bhattacharyya A and Sen. G.C / New Central Book Agency. 2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson 3. Metrology & Measurements – Bewoor & Anand Kapoor	

THERMAL ENGINEERING - II								
III B. TECH I Semester: MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A5ME21	**PCC**	3	0	0	3	30	70	100

COURSE OVERVIEW:

The primary focus of this course is on application of laws of Thermodynamics to analyse steam and gas turbine cycles. It also emphasizes on analysis of the major components of steam and gas turbine plants and their applications

COURSE OBJECTIVES:

The course should enable the students to:

- To understand the basic concepts of thermodynamics.
- To comprehend laws of thermodynamics and apply it to the related processes.
- Perform thermal analysis on behaviour and performance of systems.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Demonstrate the Rankine cycle and apply thermodynamic concepts on boilers.
2. Figure out the types and applications of steam nozzles and condensers.
3. Classify the steam turbines and describe it's working.
4. Explain the working of gas turbines and analyse the performance.
5. Demonstrate the principles of operation of refrigeration and Air- conditioning systems.

UNIT-I	**BASIC CONCEPTS AND BOILERS**

Basic Concepts: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating-Cycles.

Boilers: Classification – Working principles with sketches including H.P. Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance.

UNIT-II	**STEAM NOZZLES & STEAM CONDENSORS**

Steam Nozzles: Stagnation Properties- Function of nozzle – Applications and 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-Criteria to decide nozzle shape.

Steam Condensers: Requirements of steam condensing plant, Classification of condensers, working principle of different types, vacuum efficiency and condenser efficiency, air leakage, sources and its affects, air pump, cooling water requirement

UNIT-III	STEAM TURBINES

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.

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-IV	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, Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

UNIT-V	REFRIGERATION AND AIR CONDITONING

Refrigeration: Reversed Carnot cycle – Performance Evaluation – Vapour Compression Cycle, Vapour absorption cycle – mechanical details, working principles, use of P-H charts for calculations.
Air- Conditioning: Introduction, classification and working principles of air-conditioning systems, requirements, schematic layout of a typical plant.

Text Books:

1. R. K. Rajput, Thermal Engineering, 18th edition, Lakshmi Publications, New Delhi, India.
2. V. Ganesan, Gas Turbines, 3rd edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India.
3. CP Arora, Refrigeration and Air Conditioning, TMH.

Reference Books:

1. P.L. Ballaney, 1966, Thermal Engineering, 25 edition, Khanna Publishers, New Delhi, India
2. Cohen, Rogers, Saravana Muttoo, 2011, Gas Turbines, 9th edition, Addison Wesley Longman, New Delhi, India.
3. R. Yadav, 2011, Thermodynamics and Heat Engines, 7th Edition, Central Book Depot, Allahabad, India.

THEORY OF MACHINES - II

III B. TECH I Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME23	PCC	3	1	0	4	30	70	100

COURSEOVERVIEW:

This course is intended to deal with the forces and their effects, while acting upon the machine parts in motion. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. Study of gyroscopes is very much helpful to learn the precession and stability of moving vehicle such as aircrafts, Naval ships and automobiles. This course helps to analyse and evaluate the force and torques that causes of motions in mechanisms. It provides knowledge on clutches, brakes and dynamometers, balancing of machines and application of vibrations

COURSE OUTCOMES:

After completing this course, the student must:

1. Analyse the effect of gyroscopic couples on the stability of aeroplane, naval ship and automobiles moving in a curved path and Static and dynamic analysis of 4-link mechanism.
2. Analyse the frictional forces and torques transmitted by various components such as clutches, brakes and dynamometers.
3. Demonstrate governing systems that control the speed of engines using the inertia phenomena and centrifugal forces and analyse different types of governors.
4. Find the position and magnitude of unbalanced masses for rotating and reciprocating parts of the engine
5. Determine frequency of various machine members subjected to free and forced vibrations.

UNIT-I	PRECESSION, GYROSCOPE, STATIC & DYNAMIC FORCE ANALYSIS

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method –D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Single Slider Crank Mechanism.

UNIT-II	FRICTION, BRAKES & DYNAMOMETERS

Friction: Pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate, cone and centrifugal clutches.
Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake - effect of braking of a vehicle. Dynamometers – absorption and transmission types.

UNIT-III	TURNING MOMENT DIAGRAM AND FLYWHEELS, GOVERNORS

Turning Moment Diagram and Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram – fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines – crank effort and torque diagrams.
Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability of governors.

UNIT-IV	BALANCING

Balancing of rotating masses- Analytical and graphical methods.
Balancing of reciprocating masses- Primary, Secondary, and higher balancing. Examination of multi cylinder-in-line engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

UNIT-V	VIBRATIONS

Vibrations: Types of vibratory motion, types of free vibrations, natural frequency of free longitudinal and transverse vibrations– natural frequency of free transverse vibrations over a simply supported shaft and fixed shaft due to concentrated and distributed loads. Critical or whirling speed of a shaft–Natural frequency of torsional vibrations of one, two and three rotor systems.

Text Books:

Theory of Machines / S.S. Rattan/ Tata McGraw-Hill education.
Theory of Machines/ Sadhu Singh/ Pearson

Reference Books:

Mechanism and Machine Theoryby JS Rao and RV Duggipati, New Age International Publishers.
Theory of Machines by Shigley, Mc Graw Hill Publishers.
Theory of Machines by Thomas Bevan, CBS Publishers

DESIGN OF MACHINE MEMBERS-II

III B. TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME24	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

The Design of machine members-II focus mainly on design of power transmitting elements like gears, Connecting rod, crankpin, crankshafts, pistons, cylinders, bearings, belts, ropes, chain's, pulleys, Power Screws and nuts.

COURSE OUT COMES:

After completing this course, the student must:

1. Identify design variables and performance factors in the study of journal bearings
2. Apply the basic principles for design of piston, connecting rod and crankshaft based on maximum bending and twisting moments
3. Design screws that are applied in hosting of heavy weights like screw jack etc.
4. Explain power transmission elements like belts, chains and ropes and able to design on stress criteria.
5. Apply the design concepts to evaluate the strength of the gear.

UNIT-I	BEARINGS

Types of Journal bearings – lubrication – Bearing modulus –Full and partial bearings, Partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball and roller bearings, bearing life.

UNIT-II	ENGINE PARTS

Connecting rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends – Cranks and Crank shafts, strength and proportions of over hung and center cranks-Crank pins, Crank shafts. Pistons, Forces acting on piston-Construction Design and proportions of piston, Cylinder, Cylinder liners.

UNIT-III	POWER SCREWS

Types of screw threads for power screws, Torque required to raise and lower the loads by square threaded screws, Efficiency of square threaded screws, Overhauling and self locking, Acme threads, Stresses in power screws, Design of screw jack.

UNIT-IV	BELTS & PULLEYS

Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts-Flat and V types-Ropes- Pulleys for belt and rope drives, Materials, Chain drives.

UNIT-V	**GEARS**

Spur gears-Helical gears-Load concentration factor-Dynamic load factor, Surface compressive strength, Bending strength- Design analysis of spur gears-Estimation of centre distance, module and face width, check for plastic deformation, check for dynamic and wear considerations.

Text Books:

1. V.Bandari (2011), A Text Book of Design of Machine Elements,3rd edition, Tata McGraw hill education(P) Ltd. New Delhi, India.
2. R.L.Norton(2006),Machine Design(An Integrated approach), 2nd edition, Pearson Publishers, Chennai, India.

Reference Books:

1. A Text book of Machine Design by R.S.Khurmi
2. S.MD.Jalaludin,(2011),Machine Design,3rd Edition, Anuradha Publishers, Chennai,India.
3. P.Kannaiah(2012), ,2nd Edition, Scitech Publications,India Pvt.Ltd.New Delhi,India.

METROLOGY AND MACHINE TOOLS LAB

III B. TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME20	PCC	0	0	2	1	30	70	100

COURSE OVERVIEW:

This course intends to understand the concepts of metrology and machine tools and to get practical exposure to the metrology equipment & Machine tools.

COURSEOUTCOMES:

At the end of the course, students are able to:

1. Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting.
2. Identify basic parts and operations of lathe, shaper, planer, drilling, boring, milling and grinding machines.
3. Select a machining operation and corresponding machine tool for a specific application in real time.
4. Perform various machining operations such as turning, threading, drilling, boring, shaping etc.
5. Inspect the dimensional and geometric features of a given component by selecting proper measuring instrument.

LISTOFEXPERIMENTS

A. METROLOGY

1. Measurement of length, height, diameter by vernier callipers and vernier height guage.
2. Use of gear tooth vernier callipers and checking the chordal thickness of spur gear.
3. Angle and taper measurements by bevel protractor, Sine bars, etc.
4. Thread measurement by two wire/ three wire method & tool makers microscope.
5. Measurement of length, diameter, depth and bore diameter by using micrometer (inside and outside) and dial bore indicator.

B. MACHINE TOOLS

1. Step turning, taper turning and Knurling operations on lathe machine
2. Thread cutting and Boring operations on -lathe machine.

3. Drilling and tapping by drilling Machine
4. Shaping and planning
5. Slotting and Milling operations
6. Cylindrical and Surface grinding
7. Grinding of tool angles.

THRMAL ENGINEERING LAB

III B.TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME22	PCC	0	0	2	1	30	70	100

COURSE OUTCOMES:

At the conclusion of the course, students will be able to,

1. Illustrate the Valve timing and port timing diagrams of CI & SI Engines.
2. Examine the performance parameters of internal combustion engines.
3. Examine the heat balance sheet in an internal combustion engine
4. Plot the performance characteristics of reciprocating air compressor.

LIST OF EXPERIMENTS:

1. I.C.Engines Valve Timing Diagram
2. I.C.Engines Port Timing Diagram
3. I.C.Engines Performance Test 4-Stroke Diesel Engine
4. I.C.Engines Performance Test 4-Stroke Petrol Engine
5. I.C.Engines Performance Test 2- Stroke Petrol Engine
6. Morse test on Multi cylinder Petrol
7. I.C.Engines Heat Balance
8. I.C.Engines Air/Fuel Ratio and Volumetric Efficiency
9. Performance Test on Variable Compression Ratio Engine
10. Performance Test on Reciprocating Air–Compressor Unit
11. Dis-assembly/ Assembly of Engines
12. Study of Boilers

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

III B. TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5HS04	HSMC	0	0	2	1	30	70	100

COURSE OVERVIEW:

The English Language Lab is considered essential at Third year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context. The proposed course should be an integrated theory and lab course to enable students to use 'good' English and perform the following: Gather ideas and information, to organize ideas relevantly and coherently, engage in debates. participate in group discussions, face interviews, write project/research reports/technical reports, make oral presentations, write formal letters, transfer information from non-verbal to verbal texts and vice versa and to take part in social and professional communication.

COURSE OUTCOMES:

At the conclusion of the course, students will be able to,

1. Organize the ideas coherently from the text.
2. Participate in debates, group discussions.
3. Write project/research reports/technical reports/formal letters.
4. Make oral presentations.

SYLLABUS

The following course content to conduct the activities is prescribed for the Advanced Communication Skills (ACS) Lab

Week -1	**Activities on Fundamentals of Inter-personal Communication**
Starting a conversation - responding appropriately and relevantly - using the right body language - Role Play in different situations & Discourse Skills- using visuals.	
Week -2	**Activities on Building Vocabulary**
Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.	
Week -3	**Activities on Reading Comprehension**
General Vs Local Comprehension, reading for facts, guessing meanings from context, Scanning and Skimming.	
Week -4	**Activities on Reading for Specific Purposes**

Inferring meaning, Critical reading & Effective goggling.	
Week-5	**Activities on Writing Skills- Technical Reports**
Structure and presentation of different types of writing - letter writing/ Resume writing/ e-correspondence.	
Week-6	**Activities on Writing Skills**
Technical report writing/ Portfolio writing - planning for writing - improving one's writing.	
Week- 7	**Activities on Presentation Skills**
Oral presentations (individual and group) through JAM sessions and Seminars.	
Week- 8	**Activities on Presentation Skills Using ICT**
PPTs and written presentations through posters/ projects/ reports/ e-mails/ assignments etc.	
Week- 9	**Activities on Group Discussion**
Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process.	
Week-10	**Interview Skills**
Pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews.	
Books	

1. Raman, M & Sharma, S. (2009). Technical Communication. Oxford University Press.
2. Rani. S. (2011). Advanced Communication Skills Laboratory Manual. Pearson Education.
3. Anderson, V. (2007). Technical Communication. Cengage Learning pvt. Ltd.
4. Kelly M. Quintanilla & Shawn T. Wahl. (2011). Business and Professional Communication: Keys for Workplace Excellence. Sage South Asia Edition. Sage Publications.
5. Stev. D & David T. Mc Mahan. (2012). The Basics of Communication: A Relational Perspective. Sage South Asia Edition. Sage Publications.
6. Mc Murrey. D & Buckley. J. (2012). Handbook for Technical Communication Cengage Learning.
7. Sen. L. (2009). Communication Skills. PHI Learning Pvt Ltd.
8. Vishvamohan, A. (2009). English for Technical Communication for Engineering Students. Tata Mc Graw Hill.
9. Books on TOFEL/ GRE/ GMAT/ CAT/ IELTS by Barron's/ DELTA/ Cambridge University Press.
10. Tomalin, B & Thomas, B. (2009). International English for Call Centers. Macmillan Publishers.

HUMAN VALUES AND PROFESSIONAL ETHICS

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5MC05	MC	2	0	0	0	30	70	100

COURSEOVERVIEW:

The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

COURSEOUTCOMES:

1. Practice the moral values that ought to guide the Engineering profession.
2. Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations
3. Justify the need for protection of human rights and to know about concept of women empowerment
4. Appreciate the Ethical issues and know the code of ethics adopted in various professional body's and industries
5. Know the successful functioning of democracy in India

UNIT-I	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 fulfilment 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.
D. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order.
E. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
F. At the level of society: as mutually enriching institutions and organizations.

Text Books:

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.

Reference Books:

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.

III B.TECH II SEMESTER SYLLABUS

CAD/CAM

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME26	PCC	3	0	0	3	30	70	100

COURSEOVERVIEW:

This course will provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. It covers various concepts of CAD/CAM such as geometric modelling, NC control, NC part programming, group technology etc.

