B.E. MECHANICAL ENGINEERING

CURRICULUM

(2020 AND ONWARDS)

(REGULAR PROGRAMME)

Department of Mechanical Engineering
FACULTY OF ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University) Established Under
Section 3 of UGC Act 1956
Pollachi Main Road, Eachanari Post, Coimbatore – 641 021. INDIA
These regulations are effective from the academic year 2020 – 2021 and applicable to the candidates admitted to B. E. / B. Tech. during 2020 - 2021 and onwards.

1. ADMISSION

1.1 Candidates seeking admission to the first semester of the eight semesters B. E./B.Tech Degree Programme:

Should have passed the Higher Secondary Examination (10+2) (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any similar Examination of any other University or authority accepted by the Karpagam University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

1.2 Candidates seeking admission to the first semester of the eight semesters B. Tech. (Bio-Technology) Degree Programme:

Should have passed the Higher Secondary Examination (10+2) (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry (or) Physics, Chemistry and Biology as three of the four subjects (or) Physics, Chemistry, Botany and Zoology as subjects of study under Part-III or any similar Examination conducted by any other authority accepted by the Karpagam University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

1.3 Lateral Entry Admission

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education, Tamil Nadu or its equivalent and candidates who possess a Bachelor Degree in Science (10+2+3) with Mathematics as one of the subjects, awarded by any University or its equivalent are eligible to apply for admission to the third semester of B. E./B. Tech. Such candidates shall undergo two additional engineering subjects in the 3rd and 4th semester as prescribed by the University.
Eligibility criteria for admission in the first semester is given in the table below

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Programme</th>
<th>Eligibility criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>B. E. Automobile Engineering</td>
<td>Diploma in Automobile Enng./ Mechanical Enng./ Metallurgy/ Mechanical and Rural Enng. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Enng. / Tool and Die Design.</td>
</tr>
<tr>
<td>2.</td>
<td>B.E Bio Medical Engineering</td>
<td>Diploma in Electrical &amp; Electronics Enng. / Electronics &amp; Communication Enng./ Computer Science Enng/ Mechatronics Enng/Computer Technology/Instrumentation Technology</td>
</tr>
<tr>
<td>3.</td>
<td>B. E. Civil Engineering</td>
<td>Diploma in Civil Enng./ Sanitary Enng. / Civil and Rural Enng.</td>
</tr>
<tr>
<td>7.</td>
<td>B. E. Mechanical Engineering</td>
<td>Diploma in Mechanical Enng./ Metallurgy/Automobile Enng./ Mechanical and Rural Enng. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Enng. / Tool and Die Design</td>
</tr>
<tr>
<td>9.</td>
<td>B. Tech Chemical Engineering</td>
<td>Diploma in Chemical Engineering / Petrochemical</td>
</tr>
</tbody>
</table>
1.4 Migration from other University

Candidates who have completed their first to sixth semesters of B. E./B. Tech. study in any University are eligible to apply for admission to their next semester of B. E./B. Tech. in the branch corresponding to their branch of study. The student will be exempted from appearing for Examination of the equivalent courses passed in the earlier programme and will have to appear for courses which he/she has not done during the period of his/her earlier programme. Along with the request letter and mark sheets, he/she has to submit a copy of syllabus of the programme duly attested by the Registrar, Competent authority, he/she has undergone. Equivalence Certificate shall be provided by the “Students’ Affairs Committee” of Karpagam University. Students’ Affairs Committee comprises all the Heads of the Departments and Dean of the Faculty of Engineering and a nominee of the Registrar.

2. PROGRAMMES OFFERED

A candidate may undergo a programme in any one of the branches of study approved by the University as given below.

List of B. E. and B. Tech. Degree Programmes

1. B. E. Automobile Engineering
2. B.E. Bio Medical Engineering
3. B. E. Civil Engineering
4. B. E. Computer Science and Engineering
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
9. B. Tech Chemical Engineering
10. B. Tech Food Technology

3. MODE OF STUDY

3.1 Full-Time:
In this mode of study, the candidates are required to attend classes regularly on the specified working days of the University.

3.2 Conversion from full time mode of study to part time is not permitted.
3.3 Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

4.1 Every programme will have a curriculum with syllabus consisting of theory and practical courses such as:

(i) General core courses comprising Mathematics, Basic Sciences, Engineering Sciences and Humanities.
(ii) Core courses of Engineering/Technology.
(iii) Elective courses for specialization in related fields.
(iv) Workshop practice, computer practice, engineering graphics, laboratory work, in-plant training, seminar presentation, project work, industrial visits, camps, etc.

Every student is encouraged to participate in at least any one of the following programmes

- NSS / Sports/Physical exercise/NCC/YRC/Red Ribbon club/Environment club and Energy club
- Other Co-Curricular and Extra Curricular activities

(V) Choice Based Credit System

CBCS is introduced for students admitted in the academic year 2017-18. As per AICTE guidelines, CBCS is an approach in which students opt for courses of their choice. CBCS provides greater flexibility with multiple courses and enable students to undergo additional courses. CBCS is applicable to Full Time Undergraduate & Post Graduate Programmes of study. It provides a choice for students to select from the prescribed courses (Professional soft core, Professional Hard core, Professional Electives, Open Electives, Value added courses, Humanity Sciences, Basic sciences & Engineering sciences). A course designated as hard core for a particular programme of study must invariably be completed by the student to receive the degree in the programme. The Hardcore courses cannot be substituted by another courses. Students can exercise their choice among a set of Soft core courses from the list of Soft core courses specified for each Programme of study. The student should meet the criteria for prerequisites to become eligible to register for that course. The student should request for the course for every semester within the first week of semester. Maximum no of students to be registered in each course shall depend on availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

4.2 Each course is normally assigned certain number of credits.

- No. of credits per lecture period per week : 1
- No. of credits per tutorial period per week : 1
- No. of credits for 3 periods of laboratory course per week : 2
- No. of credits for 3 periods of project work per week : 2
- No. of credits for 2 periods of Value added course per week : 1
- No. of credits for 3 weeks of in-plant training during semester vacations : 1

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding 6 and practical courses not exceeding 3. However, the total number of courses
per semester shall not exceed 8.

4.4 The prescribed credits required for the award of the degree shall be within the limits specified below.

<table>
<thead>
<tr>
<th>PROGRAMME</th>
<th>PRESCRIBED CREDIT RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. E./B. Tech.</td>
<td>165–170</td>
</tr>
</tbody>
</table>

4.5 The medium of instruction for all Courses, Examinations, Seminar presentations and Project/Thesis reports is English.

4.6 Value Added Course

Besides core courses and elective courses, value added course is introduced. The blend of different courses is so designed that the student would be trained not only in his / her relevant professional field but also as a socially conscious human being.

4.7 Evaluation in the courses comprises two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE). Evaluation in few courses may be by Internal Assessment only.