COURSEOUTCOMES:

1. Demonstrate basic concepts of computer hard ware and software connected to CAD.
2. Explain wire frame modeling, surface modeling and solid modeling.
3. Discuss about NC, CNC, DNC, adaptive control systems, apt language, group technology and develop CNC programs.
4. Explain computer aided process planning and computer aided manufacturing resource planning.
5. Explain concepts of computer aided quality control and computer integrated manufacturing.

UNIT-I INTRODUCTION

Fundamentals of CAD, CAM, Automation, design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software, CAD database and structure. Product Design and CAD- Comparison, benefits of using CAD in product design and product development cycle.

UNIT II GEOMETRIC MODELING

Introduction, **Wire frame modelling:** Definition, advantages, dis-advantages, wire frame entities-analytic entities and synthetic entities. **Surface modelling:** Definition, advantages, dis-advantages, surface entities-analytic entities and synthetic entities. **Solid Modelling:** Definition, constructive solid geometry, advantages, modelling entities.

Curve representation: Implicit and explicit forms of straight line, circle, ellipse, cubic spline and bezier curve, differences between bezier curve and, cubic spline curve.

UNIT III NC CONTROL & GROUP TECHNOLOGY

NC Control: Introduction, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program. CNC, DNC and Adaptive Control Systems, APT language

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design using rank order cluster technique.

UNIT IV	COMPUTER AIDED PROCESS PLANNING & COMPUTER AIDED MANUFATURING

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type.

Computer aided manufacturing: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

UNIT V	COMPUTER AIDED QUALITY CONTROL AND CIM

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision, integration of CAQC with CAD/CAM.

Computer Integrated Manufacturing: Types of systems in CIM, human labour in the manufacturing systems, CIM advantages and disadvantages.

Text Books:

1. CAD/CAM Principles and Applications by P.N.Rao, TMH
2. CAD/CAM by Groover M.P., Pearson education

Reference Books:

1. CAD/CAM Theory and Practice,/ Ibrahim Zeid,TMH
2. CAD/CAM/CIMby Radhakrishnan and Subramanian, New Age
3. CAD/CAM Concepts and Applications by Alavala, PHI
4. Principles of Computer Aided Design and Manufacturing by Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming by Warren S Seames, Thomson.

HEAT TRANSFER

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME28	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course will provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications.

COURSE OUTCOMES:

1 Demonstrate the basic modes of heat transfer and compute temperature distribution on study and unsteady state heat conduction.
2 Analyse the heat transfer through variable thermal conductivity, system with heat generation and extended surfaces.
3 Interpret and analyse the free and forced convection heat transfer.
4 Comprehend the concepts of Boiling, Condensation and Heat exchangers.
5 Explain the principles of radiation heat transfer and apply the radiation laws on black and gray bodies..

UNIT-I INTRODUCTION

Modes and mechanisms of heat transfer, Basic laws of heat transfer, Applications of heat transfer. Fourier Law of conduction, general heat conduction equations in Cartesian, Cylindrical and Spherical coordinates. Different forms of the field equation, steady, unsteady and periodic heat transfer – Initial and boundary conditions.

UNIT-II ONE DIMENSIONAL HEAT CONDUCTION

Heat transfer through homogeneous slabs, hollow cylinders and spheres, Overall heat transfer coefficient, Electrical analogy and Critical radius of insulation. Systems with internal heat generation. Extended surfaces (Fins), Long, Short and insulated tips. Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems

UNIT-III CONVECTION

CONVECTIVE HEAT TRANSFER: Concepts of Continuity, Momentum and Energy Equations. Dimensional analysis-Buckingham‘s Pi Theorem - Application for developing non-dimensional correlation for convective heat transfer.

FORCED CONVECTION: External Flows, Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for Flat plates and Cylinders. Internal Flows, Concepts about Hydrodynamic and Thermal Entry Lengths, use of empirical correlations 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.

UNIT-IV	BOILING & CONDENSATION, HEAT EXCHANGERS

BOILING & CONDENSATION: Regimes of Pool boiling and Flow boiling, Critical heat flux, Calculations on Nucleate Boiling. Film wise and drop wise condensation, Nusselt's theory of condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

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	RADIATION HEAT TRANSFER

Emission characteristics, Laws of black-body radiation, Irradiation, Total and monochromatic quantities, Laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, Heat exchange between two black bodies, concepts of shape factor, Emissivity, heat exchange between grey bodies, radiation shields.

Text Books:

1. Yunus A. Cengel (2012), Heat Transfer a Practical Approach, 4th edition, Tata McGraw hill education (P) Ltd, New Delhi, India.

2. R. C. Sachdeva (2012), Fundamentals of Engineering, Heat and Man Transfer, 3rd edition, New Age, New Delhi, India.

Reference Books:

1. Holman (2012), Heat Transfer (SI Units), 10th edition, Tata McGraw hill education (P) Ltd, New Delhi, India.

2. P. S. Ghoshdastidar (2012), Heat Transfer, 2nd edition, Oxford University Press, New Delhi, India.

3. Incropera, Dewitt (2012), Fundamentals of Heat Transfer, 6th edition, John Wiley, UK.

AUTOMATION IN MANUFACTURING

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5ME30	PCC	3	0	0	3	30	70	100

Course Overview:

This course is useful to impart knowledge of different types of automation and production system used in industries. Understand the basic concept of the automated material handling system AGV, AS/RS and also to learn concepts of Group technology, Cellular manufacturing, Automated assembly and inspection.

Course Outcomes:

By studying this course, the student should be able to:

1. Recognize the steps involved in the process of automation and different types of automations systems used by industry.
2. Get exposure on workstation, Worker-and-machine combinations, and work transport system used in an automated industry.
3. Understand the various types of automated material handling equipment used for transport and storage in a factory.
4. Know the design, layout and benefits of Cellular & Flexible manufacturing systems.
5. Apply quantitative analysis to assembly and also can know the facts about Lean manufacturing and JIT.

UNIT I	INTRODUCTION

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

UNIT II	AUTOMATED FLOW LINES & LINE BALANCING

Automated Flow Lines: General terminology, Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

Line Balancing: line balancing methods, ways of improving line balance

UNIT III	AUTOMATED MATERIAL HANDLING & STORAGE SYSTEMS

Automated Material Handling & Storage Systems: Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Automated Storage Systems, Engineering Analysis of Storage Systems.

UNIT IV	CELLULAR MANUFACTURING & FLEXIBLE MANUFACTURING

	SYSTEMS
Cellular manufacturing: Objectives, Composite part concept, Machine cell design, Quantitative analysis-grouping parts and machines by rank order clustering. **Flexible Manufacturing Systems: introduction to FMS,** FMC/FMS Components, FMS Application Considerations, Analysis of Flexible Manufacturing Systems, Alternative Approaches to Flexible Manufacturing.	
UNIT V	**AUTOMATED ASSEMBLY SYSTEMS**
Automated Assembly Systems: Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems. **Just-In-Time and Lean Production:** Lean production and waste management, Just in time (JIT) production systems, worker involvement.	
Text Books:	
1. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education. 2. Industrial Automation: W.P. David, John Wiley and Sons.	
Reference Books:	
1. Handbook of Design, Manufacturing &Automation : R.C. Dorf, John Wiley and Sons. 2. An Introduction to Automated Process Planning Systems, Tiess Chiu Chang & Richard A. Wysk 3. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI 4. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE) .	

CAD/CAM LAB

III B.TECH II Semester MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5ME27	PCC	0	0	2	1	30	70	100

Course Overview:

This course is framed to have hands on experience on CATIA software so that students are able to model various mechanical engineering systems and also able to perform various machining operations on CNC machines

Course Outcomes:

At the end of the course students will be able to

1. Draft, model and assemble various machine part drawings using CATIA.
2. Perform different machining operations on CNC Lathe and CNC Milling machines.

Part A | CAD Experiments

1. Draw given 2D diagrams by using sketcher module.
2. Model given 3D objects by using part module.
3. Model and Assemble parts of knuckle joint.
4. Model and Assemble parts of stuffing box.
5. Model and Assemble parts of universal coupling.

Part B | CAM Experiments

1. Perform simple turning operation for a given model by using CNC lathe.
2. Perform step turning operation for a given model by using CNC lathe.
3. Perform profile turning operation for a given model by using CNC lathe.
4. Perform linear interpolation operations on CNC Milling machine.
5. Perform circular interpolation clock wise operations on CNC Milling machine.

HEAT TRANSFER LAB

III B.TECH II Semester MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME29	PCC	0	0	2	1	30	70	100

COURSE OVERVIEW:

Heat Transfer laboratory provides fundamental and industrial knowledge about modes of heat transfer, like conduction, convection and radiation and their application.

COURSE OUTCOMES:

At the conclusion of the course, students will be able to:

1. Apply the principles of various modes of heat transfer to evaluate thermal conductivity of different metals and non-metal objects under steady state conditions.
2. Apply the principles of various modes of heat transfer to evaluate thermal conductivity of different objects under unsteady state conditions.
3. Estimate heat transfer coefficients in forced convection, free convection, condensation and correlate with theoretical values.
4. Obtain variation of temperature along the length of the pin fin under forced and free convection.
5. Apply the principles of radiation to evaluate the surface emissivity of a test plate and Stefan- Boltzmann's constant and compare with theoretical values.

LIST OF EXPERIMENTS:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Thermal Conductivity of given metal rod.
4. Heat transfer through pin-fin
5. Heat transfer in forced convection apparatus.
6. Heat transfer in natural convection
7. Parallel and counter flow heat exchanger.
8. Emissivity apparatus.
9. Stefan Boltzmann Apparatus.
10. Heat transfer in drop and film wise condensation.
11. Critical Heat flux apparatus.
12. Study of heat pipe and its demonstration.

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PROFESSIONAL ELECTIVE – I

DESIGN FOR MANUFACTURING AND ASSEMBLY

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME41	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW

DFM techniques are focused on individual parts and components with a goal of reducing or eliminating expensive, complex or unnecessary features which would make them difficult to manufacture. This course will give insight on design for machining, casting, welding, brazing, forging, extrusion, sheet metal and assembly.

COURSE OUTCOMES:

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

1. Demonstrate steps in design process, design rules for manufacturability, material selection considerations and developments in material technology.
2. Demonstrate various machining processes and explain design considerations for machining and casting.
3. Describe various welding processes and explain design considerations for welding, brazing and forging.
4. Explain design considerations for extrusion and sheet metal work.
5. Explain objectives and design considerations for assembly.

UNIT-I	INTRODUCTION

Design philosophy steps in Design process — General Design rules for manufacturability — basic principles of designing for economical production, Materials-parameters to be considered for the selection of materials for design—criteria for material selection, material selection process for new product design, developments in material technology.

UNIT-II	DESIGN FOR MACHINING & CASTING

Overview of various machining processes — general design rules for drilling, milling and turning –General design recommendations for machined parts. Metal Casting: Appraisal of various casting processes, selection of casting process, – general design considerations for casting — casting tolerances — use of solidification simulation in casting design —product design rules for sand casting.

UNIT-III	DESIGN FOR WELDING, BRAZING & FORGING

Appraisal of various welding processes, Factors in design of weld ments — general design guidelines — pre and post treatment of welds — effects of thermal stresses in weld joints — design of brazed joints. Design considerations for Forging.

UNIT-IV **DESIGN FOR EXTRUSION & SHEET METAL WORK**

Extrusion-Design recommendations, design guidelines, Sheet Metal Work-cost effective design principles for Punching, Blanking and bending, Design principles for successful deep drawing, Keeler Goodman Forming Line Diagram.

UNIT-V **DESIGN FOR ASSEMBLY**

Design for assembly: objectives, link to design, General design rules for manual assembly, Development of systematic design for assembly methodology, Assembly efficiency, Effect of part symmetry, part thickness, size, weight on handling time, Effect of chamfer design on insertion operations, Estimation of insertion time.

TextBooks:

1. A K Chitale and R C Gupta, "Product Design and Manufacturing", PHI, New Delhi, 2003
2. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
3. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekken, N.Y. 1990.

Reference Books:

1. Engineering Design – Material & Processing Approach – George E. Deiter, McGraw Hill Intl. 2nd Ed.2000.

UNCONVENTIONAL MACHINING PROCESSES

III B. TECH II Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME42	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course covers operating principles of unconventional machining processes which helps to perform research and development activities.

COURSE OUTCOMES:

At the end of the course student will be able to

1. Explain need for unconventional machining processes, elements and working of ultrasonic machining process.
2. Demonstrate mechanical material removal processes.
3. Explain thermal metal removal processes.
4. Discuss electron beam machining and laser beam machining processes.
5. Explain chemical material removal processes.

UNIT-I INTRODUCTION

INTRODUCTION: Need for non-conventional machining processes, Comparision between conventional and unconventional machining processes, Classification of non - conventional machining processes, considerations in process selection-shape, materials, process parameters, effects on equipment and tooling, economic considerations.

Ultrasonic machining: Elements of ultrasonic machining, Mechanics of material removal-Grain throwing and Grain hammering models, Process parameters, Applications, Recent developments, simple problems.

UNIT-II MECHANICAL MATERIAL REMOVAL PROCESSES

ABRASIVE JET MACHINING: Elements of abrasive jet machining, working principle, advantages, limitations, applications.

Water Jet Machining: Working principle, elements & their functions, disadvantages, applications and mechanics of water jet machining, advantages.

Abrasive Water Jet Machining – basic principles, components, process parameters advantages and disadvantages, applications.

UNIT-III THERMAL MATERIAL REMOVAL PROCESSES

THERMAL MATERIAL REMOVAL PROCESSES: Electro Discharge Machining(EDM)-principle of operation, elements of EDM ,Power delivered, MRR, surface finish, process parameters problems on R-C generator, Layers formed on machined components during EDM, Flushing methods in EDM, Different circuits used in EDM, Factors to be considered for tool

selection in EDM, Dielectric fluids used in EDM, Advantages of EDM, Limitations of EDM, Applications of EDM. Wire EDM: working, advantages, limitations and applications, Electric Discharge Grinding: Working, process parameters.	
UNIT-IV	**ELECTRON BEAM MACHINING & LASER BEAM MACHINING**
ELECTRON BEAM MACHINING: Elements, Generation of electron beam and working, process parameters, advantages, disadvantages, applications, MRR, specific power consumption. LASER BEAM MACHINING: Elements, working, laser materials, cutting speed, accuracy, thermal features, advantages, disadvantages, applications.	
UNIT-V	**CHEMICAL MATERIAL REMOVAL PROCESSES**
CHEMICAL MATERIAL REMOVAL PROCESSES: Chemical Machining, Electro chemical machining-elements, working, accuracy, surface finish, economics, advantages, disadvantages, applications, MRR, problems, Electro chemical grinding, Electro chemical honing and Electro chemical deburring.	
Text Books:	
1. Advanced machining processes by VK Jain, Allied publishers. 2. Non Traditional Manufacturing Processes by Gary F Benedict, CRC Press.	
Reference Books:	
1. MEMS & Microsystems – Design and Manufacture by Tai-Ran Hsu, Tata McGraw Hill 2. Modern Machining Process by Pandey P.C. and Shah H.S., TMH 3. New Technology by Bhattacharya A,the Institution of Engineers, India 1984. 4. Non-Traditional Machining by P.K.Mishra, New Age. 5. Micro Machining of Engineering Materials Edited by J.Mc Geough, CRC Press.	

ADDITIVE MANUFACTURING

III B. TECH II Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5ME43	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

The course aims to study the importance of Additive Manufacturing, Classifications, and to learn the different tools, software required and the applications of additive manufacturing process.

COURSE OUTCOMES:

By studying this course, the student should be able to:

1. Classify Additive Manufacturing methods and explain important parameters.
2. Explain VAT polymerization and powder bed fusion process.
3. Outline the concept and basic features of Material Extrusion, Material Jetting, and sheet lamination process.
4. Outline the purpose and applications of Rapid Tooling process.
5. Explain about rapid prototyping data formats.

UNIT I **INTRODUCTION**

Additive Manufacturing (AM) - Distinction Between AM and Conventional Manufacturing Processes - Benefits of AM - Generic AM Process - Eight Steps in AM - Classification of AM Processes - Liquid Polymer Systems - Discrete Particle Systems - Solid Sheet Systems. Design for AM - Part Orientation - Removal of Supports - Hollowing Out Parts - Inclusion of Undercuts - Interlocking Features - Reduction of Part Count - Identification Markings/Numbers.

UNIT II

VAT POLYMERIZATION: Stereo lithography Apparatus (SLA): process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages.

Solid Ground Curing (SGC): process, working principle, applications, advantages and disadvantages, case studies.

Powder Bed Fusion – Materials - Powder Fusion Mechanisms - Selective laser sintering (SLS): process, working principle, applications, advantages and disadvantages, case studies. Three-dimensional printing (3DP): process, working principle, applications, advantages and disadvantages, case studies.

UNIT III

Material Extrusion - Basic Principles - Fused deposition modeling (FDM) - process, working principle, applications, advantages and disadvantages, case studies.

Material Jetting - Materials for Material Jetting - Technical Challenges of MJT - Droplet Formation Technologies - Process Parameters in Material Jetting - Process Benefits and Drawbacks.

Sheet Lamination - Laminated object manufacturing (LOM) – process, working principle, applications, advantages and disadvantages, case studies.

UNIT IV **RAPID TOOLING**

Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. RT classification:

Indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT V

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

Text Books:

1. Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker Mahyar Khorasani, Springer ISBN 978-3-030-56126-0, ISBN 978-3-030-56127-7 (eBook) https://doi.org/10.1007/978-3-030-56127-7

PRODUCTION PLANNING AND CONTROL (PPC)								
III B. TECH II Semester: MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A5ME44	**PEC**	3	0	0	3	30	70	100

COURSE OVERVIEW:

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise

COURSE OUTCOMES:

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

1. Upon completion of this course, the students can be able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
2. They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT-I	**INTRODUCTION AND FORECASTING**

Introduction: Definition – Objectives of Production Planning and Control – Functions of Production Planning and Control - Types of Production Systems - Organization of Production Planning and Control Department. Forecasting – Definition- Uses of Forecast- Factors Affecting the Forecast- Types of Forecasting- their Uses - General Principle of Forecasting. Forecasting Techniques- Quantitative and Qualitative Techniques. Measures of Forecasting Errors.

UNIT-II	INVENTORY MANAGEMENT

Inventory Management – Functions of Inventories – Relevant Inventory Costs – ABC Analysis – VED Analysis – Basic EOQ Model- Inventory Control Systems – Continuous Review Systems and Periodic Review Systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment Only. Aggregate Planning – Definition – Aggregate-Planning Strategies – Aggregate Planning Methods – Transportation Model.

UNIT-III	**ROUTING**

Line Balancing: Terminology, Methods of Line Balancing, RPW Method, Largest Candidate Method and Heuristic Method. Routing – Definition – Routing Procedure – Factors Affecting Routing Procedure, Route Sheet.

UNIT-IV	**SCHEDULING**

Scheduling – Definition – Scheduling Policies – Types of Scheduling Methods – Differences with Loading – Flow Shop Scheduling – Job Shop Scheduling, Line of Balance (LOB) – Objectives - Steps Involved.	
UNIT-V	**DISPATCHING**
Dispatching: Definition – Activities of Dispatcher – Dispatching Procedures – Various forms Used in Dispatching. Follow Up: Definition – Types of Follow Up – Expediting – Definition – Expediting Procedures-Applications of Computers in Planning and Control.	
Text Books:	
1. Elements of Production Planning & Control –Eilon 2. Production Planning & Control – Jain and Agarwal	
Reference Books:	
1. Operations Management – Buffa. 2. Project Management, S.C. Sharma, Khanna Publishing House 3. Production System – J.L. Riggs.	

PROFESSIONAL ELECTIVE – II

AUTOMOBILE ENGINEERING

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME45	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course is designed to introduce basic lay-out of an automobile, operation of engine cooling, lubrication, ignition, and electrical systems, principles of transmission, suspension, steering and braking system, Importance of EV's for Green Engineering.

COURSE OUTCOMES:

At the end of the course students are able to

1. Explain the basic lay-out of automobile, types of automobile engines, basic concepts like engine construction, oil filters, pumps etc.
2. Discuss various fuels supply systems of S.I and C.I engines
3. Explain the operation of engine cooling, lubrication and ignition systems.
4. Demonstrate the principles, elements and working of transmission and braking systems
5. Explain the elements and working of steering and suspension systems.

UNIT-I INTRODUCTION

Layout of four wheeler automobile , chassis and body - types , power unit , power transmission - types, types of automobile engines, engine construction, engine service, engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps , crank case ventilation, reboring, decarburization, Nitriding of crank shaft.

UNIT-II FUEL SUPPLY SYSTEMS IN S.I AND C.I. ENGINES

FUEL SYSTEM: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump, filters, carburetor, types, air filters, GDI.

C.I. ENGINES: Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps.

UNIT-III COOLING SYSTEM AND IGNITION SYSTEM

COOLING SYSTEM: Cooling Requirements, Air Cooling, Liquid Cooling, Thermosyphon and Forced Circulation System, Radiators, Types, Cooling Fan - water pump, thermostat, antifreeze solutions.

IGNITION SYSTEM: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug, Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers, spark advance and retard mechanism.

UNIT-IV	TRANSMISSION SYSTEM AND BRAKING SYSTEM

TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel. Gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Universal joint, Propeller shaft with sliding joint, Hotch Kiss drive, Torque tube drive, universal joint, differential rear axles, wheels and tires.

BRAKING SYSTEM: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder, tandem master cylinder, Requirement of brake fluid, Pneumatic and vacuum brakes

UNIT-V	STEERING SYSTEM & SUSPENSION SYSTEM

STEERING SYSTEM: steering linkages, Steering geometry, camber, caster, king pin rake, combined angle toe in, center point steering. Types of steering mechanism, Ackerman steering mechanism, Davis steering mechanism, steering gears, types.

SUSPENSION SYSTEM: Objectives of suspension systems, rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

Text Books:

1. Kirpal Singh (2012), Automobile Engineering - Vol. 1 &2, 12th edition, standard publishers, New Delhi, India.
2. William Crouse (2012), Automobile Engineering (SIE), 10th edition, Tata McGraw hill education (P) Ltd,
3. New Delhi, India.
4. Leitman, S., &. (2013). Build your own electric vehicle. McGraw-Hill Education

Reference Books:

1. B.S. Narang (2011), Automobile Engineering, 5th edition, Karman publishers, New Delhi, India
2. R. B. Gupta (2012), Automobile Engineering, satya prakhashan, New Delhi, India.
3. A Text book Automobile Engineering, Rajput.
4. Leitman, S., &. (2013). Build your own electric vehicle. McGraw-Hill Education
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

POWER PLANT ENGINEERING								
III B. TECH II Semester: MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**Total**
A5ME46	**PEC**	3	0	0	3	30	70	100

COURSE OVERVIEW

This course is framed to cover aspects of coal based thermal power plants, Diesel, Gas turbine and combined cycle power plants and nuclear power plants.It also covers economic and environmental issues of power plant.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Demonstrate concepts of coal based thermal power plants.
2. Explain principle of working and components of diesel, gas turbine and combined cycle power plants.
3. Demonstrate about Hydel Power and also generation of power from renewable energy.
4. Explain principle of working and components of nuclear power plant
5. Illustrate economic and environmental aspects of power plant.

UNIT I INTRODUCTION

Introduction to the Sources of Energy: Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Design and construction – Feed water treatment – Types of coals – Properties of coal – Coal storage – Coal handling – Fuel and Oil Systems – FBC Boilers – Turbines – Condensers – Working of different Circuits – Draught system – Dust collectors – Cooling towers – Ash handling systems – Safety Measures.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines Types – Construction – Plant layout with auxiliaries – fuel supply system – air starting equipment – lubrication and cooling system – super charging.

Gas Turbine Plant: Introduction – Classification – Construction – Layout With Auxiliaries – Principles of Working of Closed and Open Cycle Gas Turbines – Combined Cycle Power Plants.

UNIT III HYDEL POWER & POWER FROM RENEWABLE ENERGY SOURCES

Hydro Electric Power Plant: Water power – Hydrological Cycle / Flow Measurement – Drainage Area Characteristics – Hydrographs – Storage and Pondage – Classification of dams and spill ways. Typical layouts – Plant Auxiliaries – Plant Operation Pumped Storage Plants.

Renewable Energy Sources: Basic Introduction About Working of Wind – Tidal – Solar Photo Voltaic (SPV) – Geo Thermal – Biogas Power Systems.	
UNIT IV	**NUCLEAR POWER PLANTS**
Nuclear Power Station: Nuclear fuel: Breeding and Fertile Materials – Nuclear Reactor – Reactor Operation. **Types of Reactors:** Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation Hazards and Shielding – Radioactive Waste Disposal.	
UNIT V	**ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANT**
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. **Pollution Control:** Effluents From Power Plants and Impact On Environment – Pollutants and Pollution Standards – Methods of Pollution Control.	
Text Books:	
1. Rajput (2011), A Text Book of Power Plant Engineering, 4 th edition, Laxmi Publications, New Delhi, India. 2. Elanchezhian, L. Saravana Kumar, B. Vijaya Ramkanth (2007), Power plant Engineering, 1 st edition, I.K International Publishing House, New Delhi, India	
Reference Books:	
1. Arora and S. Domkundwar (2008), A Course in Power Plant Engineering, 5th edition, Dhanpat Rai & Co. Delhi. 2. P. K. Nag (2008), Power Plant Engineering, 3 rd edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi.	

REFRIGERATION AND AIR CONDITIONING

III B.TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	TOTAL
A5ME47	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Refrigeration may be defined as the process of achieving and maintaining a temperature below that of the surroundings, the aim being to cool some product or space to the required temperature. Air conditioning is the process of altering the properties of air to more comfortable conditions, typically with the aim of distributing the conditioned air to an occupied space, such as a building or a vehicle, to improve the thermal comfort and indoor air quality. This course covers analysis of various refrigeration cycles, vapour compression and absorption refrigeration systems, psychrometry, analysis of air-conditioning loads and various air conditioning systems.

COURSE OUTCOMES:

At the end of the course students are able

1. Demonstrate the basic concepts of refrigeration.
2. Explain the elements and working of vapour compression refrigeration system
3. Analyze the vapour absorption refrigeration system.
4. Discuss the basic concepts of air conditioning, psychrometric properties and processes.
5. Study the air conditioning systems and analyze their loads.

UNIT-I INTRODUCTION TO REFRIGERATION

Introduction: Necessity and applications, unit of refrigeration, C.O.P and Mechanical refrigeration. Air Refrigeration: Air Refrigeration Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Air Refrigeration systems-merits and demerits, analysis.

UNIT-II VAPOUR COMPRESSION REFRIGERATION

Working principle and essential components of the plant – simple vapour compression refrigeration cycle –COP – representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

UNIT-III VAPOUR ABSORPTION SYSTEMS

Vapour Absorption systems: Simple Vapour Absorption Refrigeration System, Absorbent – Refrigerant combinations, Water-Ammonia Systems, Water Lithium Bromide System, Contrast between the two systems, Modified Version of Aqua-Ammonia System with Rectifier and Analyser Assembly. Brief description of Refrigerants, Classification, Desirable properties, Ozone Depletion and Global warming.

UNIT-IV INTRODUCTION TO AIR CONDITIONING AND PSYCHROMETRY

Psychrometry – Air-water vapour mixtures, Psychrometric Properties, Psychrometric Processes, Psychrometric Charts, Problems using Psychrometric charts Human Comfort, Factors affecting Human Comfort, Effective Temperature.
Introduction to Air-Conditioning, Basic Definition, ASHRAE Nomenclature, Applications of Air-Conditioning.

UNIT-V	ANALYSIS OF AIR CONDITIONING LOADS AND AIR CONDITIONING SYSTEMS

Different Air-Conditioning Systems Classifications –Central –Zoned -Unitary –Winter –Summer - Year Round, Comfort AC, Industrial AC, Factors affecting Selection of System, Need For Ventilation, Infiltration, Load concepts of RSHF, GSHF- Problems, Cooling Load Estimate, Heating Load Estimate- Problems.