5. DURATION OF THE PROGRAMME

5.1 The prescribed duration of the programme shall be

<table>
<thead>
<tr>
<th>Programme</th>
<th>Min. No. of semesters</th>
<th>Max. No. of semesters</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. E./B. Tech. ( H. Sc. Candidates)</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>B. E./B. Tech. (Lateral Entry Candidates)</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

5.2 Each semester shall normally consist of 90 working days or 540 hours.

5.3 Additional classes for improvement, conduct of model test, etc., over and above the specified periods shall be arranged, if required. But for the purpose of calculation of attendance requirement for eligibility to appear for the end semester Examinations (as per Clause 11) by the students, 540 hours conducted within the specified academic schedule alone shall be taken into account and the overall percentage of attendance shall be calculated accordingly.

6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER

6.1 Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

6.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed
attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean. However, the candidate has to pay prescribed condonation fees.

6.3 Candidates who are not recommended for condonation and those who have less than 65% attendance will not be permitted to proceed to the next semester and have to redo the course. However, they are permitted to write the arrear Examinations, if any.

7. CLASS ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department notice board and also discuss with or inform the Parents/Guardian about the progress of the students. Each student shall be provided with course plan for each course at the beginning of each semester.

8. CLASS COMMITTEE

8.1 Every class shall have a class committee consisting of teachers of the class concerned, Maximum of six student representatives [boys and girls] and the concerned Head of the Department. It is like the ‘Quality Circle’ with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 4 and 5 which should be displayed on Department Notice-Board.
- Informing the student representatives the details of Regulations regarding weight age used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar, etc.) the breakup of marks for each experiment / exercise/module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Solving problems experienced by students in the class room and in the laboratories.
- Informing the student representatives the academic schedule, including the dates of assessments and the syllabus coverage for each assessment.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any and requesting the teachers concerned to provide some additional academic support.

8.2 The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Dean.
8.3 The class committee shall be constituted within the first week of each semester.

8.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

8.5 The Dean may participate in any Class Committee of the Faculty.

8.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean through the HOD within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through Dean.

8.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9. COURSE COMMITTEE FOR COMMON COURSES
   Each common theory course offered to more than one discipline or group, shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The ‘Course Committee’ shall meet to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

10.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' (Log book) which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

10.2 Continuous Internal Assessment (CIA): The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>CATEGORY</th>
<th>MAXIMUM MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Assignment</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>Seminar *</td>
<td>5</td>
</tr>
<tr>
<td>3.</td>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>Test – I</td>
<td>8</td>
</tr>
<tr>
<td>5.</td>
<td>Test – II</td>
<td>8</td>
</tr>
<tr>
<td>6.</td>
<td>Test – III</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Continuous Internal Assessment : TOTAL</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>

*Evaluation shall be made by a committee.
PATTERN OF TEST QUESTION PAPER (Test I & II)

<table>
<thead>
<tr>
<th>INSTRUCTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Marks</td>
<td>60</td>
</tr>
<tr>
<td>Duration</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Part- A</td>
<td>1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. (9 x 2 =18 Marks).</td>
</tr>
<tr>
<td>Part- B</td>
<td>Question 10 to 12 will be of either or type, covering two units of the syllabus. Each Question may have subdivision. (3 x 14 =42 Marks).</td>
</tr>
</tbody>
</table>

PATTERN OF TEST QUESTION PAPER (Test III)

<table>
<thead>
<tr>
<th>INSTRUCTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Marks</td>
<td>100</td>
</tr>
<tr>
<td>Duration</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Part - A</td>
<td>Part A will be online Examination. 20 Objective type Questions, Covering all the 5 units. (20 x 1= 20 Marks) (Online Examination).</td>
</tr>
<tr>
<td>Part- B</td>
<td>21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (5 x 2= 10 Marks).</td>
</tr>
<tr>
<td>Part- C</td>
<td>Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. (5 x 14=70 Marks).</td>
</tr>
</tbody>
</table>

PRACTICAL COURSES:

<table>
<thead>
<tr>
<th>S. No</th>
<th>CATEGORY</th>
<th>MAXIMUM MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>Observation work</td>
<td>5</td>
</tr>
<tr>
<td>3.</td>
<td>Record work</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>Model Examination</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>Viva – Voce [Comprehensive]</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Continuous Internal Assessment: TOTAL</td>
<td>40</td>
</tr>
</tbody>
</table>

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.
INTEGRATED THEORY AND PRACTICAL COURSES:

The Continuous Internal Assessment for Integrated Theory Course is awarded for 40 Marks with mark split up similar to regular theory course.

The external evaluation of integrated practical component from End semester Examination by internal mode is awarded for 50 Marks and later scaled down to 15 Marks and similarly the external evaluation for integrated theory from End semester Examination is awarded for 100 Marks and later scaled down to 45 Marks. Hence the external assessment for Integrated theory and practical components contribute to 60 Marks.

10.3 ATTENDANCE
Attendance carries a maximum of 5 marks and the distribution is as under:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Attendance %</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91 and above</td>
<td>5.0</td>
</tr>
<tr>
<td>2</td>
<td>81-90</td>
<td>4.0</td>
</tr>
<tr>
<td>3</td>
<td>76-80</td>
<td>3.0</td>
</tr>
</tbody>
</table>

10.4 PROJECT WORK/ INTERNSHIPS:
Final year project work will be always in-house. However, as a special case, if a student is able to get a project from a government organization or private or public sector company, the student may be permitted to do his/her project work in reputed institution/research organization/industry. Hence final year students may have commencement of eighth semester classes for 30 days in fast track mode and complete their final semester and are made eligible for undergoing Internships in Industry and also interested students are permitted for doing projects in Industries.

10.5 CERTIFICATION COURSES:
Students have to undergo a minimum of one value added course beyond curriculum as a certified course per semester for duration not less than 30 hours.

11. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION(ESE)
A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for Examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as arrearExaminations failing which the candidate will not be permitted to attend the next semester. A candidate already appeared for a subject in a semester and passed the Examination is not entitled to reappear in the same subject of the semester for improvement of grade.

12. END SEMESTER EXAMINATION
ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.
13. PASSING REQUIREMENTS

13.1 Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for ESE is 30 (i.e. out of 60 marks). The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in CIA and ESE) out of 100 marks.

13.1.1 The passing minimum for value added course is 50 marks out of 100 marks. There will be two tests, the first covering 50% of syllabus for 50 marks and the other for 50 marks.

13.2 If the candidate fails to secure a pass in a particular course ESE, it is mandatory that candidate shall register and reappear for the Examination in that course during the subsequent semester when Examination is conducted in that course. Further the candidate should continue to register and reappear for the Examination till a pass is secured in such supplementary Examination within the stipulated maximum duration of the programme (Clause 5.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

13.3 If the candidate fails to secure a pass in a particular course in CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such subsequent Examination within the stipulated maximum duration of the programme (Clause 5.1).

13.3.1 If a candidate fails to secure a pass in value added course, he/she has to appear for the tests when course is conducted subsequently.
13.4 ONLINE COURSE (MOOC) COORDINATOR

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a MOOC coordinator for the online courses. The Online course MOOC coordinator shall identify the courses which students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinator shall advice the students regarding the online courses and monitor their course.