Text Books:

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
3. R.S. Khurmi & J.K. Gupta., "A textbook of Refrigeration and Air Conditioning", S Chand Publications, 2010.
4. Domkundwar Arora., "Course In Refrigeration & Air Conditioning", Dhanpat Rai & Co.(p) Ltd-Delhi.

Reference Books:

1. Dossat R.J., Principles of refrigeration, John Wiley, S.I. Version, 2001.
2. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.
3. Robert W. Vance, Cryogenic Technology, John wiley & Sons, Inc., New York, London.

COMPUTATIONAL FLUID DYNAMICS

III B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	TOTAL
A5ME48	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

The primary focus of this course is to differentiate between different types of partial differential equations, to apply appropriate numerical techniques and solve heat transfer and fluid flow problems using different numerical techniques.

COURSE OUTCOMES:

At the end of the course students are able to

1. Demonstrate modes of heat transfer, methods to solve a physical problem, differentiate analytical and numerical methods.
2. Differentiate between different types of Partial Differential Equations and to apply appropriate numerical techniques
3. Solve 1-Dimensional and 2-Dimensional steady state heat conduction problems
4. Explain explicit, implicit, semi-implicit methods and application of FDM to solve 1D transient heat conduction equations
5. Formulate and solve governing equations for incompressible flow

UNIT-I INTRODUCTION

Review of Modes of Heat Transfer – Governing Equations – Initial and boundary conditions Methods to solve a physical problem –Relative advantages and disadvantages of experimental, analytical and numerical methods – Scope of CFD – Its applications and limitations - Brief comparison between different numerical methods, viz., FDM, FEM & FVM Methods

UNIT-II CLASSIFICATION OF PDE & FDM

Classification of PDE – Elliptic, parabolic and hyperbolic PDE as governing equations – Examples and their physical significance

FDM – Discretization of Partial Derivative Terms using Taylor's series of approximation – Finite Difference Formulae – Application and implementation aspects of finite-difference equations –Consistency Application of FDM to elliptic equations

UNIT-III 1-D & 2-D STEADY STATE HEAT CONDUCTION

Application of FDM to solve 1D steady state heat conduction in Curvilinear geometry – Singularities – Treatment of singularities. Application of FDM to solve 2D steady state heat conduction– with and without heat generation and subjected to different boundary conditions

UNIT-IV	PARABOLIC EQUATIONS & 1-D TRANSIENT HEAT CONDUCTION
Parabolic Equations – Use of Explicit, implicit and semi implicit methods – Errors and Stability analysis -application of FDM to solve 1D transient heat conduction equations – ADI Scheme – Treatment and Implementation	
UNIT-V	**NUMERICAL METHODS FOR INCOMPRESSIBLE FLOW**
Numerical methods for incompressible flow – Governing equations –Difficulties in solving N-S equations –Stream function and Vorticity method – Advantages and disadvantages – treatment of boundary conditions– Determination of Pressure for viscous flows – Disadvantages – Staggered Grid – SIMPLE algorithm for pressure liked equations.	

TextBooks:

1. Computational Fluid Flow and Heat Transfer/ Muralidharan & Sundarajanan/ Narosa Publications
2. Finite Difference Method in Heat Transfer – Necati Ozisik, 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 – T J CHUNG
2. Computational Fluid Dynamics basics with applications- John.D, Anderson / Mc graw hill.
3. Computational Methods for Fluid Dynamics –Firziger & peric/springer.

IV B.TECH I SEMESTER SYLLABUS

FINITE ELEMENT METHOD

IV B.TECH I Semester MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME32	PCC	3	0	0	3	30	70	100

COURSEOVERVIEW:

The aim of this course to enable students to understand fundamental theory of the FEA method, generate the governing FE equations for systems governed by partial differential equations, understand the use of the basic finite elements for structural applications using truss, beam and plane elements under static and dynamic loading; understand the application and use of the FE method for heat transfer problems.

COURSEOUTCOMES:

At the end of the course students will

1. Demonstrate basic concepts of FEM, Solve the basic spring problems
2. Formulate and solve finite element equations for 1-D elements and Trusses
3. Derive stiffness matrices, analyze beams and 2D CST Elements subjected to different load conditions
4. Formulate and solve axi-symmetric problems using constant strain triangular elements and heat transfer problems,
5. Analyze axial bar, beam and truss subjected to dynamic loads

UNIT-I INTRODUCTION TO FEM

Basic concept, historical background, applications of FEM, Basic equations of elasticity-strain-displacement relations and stress-strain relations, Convergence requirements, Principle of Minimum Potential Energy-Spring Problems.

UNIT-II ONE DIMENSIONAL PROBLEMS & ANALYSIS OF TRUSSES

ONE DIMENSIONAL PROBLEMS: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic shape functions. Problems on uniform stepped and tapered bars subjected to point loads, body force and temperature loads.

ANALYSIS OF TRUSSES: Local and Global co-ordinates, Transformation matrix, Stiffness Matrix for Plane Truss, Stress-Strain Calculations and Calculation of reaction forces.

UNIT-III ANALYSIS OF BEAMS & 2-D PROBLEMS

ANALYSIS OF BEAMS: Hermite shape functions-Element stiffness matrix for two nodes, two degrees of freedom per node beam element, load vector, slope and deflection. Simple problems-Point loads & UDL.

2-D PROBLEMS: CST Element-Stiffness matrix and load vector, Isoparametric element representation, Shape functions, convergence requirements, Problems. Shape functions of Two

dimensional four noded isoparametric element.

UNIT-IV	AXI-SYMMETRIC SOLIDS & HEAT TRANSFER

AXI-SYMMETRIC SOLIDS: Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements-simple problems.

STEADY STATE HEAT TRANSFER ANALYSIS: One Dimensional Finite Element analysis of fin and composite slabs.

UNIT-V	DYNAMIC ANALYSIS

DYNAMIC ANALYSIS: Dynamic Equations of motion, Lumped and consistent mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam.

Text Books:

1. Introduction to Finite Elements in Engineering by Chandrupatla, Ashok and Belegundu, Prentice, Hall, Pearson.
2. The Finite Element Methods in Engineering by SS Rao, Pergamon.

Reference Books:

1. Finite Element Methods: Basic Concepts and applications by Alavala, PHI
2. Finite Element Analysis Revised and Enlarged Edition by S.Md.Jalaluddin, Anuradha Publications
3. Finite Element Analysis by P.Seshu, PHI
4. Finite Element Analysis by Bathe, PHI
5. Finite Element Method by Krishna Murthy, TMH
6. An Introduction to the Finite Element Method (McGraw-Hill Mechanical Engineering) 3rd Edition. by J Reddy, McGraw-Hill

INSTRUMENTATION AND CONTROL SYSTEMS

IV B. TECH I Semester MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME34	PCC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Measurement is an essential activity in every branch of science technology. The art of measurement is a wide discipline in both engineering and science, covering the areas of detection, acquisition, control and analysis of data. Measurement plays an important role in every branch of scientific research and industrial processes interacting basically with the control system. The course objective is to provide knowledge on the fundamentals of measurement science, measuring instruments and to provide basic knowledge of control system theory.

COURSEOUTCOMES:

The students should be able to

1. Ability to understand and analyze the instruments and their applications to various industries
2. Ability to generalized measurement system and able to model and analyze the transducers
3. Knowledge in measuring techniques and to apply in field of engineering to monitor the operational systems
4. Ability to formulate certain empirical relations where adequate theory does not exit
5. Ability to apply control theory to practical engineering problem to describe the defective components that need to be out right rejected at the earliest stage.

UNIT-I BASIC PRINCIPLES OF MEASURMENTS

Definition, Basic principles of measurement, Measurement systems, generalized configuration and functional descriptions of measuring instruments, examples. Dynamic performance characteristics, 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 MEASURMENTS OF PRESSURE TEMPERATURE

MEASUREMENT OF PRESSURE: Units, classification, different principles used. Manometers, Piston, Bourdon tube pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement, Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

MEASRMENT OF TEMPERATURE: Classification–Ranges– Various Principles of measurement– Expansion, Electrical Resistance Thermistor – Thermocouple – Pyrometers– Temperature Indicators.

UNIT-III MEASURMENTS OF SPEED FLOW LEVEL

MEASUREMENT OF SPEED: Mechanical Tachometers, Electrical tachometers, Stroboscope, Non-contact type of tachometer

FLOW MEASUREMENT: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot, wire anemometer.

MEASUREMENT OF LEVEL: Direct method, Indirect methods, capacitative, ultrasonic, magnetic, Bubler level indicators.

UNIT-IV	MEASURMENTS OF STRESS STRAIN ACCELERATION AND VIBRATION

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.

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments, Principles of seismic instruments, Vibrometer and accelerometer using this principle.

UNIT-V	MEASURMENTS OF HUMIDITY CONTROL SYSTEM

MEASUREMENT OF HUMIDITY: Moisture content of gases, sling psychro meter, Absorption psychro meter, Dew point meter.

ELEMENTS OF CONTROL SYSTEMS: Introduction, Importance, Classification, Open and closed systems Servomechanisms, Examples with block diagrams, Temperature, speed & position control systems.

TextBooks:

1. D.S. Kumar (2011), Mechanical Measurements and Controls, 4th edition, Metropolitan Book Co. Pvt Ltd., New Delhi, India.
2. A. K. Tayal (2004), Instrumentation and mechanical Measurements,2nd
3. edition, Galgotia Publications, New Delhi, India.

Reference Books:

1. Er. R. K. Jain (2011), Mechanical and Industrial Measurements, 12th edition, Khanna Publishers, New Delhi, India.
2. Chennakesava R. Alavala(2010), Principles of Industrial Instrumentation and Control Systems, 1st edition, Cengage Learning, New Delhi, India.
3. B. C. Nakra, K. K. Choudhary (2010), Instrumentation, measurement andanalysis, 4th, Tata McGraw-Hill, New Delhi, India.

COMPUTER AIDED ENGINEERING AND PRODUCTION DRAWING PRACTICE LAB								
IV B. TECH I Semester MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A5ME33	**PCC**	0	0	2	1	30	70	100

COURSE OVERVIEW:

This course is intended to impart knowledge fundamentals of ANSYS software and its applications in solving problems related to Structural, Thermal, and Vibrational analysis, Also to give knowledge on various drawing conventions used in manufacturing industry.

COURSEOUTCOMES:

On completion of the course the student will be able to

1. Apply ANSYS software to find the deflections and stresses, buckling loads and natural frequencies of the structures subjected various types of boundary and lading conditions.
2. Analyse steady state heat transfer problems using ANSYS.
3. Recognize the representation of various mechanical elements in the production drawing.
4. Acquire knowledge on limits & fits, tolerances, and surface roughness.
5. Draw part drawing and assembly drawing showing all limits fits and tolerances, machining operations on the production drawing using Auto CAD.

PART A	**Computer Aided Engineering (CAE) Lab**

1. Static analysis of cantilever beam carrying point load at free end.
2. Static analysis of simply supported beam carrying udl over entire length
3. Analysis of Plane Truss to determine member forces, member strains & stresses, joint deflections under static loading.
4. Analysis of Plane Truss (Tower) to determine member forces, member strains & stresses, joint deflections under static loading.
5. Static Analysis of shell due to internal pressure to estimate the strains and stresses.
6. Static analysis of plate with a hole to determine the deformations, the Stresses to study the failure behaviour and SCF.
7. Modal analysis of beam for natural frequencies and mode shapes.
8. Buckling analysis beams to estimate BF and modes.
9. Steady state one dimensional heat transfer Analysis on a slab
10. Steady state one dimensional heat transfer Analysis on a rod

PART B	**Production Drawing Practice (PDP) Lab**
UNIT-I	

Conventional representation of Materials – conventional representation of parts – screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits – methods of indicating notes on drawings.

UNIT-II

Limits and Fits: Types of fits, exercises involving selection / interpretation of fits and estimation of limits from tables.

UNIT-III

Geometric Dimensioning and Tolerancing (GD&T): Need for GD&T, Features and rules of GD&T, datums control, Adding GD&T to a drawing/design, Form tolerances, Orientation tolerances, Profile tolerances, Location Tolerances, Runout tolerances.

UNIT-IV

Surface roughness and its indication: Definitions – finishes obtainable from various manufacturing processes, recommended surface roughness on mechanical components. Heat treatment and surface treatment symbols used on drawings.

UNIT-V

Detailed and Part drawings: Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc. Part drawing using computer aided drafting by CAD software.

Text Books:

1. Production Drawing – K L Narayana, K. Venkata Reddy, P Kannaiah 2nd ed. New Age International Pvt. Ltd., 2012.
2. Machine Drawing with AutoCAD - Pohit and Ghosh, Pearson India.

Reference Books:

1. Geometric dimensioning and tolerancing- James D. Meadows/ B.S Publications.
2. Engineering Metrology, R.K. Jain, Khanna Publications

INSTRUMENTATION AND CONTROL SYSTEMS LAB								
IV B. TECH I Semester MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A5ME33	**PCC**	0	0	2	1	30	70	100

COURSE OVERVIEW:

Calibration of pressure gauges, calibration of;resistance temperature detector for temperature measurement, thermister and rtd, thermocouple for temperature measurement, vibration setup, calibration of photo and magnetic speed pickups for the measurement of speed , measurement of angular displacement using capacitive transducer , measurment of strain gauge ,study and calibration of lvdt tranducer for displacement measurement ,study and calibration of mcleod gauge for low pressure.

COURSEOUTCOMES:

By studying this course, the student should be able to:

1. learn various control systems
2. Analyse the vibration setup
3. Analyse different types of temperature measurement
4. Calibrate the floe measurement equipment
5. Demonstrate the measurement for low pressures.

LIST OF EXPERIMENTS

1. Calibration of Pressure Gauges

2. Calibration of transducer for temperature measurement.

3. Study and calibration of LVDT transducer for displacement measurement.

4. Calibration of strain gauge for temperature measurement.

5. Calibration of thermocouple for temperature measurement.

6. Calibration of capacitive transducer for angular displacement.

7. Study and calibration of photo and magnetic speed pickups for the measurement of speed

8. Calibration of resistance temperature detector for temperature measurement.

9. Study and calibration of a rotometer for flow measurement.

10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.