13.4.1 Student Shall study atleast one online course from Sawayam/NPTEL in anyone of the first seven semesters for which examination shall be conducted at the end of the course by the respective organization.

The student can register to the course which are approved by the department. The student shall produce a pass certificate from the respective body before the end of the seventh semester.

14. AWARD OF LETTER GRADES

14.1 All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate letter grades, each carrying certain number of points will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>Marks Range</th>
<th>Grade Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>91 - 100</td>
<td>10</td>
<td>OUTSTANDING</td>
</tr>
<tr>
<td>A+</td>
<td>81 - 90</td>
<td>9</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>A</td>
<td>71-80</td>
<td>8</td>
<td>VERY GOOD</td>
</tr>
<tr>
<td>B+</td>
<td>66-70</td>
<td>7</td>
<td>GOOD</td>
</tr>
<tr>
<td>B</td>
<td>61 – 65</td>
<td>6</td>
<td>ABOVE AVERAGE</td>
</tr>
<tr>
<td>C</td>
<td>55 - 60</td>
<td>5</td>
<td>AVERAGE</td>
</tr>
<tr>
<td>D</td>
<td>50 - 54</td>
<td>4</td>
<td>PASS</td>
</tr>
<tr>
<td>RA</td>
<td>&lt;50</td>
<td>-</td>
<td>REAPPEARANCE</td>
</tr>
<tr>
<td>AB</td>
<td></td>
<td>0</td>
<td>ABSENT</td>
</tr>
</tbody>
</table>

14.2 GRADE SHEET

After results are declared, Grade sheet will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the grade scored,
ii. The Grade Point Average (GPA) for the semester and
iii. The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (C) of courses enrolled and the Grade Points (GP) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

\[
\text{GPA} = \frac{\text{Sum of } [C \times GP]}{\text{Sum of } C}
\]
CGPA will be calculated in a similar manner, considering all the courses enrolled from First semester. RA grade and value added course will be excluded for calculating GPA and CGPA.

14.3 REVALUATION
Revaluation and Re-totaling is allowed on representation. A candidate can apply for revaluation of his/her semester Examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary Examinations, Practical Examinations, Technical Seminars, In-plant Training and Project Work.

14.4 TRANSPARENCY AND GRIEVANCE COMMITTEE
A student may get the Photostat copy of the answer script on payment of prescribed fee, if he/she wishes. The students can represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HOD, the Dean of another Faculty nominated by the University), HOD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the COE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External Examiner will be final. The student has to pay prescribed fee for the same.

15. ELIGIBILITY FOR AWARD OF DEGREE
A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.

- No disciplinary action is pending against him/her.

The award of the degree must be approved by the Board of Management of Karpagam University.

16. CLASSIFICATION OF THE DEGREE AWARDED
16.1 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 5.1) securing a CGPA of not less than 8 shall be declared to have passed the Examination in First Class with Distinction.

16.2 A regular candidate or a lateral entrant is eligible to register for BE(Honors), B.Tech(Honors). If, he / she has passed all the courses in the first appearance and holds / maintains a CGPA of 7.5 at VI Semester. He / she has to take an additional 20 credits by studying online courses through Swayam/NPTEL. Such a candidate is eligible for the award of BE (Honor), B.Tech(Honor). However, is he / she fails in securing 20 additional credits but maintains CGPA of 7.5 and above is not eligible for Honors degree but eligible for First class with Distinction.

16.3 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses within the specified minimum number of semesters (vide Clause
5.1) plus one year (two semesters), securing CGPA of not less than 6.5 shall be declared to have passed the Examination in First Class.

16.3 All other candidates (not covered in Clauses 17.1 and 17.2) who qualify for the award of the degree (vide Clause 15) shall be declared to have passed the Examination in Second Class.

17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

17.1 A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

17.2 Such withdrawal shall be permitted only once during the entire duration of the degree programme. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the Examination.

17.3 Withdrawal application is valid only if it is made within 10 days prior to the commencement of the Examination in that course or courses and recommended by the Head of the Department, Dean and approved by the Registrar.

17.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions may be considered on the merit of the case.

17.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during III semester.

17.5 Withdrawal from the ESE is NOT applicable to arrear Examinations.

17.6 The candidate shall reappear for the withdrawn courses during the Examination conducted in the subsequent semester.

18. PROVISION FOR AUTHORISED BREAK OF STUDY

18.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, through the Head of the Department and Dean stating reasons thereof and the probable date of rejoining the programme.

18.2 The total number of semesters for completion of the programme from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum no. of semesters specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18) in order that he/she may be eligible for the award of the degree (vide Clause 15). The candidate thus permitted to rejoin the programme at the commencement of the semester after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the curriculum and regulations in force at that period of time.
18.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause 17). However, additional break of study granted will be counted for the purpose of classification.

18.4 The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18.3) in order that he/she may be eligible for the award of the degree.

18.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted ‘Withdrawal’ or ‘Break of Study’ (Clause 18 and 18 respectively).

19. SUPPLEMENTARY ESE: After the publication of VIII semester results, if a student has ONE arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for supplementary Examination.

20. INDUSTRIAL VISIT

Every student is required to undergo one industrial visit for every semester, starting from the third semester of the programme.

21. DISCIPLINE

Every student is required to observe discipline and decorous behavior both inside and outside the University and not to indulge in any activity which will tend to bring down the prestige of the University. The erring student will be referred to the Disciplinary Committee constituted by the University, to enquire into acts of indiscipline and recommend to the University about the disciplinary action to be taken.

If a student indulges in malpractice in any of the ESE/CIA he/she shall be liable for punitive action as prescribed by the University from time to time.

22. REVISION OF REGULATION AND CURRICULUM

The University may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi, if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam University.
Programme Specific Outcomes (PSO’s)

- **PSO1**: students acquired theoretical and practical background of technical and managerial skill to make them employable graduate.
- **PSO2**: students beamed fundamentally and rural – time (physical) problem solving skills by the use of advanced materials research lab and advanced welding laboratory.

Programme Educational Objectives (PEO’s)

- **PEO1**: Graduates will more conscious about their profession with social awareness and responsibility.
- **PEO2**: Graduates will be engineering experts, who would help solve industry's technological problems.
- **PEO3**: Graduates will be engineering professionals, consultants or entrepreneurs engaged in technology development.

Programme Outcomes (PO’s)

- **PO1 - Engineering Knowledge**: Ability to apply knowledge of mathematics, science and engineering fundamentals for solving the complex engineering problems.
- **PO2 - Problem Analysis**: Identify, formulate, review and analyze the complex engineering problems, by conceptual and fundamental principles of mechanical engineering to reach value added sustainable conclusions.
- **PO3 - Designs / development of solution**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental consideration.
- **PO4 - Conduct investigations of complex Problems**: Ability to apply appropriate tools, technique and research knowledge to investigate complex engineering problems.
- **PO5 - Modern tool usage**: To understand and apply modern techniques and IT tools for the design and analysis of mechanical systems.
- **PO6 - The engineer and society**: Understand the impact of engineering solutions in a societal context and to be able to respond effectively to the needs for sustainable development.
- **PO7 - Environment and sustainability**: Understanding the mechanism of pollutant formation and its control techniques.
- **PO8 - Ethics**: Understanding of human and ethical responsibilities towards the profession and society.