11. Study and calibration of Mcleod gauge for low pressure.

PROFESSIONAL ELECTIVE – III

COMPOSITE MATERIALS

IV B. TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME49	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course is designed to provide basic and important knowledge about the advanced class of materials, i.e. composites where its classification, fabrication, design and testing of composite materials are discussed. And, towards the end, the current state-of-the-art research work occurring in the field to generate multi-functional composites is discussed.

COURSE OUTCOMES:

The course should enable the students to

1. Explain and differentiate composite materials based on specific applications.
2. Describe the various fabrication methods of polymer composites.
3. Choose suitable manufacturing route for generating metal and ceramic matrix composites.
4. Demonstrate various methods to test the Composites through NDT methods.
5. Elucidate the purpose and significance of Multi-Functional Composites.

UNIT-I INTRODUCTION AND REINFORCEMENT MATERIALS

Introduction: Definition, functions of matrix and reinforcement, special features of composites, drawbacks, classification, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon-carbon composites, fibre reinforced composites, particulate reinforced composites and nature-made composites.

Reinforcement Materials: Glass, carbon, kevlar, boron, silica, silicon carbide, and boron carbide fibres.

UNIT-II POLYMER COMPOSITES: MANUFACTURING METHODS

Thermoset Composites Manufacturing: Hand layup, Spray up processes, Fibre placement process: AFP and ATL, Prepreg Technique, Resin transfer moulding, Vacuum assisted resin transfer moulding, Compression moulding process, Filament winding.

Thermoplastic Composites Manufacturing: Thermoplastic tape winding, Thermoplastic pultrusion process, Hot press technique, Autoclave processing, Diaphragm forming process, Injection moulding.

UNIT-III METAL AND CERAMIC COMPOSITES: MANUFACTURING METHODS

Metal Matrix Composites: Solid state methods- hot isostatic pressing (HIP), Foil diffusion bonding. Liquid state methods- Stir casting, Squeeze casting, Centrifugal casting, Melt infiltration.

Ceramic Matrix Composites: Sintering and CVD.

Manufacturing Process Selection Criteria: Production Rate/Speed, Cost, Performance, Size, Shape.

UNIT-IV	COMPOSITES DESIGN AND NDT

Composites Design: Laminate theory, Rule of mixtures, symmetry and balance.
Non-Destructive Testing (NDT) of Composites: Visual inspection, Tap testing, Ultrasonic inspection, X-ray inspection, Thermography.

UNIT-V	MULTI-FUNCTIONAL POLYMER NANOCOMPOSITES

Carbon Nanotubes (CNTs) based Multi-Functional Polymer Nanocomposites: Introduction and Necessity of multi-functional composites, CNTs based multi-functional composites fabrication methods: Ultrasonication, In-Situ method, Grafting CNTs onto fibre surfaces - spraying method, transfer printing, chemical grafting. Properties and Applications of CNTs based multi-functional composites.
Graphene based Multi-Functional Polymer Nanocomposites: Introduction, properties and applications.

Text Books:

4. Sanjay K. Mazumdar, Composites Manufacturing: Materials, Product, and Process Engineering, CRC press, 2001, ISBN: 0-8493-0585-3.
5. M. Balasubramanian, Composite materials and processing, CRC press, 2013, ISBN: 9781439880548.
6. Madhujit Mukhopadhyay, Mechanics of Composite Materials, Universities Press, 2005, ISBN: 9788173714771.
7. Ashutosh Tiwari and S. K. Shukla, Advanced Carbon Materials and Technology, Wiley, 2014, ISBN: 9781118686232.

Reference Books:

4. Flake Campbell Jr, Manufacturing processes for advanced composites, Elsevier, 2003, ISBN: 9781856174152.
5. Ehsan Bafekrpour, Advanced Composite Materials: Properties and Applications, De Gruyter Open Poland, 2017, ISBN: 9783110574401.

TRIBOLOGY

IV B. TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5ME50	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course is framed to cover basic concepts of tribology, hydrodynamic theory of lubrication, friction and power losses in journal bearings, air lubricated bearing, bearing oil pads and materials.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Demonstrate various properties of fluid and explain the basic concepts of hydrostatic lubrication.
2. Explain hydrodynamic theory of lubrication.
3. Explain friction and power losses in journal bearings.
4. Discuss in detail about air lubricated bearings.
5. Explain types of bearing oil pads and bearing materials.

UNIT I	INTRODUCTION

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	FRICTION AND POWER LOSSES IN JOURNAL BEARINGS

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, hydrodynamic 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

Friction and power losses in journal bearings: Calibration of friction loss, friction in concentric bearings, bearing moduIus, Sommer-field number, heat balance, practical consideration of journal bearing design considerations.

UNIT IV	AIR LUBRICATED BEARING

Air lubricated bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic 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 & BEARING MATERIALS

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 Books:
1. Fundamentals of Tribology by Basu, SenGupta and Ahuja, PHI 2. Tribology in Industry by Sushil Kumar Srivatsava, S. Chand &Co.
Reference Books:
1. Tribology by B.C. Majumdar

NANO TECHNOLOGY

IV B. TECH I Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME51	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy; electronics Etc., built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The course will give insight into many aspects of nanotechnology and their applications in the prospective of materials science

COURSE OUTCOMES:

At the end of the course student will be able to

1. Demonstrate various concepts of nanotechnology and explain effect of size on different properties of nano materials.
2. Explain properties, microstructure and defects in nano materials.
3. Explain how to synthesize nano materials
4. Enumerate and explain various characterization methods of nano materials
5. Explain applications of nanotechnology.

UNIT-I INTRODUCTION

Defining nanotechnology, Importance of Nano-technology, nano scale comparison, Challenges in nanotechnology. Nano science vs Nanotechnology, Classification-According to their origin, dimensions & structural configuration.

Size Effect: Structural differences on the nanoscale, Factors Influencing Properties of nanomaterials, Surface Area and Energy, effect of size on optical, electrical, physical & chemical properties

UNIT-II UNIQUE PROPERTIES OF NANO MATERIALS

Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple, and disclinations, Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility, Magnetic Properties: Soft magnetic Nanocrystalline alloy, Permanent magnetic Nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT-III SYNTHESIS OF NANO MATERIALS

Physical Methods: Mechanical Methods, Methods based on Evaporation, Sputter Deposition, Chemical Vapour Deposition, Electric Arc Deposition, Ion Beam Technique, Molicular Beam Epitaxy.

Chemical Methods: Synthesis of Metal nanoparticles by colloidal route, Sol-Gel Method, Hydrothermal synthesis, Sonochemical Synthesis, Microwave Synthesis

UNIT-IV	NANO MATERIALS CHARACTERIZATION

Nanomaterial's characterization: Instrumentation Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential Microscopies SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy

UNIT-V	APPLICATIONS OF NANO MATERIALS

Nano-medical and healthcare applications, Textiles, Paints, Energy, Defence and Space Applications, Future transportation benefits.

Text Books:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

Reference Books:

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell
6. Electron Transport in Mesoscopic systems – S. Dutta, Cambridge University press

INDUSTRIAL SAFETY ENGINEERING

IV B. TECH I Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5ME52	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Safety is one of the key dimensions of engineering asset management. Safety by design or prevention through design is in the core for maintaining engineering systems safe. The objective of this course is to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings. Upon completion of the course, the students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics, design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability.

COURSE OUTCOMES:

By studying this course, the student should be able to:

1. Understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
2. Understand the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
3. Understand safety engineering aspects in industry.

UNIT I — INTRODUCTION TO THE DEVELOPMENT OF INDUSTRIAL SAFETY AND MANAGEMENT

Introduction to the development of industrial safety and management: History and development of Industrial safety: Implementation of factories act, Formation of various councils, Safety and productivity, Safety organizations. Safety committees, safety committee structure, roll of management and roll of Govt. in industrial safety, Safety analysis.

UNIT II — ACCIDENT PREVENTIONS PROTECTIVE EQUIPMENT'S AND THE ACTS

Personal protective equipment, Survey the plant for locations and hazards, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Fire fighting equipment, Accident reporting, Investigations, Industrial psychology in accident prevention, Safety trials.

UNIT III — SAFETY ACTS

Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act, Industrial hygiene, Occupational safety, Disease prevention, Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, Engineering methods of controlling chemical hazards, safety and the physical environment, Control of industrial noise and protection against it, Code and regulations for worker safety and health.

UNIT IV — PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING:

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems –Reliability and machine availability,

Equipment Life cycle, Measures for Maintenance Performance: Equipment's breakdowns, Mean Time Between Failures, Mean Time To Repair, Factors of availability, Maintenance organization, Maintenance economics.	
UNIT V	**MAINTENANCE POLICIES AND PREVENTIVE MAINTENANCE**
Maintenance categories – Comparative merits of each category – Preventive maintenance, Maintenance schedules: Repair cycle, Principles and methods of lubrication, Fault Tree Analysis, Total Productive Maintenance: Methodology and Implementation	
Text Books:	
1. Srivastava, S.K., "Industrial Maintenance Management", S. Chand and Co. 2. Bhattacharya, S.N., "Installation, Servicing and Maintenance", S. Chand and Co. 3. Willie Hammer, "Occupational Safety Management and Engineering", Prentice Hall	
Reference Books:	
1. White, E.N., "Maintenance Planning", Documentation, Gower Press 2. Garg, M.R., "Industrial Maintenance", S. Chand and Co. 3. Higgins, L.R., "Maintenance Engineering Hand book", 5th Edition, McGraw Hill 4. Armstrong, "Condition Monitoring", BSIRSA 5. Davies, "Handbook of Condition Monitoring", Chapman and Hall 6. Ray Asfahl, C., "Industrial Safety and Health Management", 5th Edition, Prentice Hall **7.** S.C.Mishra, "Reliability and Maintenance Engineering", New Age Publishing house	

PROFESSIONAL ELECTIVE – IV

FRACTURE MECHANICS								
IV B.TECH I Semester : MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours/Week**			**Credits**	**MaximumMarks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A5ME53	**PEC**	3	0	0	3	30	70	100

COURSE OVERVIEW:

Fracture mechanics is a failure theory that determines material failure by energy criteria, possibly in conjunction with strength (or yield) criteria and considers failure to be propagating throughout the structure rather than simultaneous throughout the entire failure zone or surface. This course will impart the knowledge on basic concepts and principles of fracture mechanics, elastic fracture mechanics, Elastic-plastic fracture mechanics and applications of fracture mechanics.

COURSEOUTCOMES:

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

1. Describe the crack and its effect on the service
2. Solve the elastic crack problems
3. Demonstrate energy principle and concepts of fatigue crack growth.
4. Solve problems of elastic plastic fracture mechanics.
5. Explain applications of fracture mechanics.

UNIT-I	INTRODUCTION

Introduction: Crack in a Structure – Griffth Criterion – Cleavage fracture–Ductile fracture– Fatigue Cracking. Service failure analysis.

UNIT-II	ELASTICCRACK

Elastic Crack: Elastic Crack tip stress field – Solution to crack problems. Effect of finite size stress intensity factor – Special cases – Irwin plastic zone correction. Actual shape of plastic zone – Plane stress – Plane strain

UNIT-III	ENERGY PRINCIPLE & FATIGUE CRACK GROWTH

Energy Principle: Energy release rate – Criterion for crack growth – Crack resistance curve – Principles of crack arrest – Crack arrest in practice.

Fatigue Crack Growth: Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor – Variable amplitude service loading, retardation model.

UNIT-IV	ELASTIC PLASTIC FRACTURE MECHANICS

Elastic Plastic Fracture Mechanics: Elastic plastic fracture concept – Crack tip opening displacement – J- integral technique; Determination of J-using FEM.

UNIT-V	APPLICATION OF FRACTURE MECHANICS

Application of Fracture Mechanics: Fracture design – Selection of materials –fatigue crack growth rate curve – Stress intensity fact orrange –Use of crack growth law.

Text Books:

1. David Broek – Elementary Engineering Fracture Mechanics: Sifth off an Noordhoff Internal Publishers – 1978.
2. John M. Barson and Stanely T. Rolfe: Fracture and Fatigue Control in Structures – Prentice Hall, Inc. USA 1987.

Reference Books:

1. Jean Cemative and Jean Louis Chboche Mechanics of Solid Materials, Cambridge University Press, Cambridge, 1987.
2. Prashant Kumar, "Elements of Fracture Mechanics", Wheeler Publications, 1999

MACHINE DYNAMICS & VIBRATIONS								
IV B. TECH I Semester : MECHANICAL ENGINEERING								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A5ME54	**PEC**	3	0	0	3	30	70	100

COURSE OVERVIEW

The primary focus of this course is to make the students understand the concepts of vibrations, limitations of vibrations in industry and to the concepts how to minimize the vibrations for the better performance of the machines.

COURSE OUTCOMES:

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

1. Demonstrate the various systems of vibrations in a machine and to compute them, can apply the concepts to differentiate various classifications.
2. Can formulate the relations for various types of vibrations conditions using FFT
3. Solve the problems on rotor dynamic issues.
4. Explain the various factors for vibrations and can demonstrate them.
5. Demonstrate various instruments used to measure vibrations.

UNIT-I	**MULTI DEGREE OF FREEDOM SYSTEMS (MDOF)**

Derivation of equations of motion for mechanical lumped parameter systems FORCED RESPONSES Forced response of MDOF systems; vibration absorber Free and forced response of continuous systems (beams, shafts in torsion and bending)

UNIT-II	**VIBRATIONS IN THE FREQUENCY DOMAIN**

Frequency response function (FRF) and their main features Fourier Series, Analysis and the Fourier Transform; FFT TIME DOMAIN FACTORS Leakage, Windowing and Aliasing, Time domain response prediction using Fourier transform (DuHamel's principle)

UNIT-III	**ROTOR DYNAMICS**

Response to out of balance Whirling of shafts Critical speeds BALANCING Balancing, static balance and dynamic imbalance.

UNIT-IV	**VIBRATION INDUCED FATIGUE**

Calculation of stress from vibration mode shape and amplitude Input to fatigue calculations; Goodman diagrams

UNIT-V	**VIBRATION MEASUREMENTS**

Transducers: linear displacement, angular displacement, angular velocity, pressure Data acquisition: resolution, aliasing.