- **PO9 - Individual and team work**: Function effectively as an individual, and as a member or a leader in diverse teams, and in multi-disciplinary situations.

- **PO10 - Communication**: Ability to communicate effectively with engineering community and instruct in the form of reports, presentation and documents.

- **PO11 - Project management and finance**: Ability to understand the economics and cost analysis in order to take economically sound decisions.

- **PO12 - Lifelong learning**: To recognize the need for, and have the ability to engage in independent and lifelong learning.
### SEMESTER I

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Total number of credits: 166

**PEO: Programme Educational Objectives**

1. The passing minimum for Mandatory course is 50 marks out of 100 marks. There will be two tests, of which one will be class test covering 50% of syllabus for 50 marks and other for 50 marks.
2. Credits for mandatory courses are not counted for computation of CGPA.
3. A student will be eligible to get Under Graduate degree with Honors or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

**PO: Programme Outcomes**

L: Lecture Hour  T: Tutorial Hour  C: No. of Credits  ESE: End Semester  CIA: Continuous Internal  Note:
COURSE OBJECTIVES

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence.

COURSE OUTCOMES

Students undergoing this course will be able to

1. Use English language for communication: verbal & non–verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
4. Improve word power: lexical, grammatical and communication competence.
5. To guide the students to write business letters and other forms of technical writing.
6. To enable students to prepare for oral communication in formal contexts.

UNIT: I - BASIC WRITING SKILLS
Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

UNIT: II - VOCABULARY BUILDING
The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

UNIT: III - GRAMMAR AND USAGE
Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

UNIT: IV - LISTENING AND READING SKILLS
Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

UNIT: V - WRITING PRACTICES
Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

SUGGESTED READINGS

COURSE OBJECTIVES

The goal of this course is for the students

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To understand geometrical aspects of curvature and elegant application of differential calculus which are needed in Engineering applications.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model Engineering problems.
- To familiarize the student with functions of several variables which is the foundation for many branches of Engineering.
- To introduce sequence and series which is central to many applications in Engineering.

COURSE OUTCOMES

Upon completion of this course the students will be able

1. To solve the rank, Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices and the students will be able to use matrix algebra techniques for practical applications.
2. To equip the students to have basic knowledge and understanding in one field of materials, differential calculus
3. To solve simple standard examples using the ideas of differential equations.
4. To apply various techniques to solve Partial Differential Equations
5. To develop the tool of power series for learning advanced Engineering Mathematics.
6. To apply the knowledge acquired to solve various Engineering problems.

UNIT I - MATRICES


UNIT II – DIFFERENTIAL CALCULUS

Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes- Evolutes as Envelope of normals

UNIT III - DIFFERENTIAL EQUATIONS

Linear Differential equations of second and higher order with constant coefficients – Homogeneous equation of Euler’s and Legendre’s type – Method of variation parameters.

UNIT IV – FUNCTIONS OF SEVERAL VARIABLES


UNIT V - SEQUENCES AND SERIES

SUGGESTED READINGS:


WEBSITES :

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
(i) THEORY

COURSE OBJECTIVES
The Goal of this course is for students to

- Inculcate the basics of properties of matter, sound and its applications.
- Basics of laser and optical fiber with appropriate applications.
- Disseminate the fundamentals of thermal physics and their applications.
- Introduce the concepts of quantum mechanics for diverse applications.
- Impart the basic knowledge of crystal and its various crystal structures.

COURSE OUTCOMES
Upon completion of this course, the students will be able to

1. Understand the elastic nature of materials.
2. Infer the characteristics of laser for various engineering applications.
3. Extend the knowledge on optical fiber for communication purposes.
4. Illustrate the thermal properties of materials through various methods.
5. Develop the idea of quantum mechanics through applications.
6. Identify the different atomic arrangements of crystals and its defects.

UNIT I – PROPERTIES OF MATTER AND SOUND

Loudness, decibel, echo, reverberation, Sabine’s formula, Ultrasonic – Production, Industrial and medical applications.

UNIT II – LIGHT, LASER AND FIBER OPTICS

Fiber optics: Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram) - Fiber optic sensors: pressure and displacement.

UNIT III – THERMAL PHYSICS

UNIT IV – QUANTUM PHYSICS
UNIT V – CRYSTAL PHYSICS
Crystalline materials – types - unit cell, primitive cell, intercepts, interfacial angle - crystal systems, Bravais lattices, Miller indices – determination of inter-planar distances - Coordination number and packing factor for SC, BCC, FCC, HCP structures-crystal imperfections: point defect, line defect, surface and volume defect. Crystal growth techniques: Czochralski and Bridgman method.

SUGGESTED READINGS


JOURNALS

3. Ultrasonics and sonochemistry (Elsevier).
5. Optics and Laser Technology (Elsevier).

WEBLINKS

1. https://nptel.ac.in/courses/122/103/122103011/
2. https://nptel.ac.in/courses/113/104/113104081/
3. http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html

(ii) LABORATORY

COURSE OBJECTIVE:
• To learn the basic concepts in physics relevant to different branches of Engineering and Technology.

COURSE OUTCOME:
• To familiarize the properties of material and basic concepts in physics.

LIST OF EXPERIMENTS – PHYSICS (Any 10 Experiments)
1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc
2. Uniform bending (or) Non-uniform Bending– Determination of young’s modulus.
3. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille’s flow.
4. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
5. Laser- Determination of the wave length of the laser using grating, Acceptance angle of optical fiber.
12. Particle size determination using LASER.

(i) CONCEPTS IN CHEMISTRY FOR ENGINEERING

COURSE OBJECTIVE

The goal of this course is for students to

- Study the basics of Periodic properties, Intermolecular forces
- Understand the terminologies of electrochemistry and to study about energy storage devices
- Understand the concept of corrosion and its prevention
- Comprehend the basic water technology and its purification.
- Study about spectroscopic technique

COURSE OUTCOMES

Upon completion of the course the students will be able to

1. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
2. Analyse the mechanism of different energy storage devices.
3. Rationalise different types of corrosion and its prevention.
4. List the various methods in the purification of water.
5. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I - PERIODIC PROPERTIES, INTERMOLECULAR FORCES

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.

UNIT II – ELECTROCHEMISTRY AND STORAGE DEVICES


UNIT III – CORROSION AND ITS CONTROL

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic Coatings-Paints - Constituents and functions – Inorganic coatings- Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating - Hot dipping

UNIT IV – WATER TECHNOLOGY


UNIT V - SPECTROSCOPIC TECHNIQUES AND APPLICATIONS


SUGGESTED READINGS

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

(ii) CHEMISTRY LABORATORY

COURSE OBJECTIVES

The goal of this course is for students to

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

COURSE OUTCOMES

Upon completion of the course the students will be able to

1. The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
2. Estimate rate constants of reactions from concentration of reactants/products as a function of time
3. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc

Choice of 10 experiments from the following:

1. Determination of surface tension and viscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
3. Determination of Ca / Mg using complexometric titration
4. Thin layer chromatography
5. Determination of chloride content of water
6. Determination of the rate constant of a reaction
7. Conductometry - Determination of cell constant and conductance of solutions
8. pH Metry – Determination of Acid / Base
9. Potentiometry - determination of redox potentials and emfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.
THEORY

COURSE OBJECTIVES:
Students undergoing this course are exposed to:
- Describe the core syntax and semantics of Python programming language.
- Discover the need for working with the strings and functions.
- Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
- Indicate the use of regular expressions and built-in functions to navigate the file system.
- Infer the Object-oriented Programming concepts in Python.
- Students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.