Text Books:

1. Mechanical Vibrations by William J. Palm, 2007. ISBN: 9780471345558
2. Dynamics and Vibrations, An introduction, by Magd Abdel Wahab, Wiley (2008) ISBN 978-0-470-72300-5.
3. Engineering Mechanics, Dynamics, Hibbeler, any edition, and • Design of Machinery, Robert L Norton, any edition.

Reference Books:

1. Cheli F., Diana G., Advanced Dynamics of Mechanical Systems, Editore: Springer, Anno edizione: 2015, ISBN: 978-3-319-18199-8
2. Singiresu S. Rao, Mechanical Vibrations, Editore: Pearson, Anno edizione: 2016, ISBN: 978-0134361307

MACHINE TOOL DESIGN

IV B. TECH I Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME55	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

This course is intended to introduce Design of machine tool structures, Design and analysis of systems for specified speeds and feeds and selection of subsystems for achieving high accuracy in machining.

COURSE OUT COMES:

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

1. Explain basic concepts of machine tool drives and mechanisms.
2. Design and analyze systems for specified speeds and feeds.
3. Design machine tool structures.
4. Design Guideways, Power Screws and Spindles
5. Design Spindles and Spindle Supports.

UNIT-I	INTRODUCTION

Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

UNIT-II	REGULATION OF SPEEDS AND FEEDS

Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds,
Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

UNIT-III	DESIGN OF MACHINE TOOL STRUCTURES

Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

UNIT-IV	DESIGN OF GUIDEWAYS AND POWER SCREWS

Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

UNIT-V	DESIGN OF SPINDLES AND SPINDLE SUPPORTS
Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.	
Text Books:	
1. Machine Tool Design and Numerical Control by N.K. Mehta, TMH, New Delhi, 2010. 2. Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, 2009. 3. Design of Machine Tools by D. K Pal, S. K. Basu, 5thEdition, Oxford IBH, 2008.	
Reference Books:	
1. Machine Tool Design by N. S. Acherkhan, Vol. I, II, III and IV, MIR publications 2. Tool Design by Cyril Donaldson, 5th Edition, Mc Graw Hill.	

FLEXIBLE MANUFACTURING SYSTEM (FMS)

IV B. TECH I Semester MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	TOTAL
A5ME56	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

-

COURSE OUTCOMES:

At the end of the course students are able to

1. Ability to perform Planning, Scheduling and control of Flexible Manufacturing systems
2. Perform simulation on software's use of group technology to product classification

UNIT-I	**PLANNING, SCHEDULING AND CONTROL OF FMS**

Introduction to flexible manufacturing systems. Planning and scheduling and control of FMS. Knowledge based scheduling. The Development of Manufacturing systems. Pallets, Fixtures and Machines, work handling system layouts

UNIT-II	**COMPUTER CONTROL AND SOFTWARE FOR FMS**

Hierarchy of computer control. Supervisory computer. System Management, Tool Management, Simulation and Analysis in the Design of FMS

UNIT-III	**FMS SIMULATION AND DATABASE**

Software for simulation and database of FMS. Specification and selection, trends, application of simulation software. Simulation Modelling for FMS

UNIT-IV	**FLEXIBLE MANUFACTURING SYSTEMS DESIGN**

Manufacturing data systems data flow, CAD/CAM considerations. Planning FMS database, just in time characteristics, pull method, quality small lot sizes, work station loads, close supplier ties, flexible workforce — line flow strategy. Simulation for FMS Design.

UNIT-V	**APPLICATIONS OF FMS AND FACTORY OF THE FUTURE**

Preventive maintenance. Kanban system, implementation issues. Economic justification of FMS; Artificial Intelligence in the Design of FMS

Text Books:

1. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.

ReferenceBooks:

1. Radhakrishnan P. and Subramanyam S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994
2. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
3. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995

PROFESSIONAL ELECTIVE – V

INDUSTRY 4.0

IV B.TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		CIE	SEE	Total
A5ME57	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Industry 4.0 is commonly referred to as the fourth industrial revolution. Many modern technological developments such as artificial intelligence, quantum computing, gene sequencing, augmented and virtual reality, 5th generation (5G) wireless communication technologies, and 3D printing acted as the step- ping stone toward the evolution of Industry 4.0. This course will give insights into the important aspects of Industry 4.0 aligned with Industrial Internet of Things.

COURSE OUTCOMES:

By studying this course, the student should be able to:

1. Summarize the history of the industrial revolution and the evolution of Industry 4.0.
2. Outline the concept and basic features of the Industrial Internet of Things (IIoT)
3. Interpolate the major technologies such as cloud computing, fog computing, AR, VR, Big Data and Advance Analytics applicable to smart factories.
4. Exemplifies the usage of Sensors and Actuators applicable to smart factories.
5. Outline the purpose and applications of Industrial robots in integrated manufacturing environment.

UNIT I **INDUSTRY 4.0**

Industrial revolution: Phases of development. Evolution of Industry 4.0 - Concepts and Components of Industry 4.0 - Supportive Technologies - Adaptive robotics, Cyber-Physical Systems (CPS), Additive manufacturing, Cloud technologies, AR/VR, Data Analytics and Artificial Intelligence. Economic potential. Drivers of Industry 4.0 - megatrends – tipping points.

UNIT II **INDUSTRIAL INTERNET OF THINGS (IIOT)**

Industrial Internet of Things (IIoT) – Benefits - Prerequisites of IIoT - Comparison between IoT and IIoT - Applications of IIoT - Features of IIoT for industrial processes. Industrial Internet Systems – Design – Impact - Economic perspective - Energy consumption perspective - Physical assets - Benefits of Industrial Internet.

Industrial plant – The future architecture - viewpoint of industrial processes - functional viewpoint - operational viewpoint.

UNIT III **OFF-SITE & ON-SITE TECHNOLOGIES**

Off-site Technologies - Cloud Computing - Necessity of cloud computing - Cloud computing services in IIoT - Cloud models - Fog computing - fog computing in industrial analytics - Advantages of fog-enabled industries - Applications of fog.

On-site Technologies - Augmented Reality - History of AR, Categorization of AR, Applications of AR. Virtual Reality - History of VR, Categorization of VR, Applications of VR. Big Data and Advanced Analytics - Characteristics of big data - Big data acquisition and storage - Necessity of data analytics - Types of analytics.

UNIT IV **SMART FACTORIES**

Smart factories - Characteristics of smart factory- Technologies used in smart factories. Lean manufacturing system - Value streams in lean production system - Necessity of lean production

system - Implementation of lean manufacturing system.
Sensors - Introduction to Sensors – Characteristics - Sensor calibration - Sensor profile - Sensor accuracy - Sensor resolution - Sensor rating - Operating voltage – Output - Sensor Categories - Thermal sensors - Mechanical sensors - Electrical sensors - Optical sensors - Acoustic sensors.
Actuators - Thermal Actuators - Hydraulic Actuators - Pneumatic Actuators - Electromechanical Actuators -

UNIT V	**ROBOTICS IN THE ERA OF INDUSTRY 4.0**

Robotics in the Era of Industry 4.0 - Technological Components of Robots - Internet of Robotic Things - Cloud Robotics - Cognitive Architecture for Cyber-Physical Robotics. Industrial Robotic Applications – Manufacturing, Maintenance, and Assembly.

Text Books:

1. Introduction to Industrial Internet of Tings and Industry 4.0, Sudip Misra Chandana Roy Anandarup Mukherjee, CRC Press. *ISBN 9780367897581*

MECHATRONICS

IV B. TECH II Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME58	PEC	3	0	0	3	30	70	100

COURSEOVERVIEW:

This program, developed in direct response to industrial demand for engineers with multi-disciplinary skills, is a combination of mechanical, electronics, control, computer and systems design engineering streams. The program allows engineers to design construct and run factory production lines and automated processes, where they use their skills in computers, micro-controllers, programmable logic controllers, programming, industrial sensors, hydraulic, pneumatic and electric drives, design of mechanical structures and mechanisms and knowledge of manufacturing processes.

COURSEOUTCOMES:

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

1. Demonstrate basic concepts of mechatronics.
2. Explain actuators and elements of motion control.
3. Classify and discuss about sensors.
4. Explain elements and working of various transducers.
5. Explain concepts of PLC's and artificial intelligence.

UNIT-I	INTRODUCTION

Introduction: Evolution of Mechatronics, Modules in Mechatronic Systems, Design process, Control Systems - Open and Closed loop systems, Analog and digital control systems, Mechatronics in Manufacturing – Adaptive and distributed control systems–Modelling and simulation of mechatronics

UNIT-II	ACTUATORS & MOTION CONTROL

Actuators and Motion Control: Characteristics of Mechanical, electrical, Hydraulic and pneumatic actuators and their limitations. Control parameters and system objectives. Mechanical configurations, Popular control system configurations, S-curve, Motor/load inertia machining, design with linear studies.

UNIT-III	SENSORS

Sensors: Definition of sensor, Classification of sensors by function , Classification of performance, Performance parameters, Classification of sensors by output, Pressure sensors, flow sensors , Hall-effect sensors-Linear and threshold type, Light sensors-photo diodes, Proximity Sensors-Inductive and Ultrasonic type; Optical sensor.

UNIT-IV	TRANSDUCERS
Transducers: Difference between transducer and sensor, Transducer principle, Photo electric transducers-photo emissive transducer, photo conductive transducer, photovoltaic transducer; Inductive transducers, Capacitive Transducers, pyro electric transducers, piezo electric transducer, Ionization transducers, strain gauge, load cells and flow transducers.	
UNIT-V	**PLCs & ARTIFICIAL INTELLIGENCE**
PLCs: Programmable Logic Controllers Architecture of Programmable Logic Controllers – Input/output modules – programming methods – Timers and counters – Master control – Branching – Data handling – Analog input/output – Selection of PLC and troubleshooting. AI: Intelligent Mechatronics and Case Studies Fuzzy logic control and Artificial Neural Networks in mechatronics – Algorithms – Computer based instrumentation – Real-time Data Acquisition and Control – Software integration – Man Machine interface –Vision system.	
Text Books:	
1. Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill 2. Ganesh S.Hegde, Mechatronics, University Science Press.	
Reference Books:	
1. Designing Intelligent Machines, Michel B.Histand and David G.Alciatore, Open University London 2. Control Sensors and Actuators, ICW. Desiha, Prentice Hall	

INDUSTRIAL ROBOTICS

IV B.TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME59	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Today robot finds applications in industries, medical and other fields. For example, in eye surgery (replacement of retina), where a cylindrical portion needs to be replaced, the operation is best done by robots. Mobile robots like walking machines, hopping machines are examples of robots, Nuclear and power plants uses fish like robots which move inside pipes for purpose of inspection. This course will give an insight on various types of industrial robots, their kinematic and kinetic aspects, different types of grippers, mechanics of grippers, trajectory planning etc.

COURSE OUT COMES:

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

1. Demonstrate different types of robots, specifications of robots and different end effectors used in robots.
2. Analyze gripper forces and evaluate composite rotation and transformation matrices.
3. Model forward, inverse and differential kinematics of robot manipulators.
4. Explain trajectory planning techniques; formulate lagrangian - euler and newton - euler equations.
5. Explain about actuators, feedback components used in robots and industrial applications.

UNIT-I INTRODUCTION

Introduction: Automation and Robotics, Asimov's laws, Robot Architecture, Components, Anatomy of robot, Factors to be considered in the selection of robot, present and future applications, Specifications - Degree of freedom, Pay load, Parts per hour, Accuracy, Repeatability, Speed, Work space, Work volume, Work envelope, classification of robots based on configuration and control systems

End effectors: Mechanical and Non-mechanical grippers, Types of actuation mechanisms, requirements for the design of grippers, considerations for the selection of grippers.

UNIT-II MOTION ANALYSIS

Motion Analysis: Basic Rotation Matrices, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

UNIT-III MANIPULATOR & DIFFERENTIAL KINEMATICS

Manipulator Kinematics: D-H notation, D-H method of Assignment of frames, D-H Transformation Matrix, joint coordinates and world coordinates, Forward kinematics of 2R, RP, 3R and SCARA manipulators and Inverse kinematics of 2R, RP and 3R manipulators.

UNIT-IV	TRAJECTORY PLANNING & DYANIMCS
Trajectory Planning: Definition of Trajectory planning, Path, Trajectory, Knot points, Steps involved in trajectory planning, Trajectory planning techniques-Joint space and Cartesian space techniques, Cubic polynomial trajectory.	
UNIT-V	**ACTUATORS, FEEDBACK COMPONENTS & APPLICATIONS**
Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback Components: Position sensors – potentiometers, resolvers, optical encoders, Velocity sensor, Contact Sensors-Touch sensors, Tactile and Range sensors, Force and Torque sensors, Proximity sensor, Inductive sensor. Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.	
Text Books:	
1. Industrial Robotics by Groover M P, Pearson Edu. 2. Robotics and Control by Mittal RK & Nagrath IJ,TMH. 3. Theory of Applied Robotics (kinematics, Dynamics and Control) - Jazar, Springer.	
Reference Books:	
1. Fu K S, Robotics, McGraw Hill. 2. Spony and Vidyasagar, Robot Dynamics and Control, John Wiley 3. Asada and Slotine, Robot Analysis and control, Wiley Inter-Science 4. John J Craig, Introduction to Robotics, Pearson Education	

PRODUCT LIFE CYCLE MANAGEMENT

IV B.TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME60	PEC	3	0	0	3	30	70	100

COURSEOVERVIEW:

This course aim at provides the students with knowledge about how a Product Lifecycle Management (PLM) system is used to structure and manage the information which guides the product during its lifecycle. The course identifies different stakeholders which both generates and consumes information related to the product and its manufacturing system over the lifecycle. The course also presents an overview of integration of PLM with other applications.

COURSEOUTCOMES:

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

1. Explain basic concepts of product life cycle management.
2. Demonstrate product development approaches.
3. Explain elements of product modelling.
4. Discuss in detail the concept of product data management.
5. Discuss about integration of PLM with other applications.