COURSE OUTCOMES:
Upon Completion of this course, the student will be able to:
1. Explain various operators used in Python.
2. Apply the string handling functions to solve the given problem.
3. Describe Object-oriented concepts with Python.
4. Use image processing techniques in Python programming to solve a given problem.
5. Discuss the functions of networking in Python.
6. Solve a given analogy.

UNIT I INTRODUCTION
Installing Python; basic syntax, interactive shell, editing, saving, and running a script; variables; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages.

UNIT II CONDITIONAL STATEMENT & STRING HANDLING
Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation – Manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

UNIT III OBJECT ORIENTED PROGRAMMING WITH PYTHON
Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects – OOP, continued: inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block.

UNIT IV IMAGE PROCESSING WITH PYTHON
Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions. Simple Graphics and Image Processing: “turtle” module; simple 2d drawing – colors, shapes; digital images, image file formats, image processing Simple image manipulations with ‘image’ module (convert to b/w, rayscale, blur, etc).

UNIT V NETWORKING WITH PYTHON
Multithreading, Networks, and Client/Server Programming; introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming a simple CGI form.
SUGGESTED READINGS:
5. “Python Cookbook” O’Reilly Media; 3rd edition (June 1, 2013) by David M. Baezly.

WEBSITES:
1. https://www.codecademy.com/learn/python
2. www.learnpython.org/

(ii) LABORATORY

PYTHON PROGRAMMING

COURSE OBJECTIVES:
Students undergoing this course are exposed to:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS:
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball in Pygame
SEMESTER I

20BEME111 ENGINEERING GRAPHICS I 5 H – 3 C

Instruction hours / week L : 1 T : 0 P:4  Marks: Internal : 40 External : 60 Total:100
End Semester Exam :3 Hours

COURSE OBJECTIVES

- To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES

On completion of this course, students will be able to
1. Understand the engineering drawing and its place in society.
2. Expose the visualization of engineering drawing and engineering graphics standards.
3. Expose the engineering communication.

UNIT I  INTRODUCTION

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning—linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute.

UNIT II  FREE HANDSKETCHING

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT III  INTRODUCTION TO COMPUTER GRAPHICS – 2D

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars, Drawing Area, Dialog boxes and windows, Shortcut menus ,The Command Line (where applicable), Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Annotations, layering & other functions.

UNIT IV  PROJECTION OF POINTS AND LINES

Projection of points and straight lines located in the first quadrant inclined to both planes– Determination of true lengths and true inclinations.

UNIT V  PROJECTION OF PLANESURFACES

Projection of polygonal surface and circular lamina inclined to both reference planes.

SUGGESTED READINGS

COURSE OBJECTIVES
The goal of this course is for students to

- To help students acquire their ability to speak effectively in real life situations.
- To enable students to communicate in effective way without any barriers.
- To inculcate the habit of listening and to develop their effective listening skills.
- To ensure that students use different aids in order to attain effective communication.
- To enable students to improve their group behavior and presentation skill.

COURSE OUTCOMES
Students undergoing this course will be able to

1. Enrich comprehension and acquisition of listening, speaking & writing ability.
2. Gain confidence in using English language and develop leadership qualities.
3. To guide the students to effectively manage the team as a team player.
4. To develop the students Interpersonal and Interview skills.
5. Use English language for communication: verbal & non-verbal
6. To enable students to prepare for oral communication in formal contexts.

Unit: I - COMMUNICATION SKILLS:
Communication Skills: Introduction, Definition, The Importance of Communication
The Communication Process – Source, Message, Encoding, Channel, Decoding Receiver, Feedback, Context
Barriers to Communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional Barriers
Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective-Past Experiences, Prejudices, Feelings, Environment

Unit: II - ELEMENTS OF COMMUNICATION
Introduction, Face to Face Communication- Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.


Unit: III - BASIC LISTENING SKILLS
Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations.
Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience Organization of the Message.

Unit: IV - INTERVIEW SKILLS AND GIVING PRESENTATIONS
Purpose of an interview, Do’s and Don’ts of an interview- Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.

Unit: V.-WRITING PRACTICES
Group Discussion: Introduction, Communication skills in group discussion, Do’s and Don’ts of group discussion

Note: Students shall have hands on training in improving Speaking skill in the language laboratory @ 2
periods per each unit.

SUGGESTED READINGS

COURSE OBJECTIVES:

The goal of this course is for the students

• To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
• To calculate and establish identities connecting these quantities, to evaluate line, surface and volume integrals in simple coordinate systems and to use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.
• To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their study as a function of a complex variables.
• To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, to specify some difficult integration that appear in applications can be solved by complex integration in application areas such as fluid dynamics and flow of the electric current.
• To use Laplace transforms efficiently for solving the problems that occur in various branches of engineering disciplines.

COURSE OUTCOMES:

Upon completion of this course the students will be able

1. To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition to change of order and vector integration.
2. To acquaint the student with the concepts of vector calculus, needed for problems in all Engineering disciplines
3. To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions.
4. To understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
5. To evaluate complex integrals using the Cauchy integral formula and the residue Theorem and to appreciate how complex methods can be used to prove some important theoretical results.
6. To evaluate Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

UNIT I - MULTIPLE INTEGRALS

Double integral – Cartesian coordinates – Polar coordinates – Area as double integrals -Change of order of integration – Triple integration in Cartesian co-ordinates

UNITII- VECTOR CALCULUS

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green’s theorem, Gauss divergence theorem and Stoke’s theorems (Statement Only)- Surfaces : hemisphere and rectangular parallelopipeds.

UNITIII- ANALYTIC FUNCTIONS

Analytic functions - Cauchy-Riemann equations in Cartesian and polar forms – Sufficient condition for an analytic function (Statement Only) - Properties of analytic functions – Constructions of an analytic function - Conformal mapping: \( w = z+a, az, 1/z \) and bilinear transformation.
UNIT IV - COMPLEX INTEGRATION
Complex Integration - Cauchy’s integral theorem and integral formula (Statement Only) – Taylor series and Laurent series - Residues – Cauchy’s residue theorem (Statement Only) - Applications of Residue theorem to evaluate real integrals around unit circle and semi circle (excluding poles on the real axis).

UNIT V - LAPLACE TRANSFORM

SUGGESTED READINGS:


WEBSITES:

1. www.intmath.com
2. www.efunda.com
3. www.mathcentre.ac.uk
4. www.sosmath.com/diffeq/laplace/basic/basic.html
COURSE OBJECTIVES
The Goal of this course is for students to
• Introduce the essential theorems, principles and its applications of Motion
• Impart the basic knowledge about rigid body dynamics and friction
• Inculcate the concepts of viscosity and its measurement techniques
• Disseminate the magnetic, dielectric and super conducting properties of materials and their applications.
• Introduce the essential principles of materials science for mechanical and related engineering applications.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
• Have knowledge on the various types of motions and their applications.
• Acquire knowledge on rigid body dynamics and friction.
• Understand the concept of viscosity and various measurement techniques.
• Gain knowledge on magnetic, dielectric and superconducting properties of materials.
• Understand the basics of ceramics, composites and nanomaterials.
• Get fundamental knowledge on engineering mechanics and composite materials.

UNIT I MOTION AND SYSTEM OF PARTICLES
Motion: Newton’s Laws of Motion, Motion in a resistive medium; Drag force & Drag Coefficient, Drag force – derivation for velocity and position - terminal velocity.

System of particles: Centre of mass of rigid bodies – General expression; Newton's law for a system of particles; Linear momentum for a particle and a system of particles; Conservation of linear momentum; System with varying mass; Single stage Rocket, motion - Velocity & Acceleration with and without gravity; Elastic and inelastic collisions.

UNIT II DYNAMICS OF RIGID BODY AND FRICTION
Moment of Inertia - Kinetic energy and angular momentum of rotating body - centripetal and centrifugal force - Theorems of perpendicular and parallel axes - smooth surface - Compound pendulum - Centre of suspension and centre of oscillation - Centre of percussion - Minimum period of a compound pendulum - Kater’s pendulum. Friction - Laws of friction - Resultant reaction - Angle and cone of friction - Equilibrium of a body on a rough plane inclined to the horizontal - The friction clutch.

UNIT III VISCOSITY
Newton’s law of viscous flow - streamlined and turbulent motion - Reynold’s number - Poiseuille’s formula for the flow of a liquid through a horizontal capillary tube - Experimental determination of co-efficient of a liquid by Poiseuille’s method - Ostwald’s viscometer –Stokes’ formula - Viscosity of gases - Meyer’s formula - Rankine’s method - Variation of viscosity with temperature and pressure - Lubrication. Equation of continuity of flow - Euler’s equation for unidirectional flow - Bernoulli’s theorem – Filter pump and Wings of aeroplane - Torricelli’s theorem - Pitot tube.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS
UNIT V – NEW ENGINEERING MATERIALS

SUGGESTED READINGS


JOURNALS

1. Journal of Applied Mechanics (ASME)
2. Journal of Alloys and Compounds (ELSEVIER)
3. Ceramics International (ELSEVIER)
4. Magnetism and Magnetic Materials (ELSEVIER)
5. IEEE Transactions on Magnetics (IEEE)
6. Journal of Superconductor and Novel Magnetism (SPRINGER)

WEBLINKS

1. https://nptel.ac.in/courses/122104014/
2. https://nptel.ac.in/courses/118104008/
3. https://nptel.ac.in/courses/115101012/
THEORY

COURSE OBJECTIVES
- To impart the basic knowledge about the Electric circuits.
- To understand the concept of Electro Mechanical Energy Conversion and Transformers.
- To understand the working of Semiconductor devices and Measuring Instruments.
- To impart the basic knowledge of Digital Circuits.

COURSE OUTCOMES
At the end of this course, students will be able to
1. Attributing the electric circuits with DC and AC excitation by applying various circuit laws.
2. Attributing the magnetic circuits and transformer.
3. Reproduce the two port networks.
4. Evaluate the various digital circuits in real time applications.
5. Analysis various semiconductor devices in real time applications.
6. Reproduce the Measuring Instruments.

UNIT I - DC CIRCUITS

UNIT II - AC CIRCUITS
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III - ELECTRICAL MACHINES AND TRANSFORMER

UNIT IV- SEMICONDUCTOR DEVICES AND DIGITAL ELECTRONICS
Bipolar Junction Transistor – Characteristics. Introduction to operational Amplifier – Model – Applications. Number systems – binary codes - logic gates - Boolean algebra, laws & theorems

UNIT V- MEASURING INSTRUMENTS AND ELECTRICAL INSTALLATION
SUGGESTED READINGS

WEBSITES:
1. www.nptel.ac.in.
COURSE OBJECTIVES

- to prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. Students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.

(i) LECTURES & VIDEOS:

- Detailed contents
  1. Manufacturing Methods - casting, forming, machining, joining, advanced manufacturing methods
  2. CNC machining, Additive manufacturing
  3. Fitting operations & powertools
  4. Electrical & Electronics
  5. Carpentry
  6. Plastic molding, glass cutting
  7. Metal casting
  8. Welding

(ii) WORKSHOP PRACTICE:

- Machineshop
- Fittingshop
- Carpentry
- Electrical & Electronics
- Welding shop
- Casting
- Plumbing Exercises

SUGGESTED READINGS

COURSE OBJECTIVES

- To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES

On completion of this course, students will be able to
1. Understand the projection, section and development of solids.
2. Expose the visualization of 3-dimensional drawing.
3. Expose the engineering communication through software.

UNIT I  PROJECTION OF SOLIDS

Projection of simple solids like prisms, pyramids, cylinders, and cones when the axis is inclined to one reference plane by change of position method.

UNIT II  SECTION OF SOLIDS

Sectioning of Prism, Cylinder, Pyramid, and Cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

UNIT III  DEVELOPMENT OF SURFACES

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders, and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT IV  COMPUTER GRAPHICS – 3D

Introduction to 3D modeling packages. Drafting practices - modeling of simple engineering components, sections and extraction of 2D drawings.

UNIT V  ISOMETRIC PROJECTIONS

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders, and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

SUGGESTED READINGS:

COURSE OBJECTIVES:
The goal of this course is for the students
• To introduce the basic concepts of PDE for solving standard partial differential equations
• To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
• To provide an overview of probability and statistics to engineers
• To introduce the basic concepts of two-dimensional random variables
• To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.

COURSE OUTCOMES:
Upon Completion of this course the students will be able
1. To solve field problems in engineering involving PDEs.
2. To appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.
3. To apply the basic concepts of probability and have knowledge of standard distribution which can describe real life phenomenon.
4. To apply one- and two-dimensional random variables to solve engineering applications.
5. To formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data
6. To apply the concept of testing of hypothesis for small and large samples in real life problems.

UNIT I - PARTIAL DIFFERENTIAL EQUATIONS
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

UNIT II - APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variable.

UNIT III-PROBABILITY AND RANDOM VARIABLES
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities

UNIT IV - TWO -DIMENSIONAL RANDOM VARIABLES
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule. Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis -Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.
UNIT V - TESTING OF HYPOTHESIS

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

SUGGESTED READINGS:


WEBSITES:

1. www.cut-theknot.org/probability.shtml
2. www.mathcentre.ac.uk
3. www.mathworld. Wolfram.com
4. www.sosmath.com
COURSE OBJECTIVE:

The goal of this course is for students

To provide knowledge in analyzing the effect of force systems in order to carry out the effective design for a mechanical system.