UNIT-I INTRODUCTION TO PLM

Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement. Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM

UNIT-II PRODUCT DEVELOPMENT

Product Development Approaches: Bottom-up design, Top-down design, Front-loading design workflow, Design in context, Modular design. Concurrent engineering, partnership with supplier, collaborative and Internet based design, work structuring and team deployment, Product and process systemization, problem, identification and solving methodologies, improving product development solutions

UNIT-III PRODCUT MODELING

Product Modelling - Definition of concepts - Fundamental issues – Role of Process chains and product models -Types of product models – model standardization efforts-types of process chains - Industrial demands. Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration)

UNIT-IV	PRODUCT DATA MANAGEMENT
Product Data Management (PDM) –Benefits and Terminology, PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation. Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Functional applications (e.g., configuration Management).	
UNIT-V	**INTEGRATION OF PLM WITH OTHER APPLICATIONS, PLM SOFTWARES**
Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. PLM Softwares - Basic features and modules of ENOVIA and Windchill.	
Text Books:	
1. Grieves, Michael. Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303 2. Saaksvuori Antti / ImmonenAnselmie, product Life Cycle Management Springer, Dreamtech,3-540- 25731-4.	
Reference Books:	
1. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004. ISBN 1852338105. 2. Fabio Giudice, Guido La Rosa, Product Design for the environment -A life cycle approach, Taylor & Francis 2006.	

PROFESSIONAL ELECTIVE – VI

INDUSTRIAL MANAGEMENT

IV B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	TOTAL
A5ME61	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

-

COURSE OUTCOMES:

At the end of the course students are able to:

1. Describe the most well-known theories and perspectives on management
2. Basic understanding of the relationship between organizational structure, technology and the conditions of the organizational environment
3. Describe the dynamics of change management
4. Pursuit a minor organizational analysis
5. Basic understanding of contemporary organizational forms

UNIT-I INTRODUCTION TO MANAGEMENT

Entrepreneurship and organization – 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 Management.

UNIT-II DESIGNING ORGANIZATIONAL STRUCTURES

Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT-III OPERATIONS MANAGEMENT

Objectives- product design process- Process selection-Types of production system(Job, batch and Mass Production),Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method) Value analysis-Definition-types of values-Objectives- Phases of value analysis- Fast diagram.

UNIT-IV WORK STUDY & STATISTICAL QUALITY CONTROL

Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling.

Statistical Quality Control: variables attributes, Shewhart control charts for variables-chart, R chart– Attributes- Defective - Defect- Charts for attributes - p - chart - c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OCcurves.

UNIT-V	JOB EVALUATION & PROJECT MANAGEMENT

Job Evaluation: Methods of job evaluation — simple routing objective systems—classification method factor comparison method, point method, benefits of job evaluation and limitations.

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).

TextBooks:

1. Industrial Engineering and Management/O.P. Khanna/KhannaPublishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma /Khanna Publishers.

ReferenceBooks:

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study bylLO.
2. Human factors in Engineering & Design/Ernest J McCormick/TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia.

OPERATIONS RESEARCH

IV B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME62	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

Operations research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations. In operations research, problems are broken down in to basic components and then solved in defined steps by mathematical analysis. This course givesinsightofLinearProgramming,Transportation,assignmentproblems,sequencingetc.

COURSE OUTCOMES:

At the end of the course student will be able to

1. Describe types of models and solve linear programming problem.
2. Solve transportation and assignment problems.
3. Analyze sequencing and replacement models and apply them for optimization.
4. Apply gaming theory for optimal decision making and analyze inventory models to optimize the cost.
5. Model and solve problems using dynamic programming

UNIT-I INTRODUCTION&ALLOCATION

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

UNIT-II TRANSPORTATION&ASSIGNMENTPROBLEMS

TRANSPORTATION PROBLEM: Formulation–Optimal solution, unbalanced transportation problem,Degeneracy.
ASSIGNMENT PROBLEM: Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT-III SEQUENCING & REPLACEMENT

SEQUENCING: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines REPLACEMENT: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT-IV THEORYOFGAME & INVENTORY

THEORY OF GAMES: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games -

dominance principle. INVENTORY: Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

UNIT-V

WAITING LINES: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

DYNAMIC PROGRAMMING: Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

Text Books:

1. Operation Research by J.K.Sharma, MacMilan.
2. Operations Research by ACS Kumar, Yesdee

Reference Books:

1. Operations Research: Methods and Problems by Maurice Saseini, Arhur Yaspan and Lawrence Friedman
2. Operations Research by A.M.Natarajan, P.Balasubramaniam, A.Tamilarasi, Pearson Education.
3. Operations Research by Wagner, PHI Publications.
4. Introduction to O.R by Hillier & Libermann, TMH.

TOTAL QUALITY MANAGEMENT

IV B. TECH II Semester : MECHANICAL ENGINEERING

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME63	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW

Total Quality Management (TQM) is an approach that organizations use to improve their internal processes and increase customer satisfaction. When it is properly implemented, this style of management can lead to decreased costs related to corrective or preventative maintenance, better overall performance, and an increased number of happy and loyal customers. This course is developed to impart knowledge on principles, tools and techniques of TQM, control charts, quality cost and systems.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Demonstrate basic concepts of total quality management.
2. Explain principles of total quality management.
3. Explain seven tools of quality, management tools and bench marking.
4. Enumerate and describe various control charts, quality costs and quality management.
5. Explain quality systems for TQM.

UNIT-I	INTRODUCTION

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention

UNIT-II	TQM PRINCIPLES

Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT-III	TQM TOOLS & TECHNIQUES

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT-IV	CONTROL CHARTS & COST OF QUALITY

Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT-V	**QUALITY SYSTEMS**

Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.

Text Books:

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

Reference Books:

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4. Quality Management/Kanishka Bedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

OPTIMIZATION TECHNIQUES

IV B. TECH II Semester: MECHANICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME64	PEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming

Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.

To explain the concept of Dynamic programming and its applications to project implementation.

COURSE OUTCOMES:

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

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

UNIT-I INTRODUCTION AND CLASSICAL OPTIMIZATION TECHNIQUES

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT-II LINEAR PROGRAMMING

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

UNIT-III UNCONSTRAINED NONLINEAR PROGRAMMING

Unconstrained Nonlinear Programming: One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method.

Unconstrained Optimization Techniques: Univariant method, Powell's method and steepest descent method.

UNIT-IV	CONSTRAINED NON LINEAR PROGRAMMING

Constrained Nonlinear Programming: Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

UNIT-V	DYNAMIC PROGRAMMING

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Text Books:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

Reference Books:

1. George Bernard Dantzig, Mukund Narain Thapa, “Linear programming”, Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, “Operations Research: An Introduction”, 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, “Optimization for Engineering Design – Algorithms and Examples”, PHI Learning Pvt. Ltd, New Delhi, 2005.

OPEN ELECTIVE COURSES OFFERED BY MECHANICAL DEPARTMENT

OPEN ELECTIVE COURSE - I			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1.	A5ME71	Elements of Mechanical Engineering	Mechanical Engineering
2.	A5ME72	Fundamentals of Engineering Materials	
OPEN ELECTIVE COURSE - II			
3.	A5ME73	Fundamentals of Mechatronics	Mechanical Engineering
4.	A5ME74	Basics of Thermodynamics	
OPEN ELECTIVE COURSE - III			
5.	A5ME75	Basics of Robotics	Mechanical Engineering
6.	A5ME76	Fundamentals of Operations Research	
OPEN ELECTIVE COURSE - IV			
7.	A5ME77	Introduction to Material Handling	Mechanical Engineering
8.	A5ME78	Renewable Energy Sources	

ELEMENTS OF MECHANICAL ENGINEERING

V Semester: OPEN ELECTIVE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME71	OEC	3	-	-	3	30	70	100

COURSE OVERVIEW:

This course deals with fundamental concepts of design, manufacturing and thermal engineering.

COURSE OBJECTIVES:

The course aims to enable the students learn basic concepts of mechanics, materials, thermodynamics, manufacturing and CAD/CAM.

COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability:

1. To demonstrate basic concepts of mechanics of rigid and deformable bodies.
2. To explain fundamentals of metallurgy and material science.
3. To discuss basic concepts and principles of thermodynamics.
4. To demonstrate the elements of fabrication processes and equipment.
5. To explain basic concepts of CAD/CAM.

UNIT-I MECHANICS

MECHANICS OF RIGID BODIES: Force, Force system, Classification of force systems, triangle law, parallelogram law-derivation and problems, polygon law, resolution of forces in coplanar-concurrent force system-problems; Definition of friction, laws of friction, coefficient of friction, types of friction, angle of friction, angle of repose, Definition of centroid and centre of gravity, pappus and guldinus theorems, problems on centroid of plane areas; Definition of area moment of inertia, parallel axis theorem, perpendicular axis theorem, simple problems on area moment of inertia.

MECHANICS OF DEFORMABLE BODIES: Stress, Strain, Types of stresses and strains, Poisson's ratio, stress-strain curve of mild steel, Hooke's Law, factor of safety, mechanical properties of materials, bulk modulus, shear modulus, bars of uniform and varying sections-simple problems.

UNIT-II METALLURGY & MATERIAL SCIENCE

Bonds in Solids, crystallization of metals, Classification of steels, Necessity of alloying, types of solid solutions, lever rule, phase rule, cooling curve of pure iron, Iron-Iron carbide diagram, Heat treatment-Annealing, quenching, normalizing, Hardening, tempering; Ceramic materials-classification, properties and applications.

UNIT-III	THERMO DYNAMICS

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic view points, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry , First law of Thermodynamics – Corollaries, First law applied to a Closed System, applied to a flow system, Steady Flow Energy Equation and Limitations of the First Law, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements, Carnot cycle and its specialties.

UNIT-IV	MANUFACTRUING

Casting-Types of casting, advantage of casting and its applications, defects in castings; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Welding-classification, Heat affected zone in welding, welding defects-causes and remedies; Basic extrusion process and its characteristics, Forging operations and principles; Basic machining operations-drilling, milling, turning, step turning, threading, grinding and shaping; Limits, fits and tolerances- Unilateral and bilateral tolerance system, hole and shaft basis system.

UNIT-V	CAD/CAM

Fundamentals of CAD/CAM- Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD; Wire frame modeling: Definition, advantages, dis-advantages, wire frame entities-analytic entities and synthetic entities; Surface modeling: Definition, advantages, disadvantages, surface entities-analytic entities and synthetic entities; Solid Modeling: Definition, constructive solid geometry, advantages, modeling entities.

Text Books:

1.Singer's Engineering Mechanics by K.Vijay Kumar Reddy and J.Suresh Kumar, B.S Publications
2. Introduction to physical metallurgy by Avner, TATA McGawHill Edition.
4.Thermodynamics by P.K Nag, McGaw Hill Education.
5.Production Technology by R.K Jain, Khanna Publishers.
6.CAD/CAM Theory & Practice by Ibrahim Zeid & R.Sivasubramanian, McGaw Hill Education.

Reference Books:

1. Engineering Mechanics By R.K.Bansal, Laxmi Publications
2. Material science and metallurgy by OP Khanna, Dhanpat Ray Publications
3. Engineering Thermodynamics By Pakirappa, V.Naveen Kumar, V.Naresh, Durga Publishing House
4. Production Technology by Dr. P.C Sharma, S.CHAND
5. CAD/CAM By P.Radha Krishnan, S.Subramanyan and V.Raju, New Age International Publishers.
6. Sterngth of Materials By Dr.Sadhu Singh, Khanna Publishers.

FUNDAMENTALS OF ENGINEERING MATERIALS

V Semester: OPEN ELECTIVE - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME72	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

This course will enable students to understand basic structure and crystal arrangement of materials, the phase diagrams, advantages of heat treatment, various heat treatment processes, the need and application of composite materials.

COURSE OUTCOMES:

At the end of course students are able to

1. Explain basic concepts of crystal structure such as unit cells, crystal systems of metals etc.
2. Demonstrate the concept of alloying and formation of different types of phases in alloys.
3. Differentiate ferrous and non ferrous alloys.
4. Explain various heat treatment processes.
5. Classify and explain polymers, ceramics and composites.

UNIT-I CRYSTAL STRUCTURE

Unit cells, crystal systems of metals, Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, determination of grain size, effect of grain size on the properties of alloys.

UNIT-II ALLOYS & PHASE DIAGRAMS

Alloys- substitutional and interstitial solid solutions.

Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructure of ledeburite, austenite, ferrite and cementite.

UNIT-III FERROUS AND NON FERROUS ALLOYS

Alloying of steel, properties of stainless steel and tool steels, maraging steels; cast irons-grey, white, malleable and spheroidal cast irons; copper and copper alloys- brass, bronze and cupro-nickel; Aluminium and Aluminium alloys.

UNIT-IV HEAT TREATMENT OF STEEL

Annealing, tempering, normalizing and spheroidising, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V POLYMERS, CERAMICS AND COMPOSITES

Classification, properties and applications of polymers, ceramics, composites and nano materials.

Text Books:

1. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
2. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.
3. Sidney H. Avener (2007,) *Introduction to Physical Metallurgy*, 2nd edition, Tata McGraw hill education (P) Ltd, New Delhi, India.

Reference Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. D. Kodgire (2006), Material Science and Metallurgy for engineers, 1st Edition, Everest, Pune, India.

FUNDAMENTALS OF MECHATRONICS

VI Semester: OPEN ELECTIVE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME73	OEC	3	-	-	3	30	70	100

COURSE OVERVIEW:

The aim is to introduce students to the fundamental concepts and principles mechatronics. It builds upon the awareness and necessity of interdisciplinary dependency of 21st century. It aim is also to engage students to understand the introduction to mechatronics with emphasis on analog electronics, digital electronics, sensors and transducers, actuators, and microprocessors. Lectures are intended to provide the student with foundational concepts in mechatronics and practical familiarity with common elements making up mechatronic systems.

COURSE OUTCOMES:

At the end of the course students are able to

1) Demonstrate various elements underlying mechatronic systems, electronics, control systems and able differentiate their purpose in the system.
2) Analyze and select sensors, actuators, electromechanical components needed for an application.
3) To evaluate microprocessor and microcontroller interfacing to mechanical application.
4) To choose PLC to a mechanical application.
5) To design mechatronic systems for mechanical applications.

UNIT-I	INTRODUCTION

Introduction to Mechatronics –-Mechatronics systems - Mechatronics design process - Mechatronics in Manufacturing –Adoptive and distributed control systems – Modelling and simulation of mechatronics systems.