COURSE OUTCOMES:

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

1. Understand the concepts of force, laws of mechanics and unit systems.
2. Develop free body diagrams for a mechanical system and to apply equilibrium conditions for effective design.
3. Determine the centroid and second order moment for a plane figure.
4. Analyze statically determinate planar frames.
5. Analyze the motion and calculate trajectory characteristics.
6. Understand the concepts of kinetics of particles and friction.

UNIT I  STATICS OF PARTICLES

Forces – system of forces – concurrent forces in plane and space – resultant – problems involving the equilibrium of a particle – free body diagram – equilibrium of particle in space.

UNIT II  STATICS OF RIGID BODIES IN TWO DIMENSIONS


UNIT III  CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA


UNIT IV  KINEMATICS OF PARTICLES


UNIT V  KINETICS OF PARTICLES AND FRICTION


SUGGESTED READINGS

COURSE OBJECTIVE

The goal of this course is for students
To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

COURSE OUTCOMES

Upon completion of this course, the students will be able to
1. Understand the first law and able to differentiate closed and open system, also able to apply first law to both types of systems
2. Define the physical description of second law and its application to heat engine, refrigerator and heat pump.
3. Also understand the concepts of entropy and able to find out the entropy generated in a thermodynamic system
4. Understand the properties of pure substance and ideal gas concepts
5. Describe the importance of availability concept and able to apply the thermodynamic relations in applications.
6. Understand the psychrometric properties and various processes to create human comfort at various physical conditions.

UNIT I BASIC CONCEPTS AND FIRST LAW

Basic concepts - Classical and Statistical approaches - Thermodynamic systems - closed, open, isolated - Property - State - Process-adiabatic - Quasi-static process - Cycle - Point and Path function - Energy - Work transfer - Concept of temperature and heat - Zeroth law of thermodynamics - Concept of ideal gases - First law of thermodynamics - PMM1, internal energy, specific heat capacities, enthalpy, and its application to closed system and open system - steady flow energy equation.

UNIT II SECOND LAW AND ENTROPY

Physical description of the second law - Kelvin-Planck and Clausius statements - Equivalence - Reversible processes and cycles - Carnot cycle - Corollaries - Absolute temperature scale - Clausius Theorem, inequality - Entropy Principle, transfer, generation, balance - Third law of thermodynamics

UNIT III THERMODYNAMIC AVAILABILITY AND RELATIONS


UNIT IV PROPERTIES OF PURE SUBSTANCE AND GAS MIXTURES


UNIT V PSYCHROMETRY


(Permitted to use standard thermodynamic table, Mollier diagram, and Psychometric chart in the examination)

SUGGESTED READINGS

B. E. Mechanical Engineering

SEMESTER – III

20BEME344 MANUFACTURING TECHNOLOGYI
(Theory & Laboratory)

Instruction hours / week L :3 T :0 P:2

Marks: Internal : 40 External : 60 Total:100
End Semester Exam :3 Hours

(i) THEORY

COURSE OBJECTIVE

1. To know the procedures of moulding and casting.
2. To learn about the Metal joining processes.
3. To understand the sheet metal operations and metal forming operations.
4. To be familiar with the deformation processes.

COURSE OUTCOMES

Upon completion of this course, the students can able to
4. Apply suitable molding and casting methods for producing components.
5. Know the methods of inspecting the castings
6. Decide the type of metal joining processes.
7. Work with various metal forming processes
8. Work with various sheet metal operations.
9. Select the type of deformation processes.

UNIT I CASTING PROCESSES


UNIT II JOINING PROCESSES


UNIT III METAL FORMING PROCESSES


UNIT IV SHEET METAL OPERATIONS


UNIT V POWDER METALLURGY PROCESS


SUGGESTED READINGS

LABORATORY

COURSE OBJECTIVES:
• To teach the process-level dependence of manufacturing systems through tolerances
• To expose the students to a variety of manufacturing processes including their typical use and capabilities.
• To teach the important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most common processes.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Understand the idea for selecting materials for patterns.
2. Types and allowances of patterns used in casting and analyze the components of moulds.
3. Design core, core print and gating system in metal casting processes
4. Understand the application of arc and gas welding in industries.
5. Understand the principle behind the sheet metal forming process
6. Understand the working of the powder metallurgy process

LIST OF EXERCISES
METAL CASTING:
• Pattern Design and making – for one casting drawing.
• Sand properties testing – Exercise for strengths, and permeability
• Moulding Melting and Casting

WELDING:
• Exercises in ARC Welding
• Exercises in GAS Welding

SHEET METAL FORMING
• Develop a flat blank layout from an assembly print, transfer the layout to the sheet metal, cut and form to the desired shape

POWDER METALLURGY
• Form parts from metallic powders, record and plot pressing data, perform destructives tests on sintered powder metal parts.
SEMESTER – III

20BEME311 MACHINEDRAWING 4 H – 3 C

Instruction hours / week L : 2 T : 0 P : 2

Marks: Internal : 40 External : 60 Total : 100
End Semester Exam : 3 Hours

COURSE OBJECTIVES:
The goal of this course is for students

1. To familiarize the code of practice followed in machinedrawing.
2. To understand the assembling procedure of machine parts.
3. To understand sectional views for various machine elements.
4. To detail intricate cross-sectional part drawings.

COURSE OUTCOMES:
Learners should be able to

1. Express the importance of machine drawing and GD&T.
2. Interpret drawings of machine components.
3. Create assembled machinedrawings.
4. Make part drawings from an assembly drawing.
5. Interpret the details of complex parts in cross-sectional views.
6. Sketch production drawing from assembly drawing.

INTRODUCTION

CONVENTIONS
Code of practice for engineering drawing-conventional representation of details- drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

FITS AND TOLERANCES
Introduction to Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance-uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols-methods of indicating the surface roughness.

ASSEMBLY DRAWING PRACTICE
Making free hand sketches of typical subassemblies-flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints.

ASSEMBLY DRAWING PRACTICE USING CAD SOFTWARE

SUGGESTED READINGS
COURSE OBJECTIVES
1. To know about Indian constitution.
2. To know about central and state government functionalities in India.
3. To know about Indian society.

COURSE OUTCOMES
Upon completion of the course, students will be able to:
1. Understand the functions of the Indian government.
2. Understand and abide the rules of the Indian constitution.
3. Understand and appreciate different culture among the people.

UNIT I INTRODUCTION

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT
Union Government – Structures of the Union Government and Functions – all India services – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT

UNIT IV CONSTITUTION FUNCTIONS
Indian Federal System – Center – State Relations – President’s Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V INDIAN SOCIETY
Society: Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

SUGGESTED READINGS
1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, New Delhi
2. R. C. Agarwal, (1997). Indian Political System, S. Chand and Company, New Delhi,
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, New Delhi
4. K. L. Sharma (1997)., Social Stratification in India: Issues and Themes, Jawaharlal Nehru University, New Delhi,
5. Sharma, Brij Kishore, (2011)., Introduction to the Constitution of India, Prentice Hall of India, New Delhi,
COURSE OBJECTIVES

The goal of this course is for students

1. To create the awareness about environmental problems among people.
2. To develop an attitude of concern for the environment.
3. To motivate public to participate in environment protection and improvement.