UNIT-II	SENSORS AND ACTUATORS

Sensors and actuators: Overview of sensors and transducers – Microsensors - Signal conditioning – Operational amplifiers – Protection – Filtering - Analog and Digital converters. Electro – pneumatics and Electro – hydraulics - Solenoids – Direct Current motors – Servomotors – Stepper motors - Micro actuators; Drives selection and application.

UNIT-III	INTERFACING

Interfacing: Microprocessor based Controllers Architecture of microprocessor and microcontroller – System interfacing for a sensor, keyboard, display and motors - Application cases for temperature control, warning and process control systems

UNIT-IV	PLCs

PLCs: Programmable Logic Controllers Architecture of Programmable Logic Controllers – Input/Output modules – programming methods – Timers and counters – Master control – Branching – Data handling – Analog input/output – Selection of PLC and troubleshooting.

UNIT-V	ARTIFICIAL INTELLIGENCE
AI: Intelligent Mechatronics and Case Studies Fuzzy logic control and Artificial Neural Networks in mechatronics – Algorithms – Computer – based instrumentation - Real-time Data Acquisition and Control – Software integration – Man Machine interface -Vision system – Mechatronics system case studies.	
Text Books:	
1. Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill	
Reference Books:	
1. Designing Intelligent Machines, Michel B. Histand and David G. Alciatore, Open University London 2. Control Sensors and Actuators, ICW. Desiha, Prentice Hall	

BASICS OF THERMODYNAMICS

VI Semester: OPEN ELECTIVE - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME74	OEC	3	-	-	3	30	70	100

COURSE OVERVIEW:

Thermodynamics is the field of physics that deals with the relationship between heat and work in a substance during a thermodynamic process. This course covers fundamental concepts of thermodynamics such as laws of thermodynamics, purse substances, perfect gas laws, mixture of perfect gases, moiler charts and Psychrometry.

COURSE OBJECTIVES:

To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics for the analysis of thermal equipment

COURSE OUTCOMES:

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

1. Demonstrate basic concepts of thermodynamics.
2. Explain laws of thermodynamics.
3. Explain pure substances and power cycles.
4. Explain perfect gas laws and concepts of mixture of perfect gases.
5. Discuss fundamental concepts of psychrometry.

UNIT-I INTRODUCTION

Introduction: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry

UNIT-II LAWS OF THERMO DYNAMICS

First law of Thermodynamics – Corollaries – First law applied to a Closed System – applied to a flow system – Steady Flow Energy Equation. Limitations of the First Law

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Elementary Treatment of the Third Law of Thermodynamics

UNIT-III PURE SUBSTANCES & POWER CYCLES

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.

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

UNIT-IV PERFECT GAS LAWS & MIXTURE OF PERFECT GASES

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states

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.

UNIT-V	PSYCHROMETRY

Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

Text Books:

1. Engineering Thermodynamics, P.K. Nag, 6th Edition, Mc Graw Hill Education.
2. Thermodynamics an engineering approach, Yunus A. Cengel & Michael A. Boles, 8th Edition, Mc Graw Hill Companies.
3. Fundamentals of Thermodynamics, Richard E. Sonntag Claus Borgnakke, 7th Edition, Wiley.

Reference Books:

1. Fundamentals of engineering thermodynamics, Radhakrishnan. E, 2nd Edition, Prentice hall of India Pvt Ltd., 2006.
2. Thermodynamics, Arora.C.P, Tata Mc Graw Hill, New Delhi.
3. Applied Thermodynamics, Onkar Singh, 3rd Edition, New Age, India

BASICS OF ROBOTICS

VII Semester: OPEN ELECTIVE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME75	OEC	3	-	-	3	30	70	100

COURSE OVERVIEW:

Today robot finds applications in industries, medical and other fields. For example, in eye surgery (replacement of retina), where a cylindrical portion needs to be replaced, the operation is best done by robots. Mobile robots like walking machines, hopping machines are examples of robots, Nuclear and power plants uses fish like robots which move inside pipes for purpose of inspection. This course focuses on b various types of industrial robots, their kinematic and kinetic aspects, different types of grippers, mechanics of grippers, trajectory planning etc.

COURSE OUTCOMES:

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

1. Demonstrate different types of robots, specifications of robots and different end effectors used in robots.
2. Explain various types of end effectors
3. Evaluate rotation matrices, forward kinematics of RR, RP and 3R Manipulators.
4. Explain inverse kinematics of RR manipulator, RP manipulator and trajectory planning techniques.
5. Explain feedback components used in robots and industrial applications.

UNIT-I	INTRODUCTION

Introduction: Automation and Robotics, Asimov's laws, Robot Architecture, Components, , Anatomy of robot, Factors to be considered in the selection of robot, present and future applications, Specifications- Degree of freedom, Pay load, Parts per hour, Accuracy, Repeatability, Speed, Work space, Work volume, Work envelope, classification of robots based on configuration and control systems

UNIT-II	END EFFECTORS & ACTUATORS

End effectors: Mechanical and Non-mechanical grippers, requirements for the design of grippers, considerations for the selection of grippers, Types of actuation mechanisms.

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators

UNIT-III	MOTION ANALYSIS & DIRECT KINEMATICS

Motion Analysis: Basic Rotation Matrices, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.
Manipulator Kinematics: D-H notation, D-H method of Assignment of frames, D-H Transformation Matrix, joint coordinates and world coordinates, Forward kinematics of 2R, RP and 3R manipulators

UNIT-IV	INVERSE KINEMATICS & TRAJECTORY PLANNING

Inverse kinematics : Inverse kinematics of 2R and RP manipulators.
Trajectory Planning: Definition of Trajectory planning, Path, Trajectory, Knot points, Steps involved in trajectory planning, Trajectory planning techniques-Joint space and Cartesian space techniques, Cubic polynomial trajectory

UNIT-V	FEEDBACK COMPONENTS & APPLICATIONS

Feedback Components: Position sensors – potentiometers, resolvers, optical encoders, Velocity sensor, Contact Sensors-Touch sensors, Tactile and Range sensors, Force and Torque sensors, Proximity sensor, Inductive sensor.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Text Books:

1. Industrial Robotics by Groover M P, Pearson Edu.
2. Robotics by Fu K S, McGraw Hill.
3. Theory of Applied Robotics (kinematics,Dynamics and Control-Jazar,Springer.

Reference Books:

1. Robotics and Control by Mittal R K & Nagrath I J, TMH.
2. Robot Dynamics and Controls by Spony and Vidyasagar, John Wiley
3. Robot Analysis and control by Asada and Slotine, Wiley Inter-Science
4. Introduction to Robotics by John J Craig, Pearson Education

FUNDAMENTALS OF OPERATIONS RESEARCH

VII Semester: OPEN ELECTIVE - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME76	OEC	3	-	-	3	30	70	100

COURSE DESCRIPTION:

Operations research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations. In operations research, problems are broken down into basic components and then solved in defined steps by mathematical analysis. This course gives insight of Linear Programming, Transportation, assignment problems, sequencing etc.

COURSE OBJECTIVES:

The objectives of this course are to learn quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

COURSE OUTCOMES:

At the end of course students will be able to

1. Describe types of models and solve linear programming problem.
2. Solve transportation and assignment problems.
3. Analyze sequencing and replacement models and apply them for optimization.
4. Apply gaming theory for optimal decision making.
5. Analyze inventory models to optimize the cost

UNIT-I INTRODUCTION & ALLOCATION

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

ALLOCATION: Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

UNIT-II TRANSPORTATION & ASSIGNMENT PROBLEMS

TRANSPORTATION PROBLEM: Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

ASSIGNMENT PROBLEM: Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT-III SEQUENCING & REPLACEMENT

SEQUENCING: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines

REPLACEMENT: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely.

UNIT-IV	THEORY OF GAMES
THEORY OF GAMES: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.	
UNIT-V	**INVENTORY**
INVENTORY: Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.	
Text Books:	
1. Operation Research by J.K.Sharma, MacMilan. 2. Operations Researchby ACS Kumar, Yesdee	
Reference Books:	
1. Operations Research: Methods and Problems by Maurice Saseini, Arhur Yaspan and Lawrence Friedman 2. Operations Research by A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi, Pearson Education. 3. Operations Research by Wagner, PHI Publications. 4. Introduction to O.Rby Hillier & Libermann,TMH.	

INTRODUCTION TO MATERIAL HANDLING

VIII Semester: OPEN ELECTIVE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME77	OEC	3	-	-	3	30	70	100

COURSE OVERVIEW:

Material handling is the movement, protection, storage and control of materials and products throughout manufacturing, warehousing, distribution, consumption and disposal. As a process, material handling incorporates a wide range of manual, semi-automated and automated equipments and systems that support logistics and make the supply chain work. This course will give an insight material handling equipment such as transport systems and storage systems, various inventory models and forecasting techniques.

COURSE OBJECTIVES:

The aim of this course is to enable the students to learn basic concepts of material handling, consideration in material handling system, materials transport and storage system, various inventory models and forecasting techniques.

COURSE OUTCOMES:

At the end of the course students are able to

1. Demonstrate basic concepts and principles of material handling.
2. Discuss about various material transport systems.
3. Explain conventional and automated storage systems.
4. Explain various inventory models.
5. Demonstrate different forecasting techniques.

UNIT-I	INTRODUCTION

Introduction: Overview of material handling equipment, considerations in material handling system design, The 10 principles of material handling.

UNIT-II	MATERIAL TRANSPORT SYSTEMS

Material Transport Systems: Industrial trucks, Automated guided vehicle systems, Monorails and other rail guided vehicles, conveyor systems, cranes and hoists, Analysis of material transport systems.

UNIT-III	STORAGE SYSTEMS

Storage Systems: Storage system performance, storage location strategies, conventional storage methods and equipment, automated storage systems and analysis of automated storage systems.

UNIT-IV	INVENTORY

Inventory: Introduction, Inventory management, Static Inventory models, ABC Analysis, VED analysis, Just in Time, Aggregate inventory analysis, Inventory models with quantity discounts.

UNIT-V	FORECASTING
Forecasting: Forecasting techniques, Make or Buy decision, Acceptance sampling, Materials requirement planning, objectives of master schedule.	
Text Books:	
1. Mikell P. Groover, Automation Production Systems and Computer Integrated Manufacturing, Pearson International Edition. 2. A.K Singh, Materials Management, Laxmi Publications (P) Ltd.	
Reference Books:	
1. Dr.K.C Arora, Vikas V.Shinde, Aspects of Material Handling, Laxmi Publications (P) Ltd. 2. Charles Reese, Material Handling Systems, Taylor & Francis Network	

RENEWABLE ENERGY SOURCES

VIII Semester: OPEN ELECTIVE - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5ME78	OEC	3	0	0	3	30	70	100

COURSE OVERVIEW:

The energy has become an important and one of the basic infrastructures for the economic development of the country. It is imperative for the sustained growth of the economy. This course envisages the new and renewable source of energy, available in nature and to expose the students on sources of energy crisis and the alternates available, also stress up on the application of non-conventional energy technologies.

COURSE OBJECTIVES:

To impart the knowledge of basics of different non conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature.

COURSE OUTCOMES:

At the end of the course students are able to

1. Demonstrate various energy sources and their availability.
2. Explain concepts and applications of solar radiation
3. Discuss in detail about the principles of wind energy conversion
4. Explain Biomass conversion techniques and Geothermal Sources and resources
5. Explain about tidal energy and Ocean Thermal Energy.

UNIT- I ENERGY SOURCES & THEIR AVAILABILITY

Energy Sources & their Availability - Importance of Non Conventional Energy Resources - Classification of NCES - Solar, Wind, Geothermal, Bio-mass, Nuclear Energy & Fuel Cells, Ocean Energy Sources, Comparison of these Energy Sources, Prospects of Renewable Energy Sources - Criteria for Assessing the Potential of NCES, Statistics on Conventional Energy Sources and supply in Developing Countries

UNIT- II INTRODUCTION TO SOLAR RADIATION & APPLICATIONS OF SOLAR ENERGY

Introduction to Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. Solar Energy Storage – Collectors: Flat plate and Concentrating collectors, collector efficiency, Focusing and non-focusing type

Applications of Solar Energy - solar water heater- Solar Cooker-Box type- Solar dryer - solar greenhouse—Summer and winter greenhouse-solar electric power generation- Solar Photo- Voltaic, Solar Cell Principle, Conversion efficiency and power output, Basic Photo Voltaic System for Power Generation.

UNIT- III	PRINCIPLE OF WIND ENERGY CONVERSION

Principle of Wind Energy Conversion - Basic components of Wind Energy Conversion Systems : Wind data and energy estimation, Site Selection Considerations - Wind mill Components, Various Types and their Constructional Features - Effect of Density, Frequency Variances, Angle of attack, and Wind Speed - Design Considerations of Horizontal and Vertical Axis Wind Machines - Analysis of Aerodynamic Forces Acting on Wind Mill Blades and Estimation of Power Output.

UNIT- IV	BIOMASS CONVERSION TECHNIQUES , GEOTHERMAL SOURCES AND RESOURCES

Biomass conversion techniques - Biogas Generation - Factors affecting biogas Generation-Types of biogas plants - Advantages and disadvantages of biogas plants - site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas - urban waste to energy conversion.

Geothermal Sources and resources like hydrothermal, geo-pressured hot dry rock, magma. advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India - exhaust types of conventional steam turbines.

UNIT- V	TIDAL ENERGY & OCEAN THERMAL ENERGY CONVERSION

Tidal Energy - Principle of working, performance and limitations. Wave Energy - Principle of working, performance and limitations.

Ocean Thermal Energy Conversion - Availability, theory and working principle, performance and limitations. OTEC power plants, Operational of small cycle experimental facility, Economics of OTEC, Environmental impacts of OTEC.

Text Books:

1. G. D. Rai, “Non-Conventional Energy Sources”,4th Edition, Khanna Publishers, 2000

2. B H Khan, “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011

Reference Books:

1. S.Hasan Saeed and D.K.Sharma , “Non-Conventional Energy Resources”,3rd Edition,S.K.Kataria & Sons, 2012
2. Renewable energy sources and conversion technology by N.K. Bansal, M. Kleemann, M. Heliss, Tata McGraw Hill 1990.
3. S. P. Sukhatme”, “Solar Energy Principles and Application”, TMH, 2009