COURSE OUTCOME

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
7. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and practitioners.

UNIT I INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS
Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES
Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources - Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources - Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III BIODIVERSITY AND ITS CONSERVATION

UNIT IV ENVIRONMENTAL POLLUTION
UNIT V SOCIAL ISSUES AND THE ENVIRONMENT

SUGGESTED READINGS
TABLE OF CONTENTS

(i) THEORY

COURSE OBJECTIVE
1. To understand the concepts of metal cutting principles
2. To understand the conventional machine tools and CNC machining.
3. To understand the working of abrasive processes and electrical/electrochemical processes.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Calculate the cutting force during machining and other parameters related to metal cutting
2. Know the working of various conventional machinetools
3. Prepare manual part programming for simple components for a CNC machine
4. Select the various abrasive processes for different machining conditions.
5. Differentiate and select the various surface finishing methods used.
6. Explain the working of the electrical and electro chemical machining processes.

UNIT I THEOREY OF METALCUTTING

UNIT II CONVENTIONAL MACHINETOOLS

UNIT III CNC MACHINING

UNIT IV ABRASIVE PROCESSES

UNIT V ELECTRICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVE

1. To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry

COURSE OUTCOME

Upon completion of this course, the students will be able to
1. Perform shaping operation
2. Perform milling & slotting operation
3. Perform drilling, tapping and reaming operation
4. Perform grinding operations
5. Work with tool grinding machine
6. Work in a capstan and turret lathe

LIST OF EXERCISES

1. Exercises in shaping.
2. Exercises in Milling.
3. Exercises in slotting.
4. Exercises in Drilling / Tapping / Reaming.
5. Exercises in Surface grinding and cylindrical grinding process.
7. Exercises in Capstan and Turret Lathe.
(i) THEORY
COURSE OBJECTIVES

The goal of this course is for students

1. To incorporate the concepts and laws in thermodynamic analysis of cyclic processes.
2. To impart the mechanisms of combustion of fuels.
3. To apply the thermodynamic concepts in steam turbines and nozzles.
4. To learn about the performance of compressors.
5. To understand the concept of cogeneration and waste heat recovery in engineering applications.

COURSE OUTCOMES

Learners should be able to

1. Calculate the efficiency of various gas power cycles.
2. Calculate the performance characteristics of engines.
3. Analyze combustion mechanism in IC engines.
4. Evaluate the characteristic of steam turbines and nozzles.
5. Evaluate the performance characteristics of compressors.
6. Identify and utilize the concepts of refrigeration and air conditioning in engineering applications

UNIT I STEAM POWER CYCLES AND STEAM NOZZLES
Introduction to steam power cycle – Rankine cycle, Reheated Rankine cycle, Regenerated Rankine cycle.
Formation of Steam – PVT behaviour of pure substance - steam nozzles – flow through steam nozzles, effect of friction, critical pressure ratio, super saturated flow.

UNIT II IC ENGINE

UNIT III GAS POWER CYCLES
Otto, Diesel, Dual, Brayton cycles – actual and theoretical PV and TS diagram – Calculation of mean effective pressure and air standard efficiency

UNIT IV REFRIGERATION AND AIRCONDITIONING
Fundamentals of refrigeration – COP – Vapour compression refrigeration system – cycle, p-h chart, Vapour absorption system – comparison, properties of refrigerants. Fundamentals of air conditioning system, cycle, controls, air handling and distribution, simple cooling and heat load estimation

UNIT V AIR COMPRESSORS

(Permitted to use standard thermodynamic table, Mollier diagram, Psychometric chart and Refrigeration property table in the examination)

SUGGESTED READINGS

(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students
1. Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/steam turbines.

COURSE OUTCOME

Upon completion of this course, the students will be able to
1. conduct experiment on IC engine to study the characteristic and performance of ICEngine
2. conduct experiment to find the thermo physical properties of given fluid.

LIST OF EXPERIMENTS

I C ENGINES AND FUELS

2. Performance Test on 4–stroke CIEngine.
4. Load test on 4–stroke CIEngine.
5. Retardation Test to find Frictional Power of a CIEngine.
7. Determination of Flash Point and Fire Point.
8. Performance test on single/two stage reciprocating air compressor.
9. Determination of COP of a refrigeration system
10. Experiments on air–conditioning system
(i) THEORY

COURSE OBJECTIVES
The goal of this course is for students
1. To study about simple stresses, strains and deformation of materials due to externally applied loads and thermal loads.
2. To draw shear force and bending moment diagram for various loads on beams.
3. To realize the deflection of beams and columns.
4. To understand the principal stresses and stresses developed in shells.
5. To impart knowledge in torsion of shafts and springs.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Determine stress and strain on deformation of solids.
2. Draw the shear force and bending moment diagram for various types of beams.
3. Compute safe working stresses and load carrying capacity of beams.
4. Estimate the deflection in beams and columns in engineering applications.
5. Determine principal stresses and analyse thin cylinders and shells subjected to pressure forces.
6. Analyse the effect of torsion on shafts and springs.

UNIT I  STRESS, STRAIN AND DEFORMATION OF SOLIDS
Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT II  BEAMS – LOADS AND STRESSES
Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Relationship between load, shear force and bending moment – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III  BEAM DEFLECTION
Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope:
Macaulay Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine’s formula for columns

UNIT IV  TORSION
Analysis of torsion of circular bars – Torsional Shear stress – Bars of solid and hollow circular section – Stepped shaft – Torsional rigidity – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

UNIT V  SHELLS AND PRINCIPAL STRESSES
Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr’s circle for biaxial stresses – Maximum shear stress – Strain energy in bending and torsion.

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students

- To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness.

COURSE OUTCOMES

1. Ability to perform different destructive testing
2. Ability to characteristic materials

LIST OF EXPERIMENTS

1. Tensile test on metals–stress strain characteristics
2. Cupping test on metal sheets–load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals–Brinell and Rockwell Hardness tests.
4. Impact test on metals–Charpy, Izod impact tests.
5. Shear test on metals–direct shear strength, single shear, double shear.
7. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
(i) THEORY

COURSE OBJECTIVES
The goal of this course is for students
- To understand the properties and flow characteristics of fluids.
- To learn applications of the conservation laws to flow through pipes, and hydraulic machines are studied
- To understand the importance and applications of dimensional analysis.
- To learn the performance of various types of hydraulic turbines.
- To learn the performance of various types of hydraulic pumps.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Determine fluid properties to solve engineering problems.
2. Understand the flow characteristics of fluids and its mathematical relations.
3. Identify fluid behaviors and perform dimensional analysis for fluid flow.
4. Characterize the fluid flow in a fixed boundary.
5. Draw velocity vector diagram for hydraulic machines.
6. Investigate performances of hydraulic machines.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS
Fluid properties: Mass density, weight density, specific gravity, viscosity, compressibility, surface tension and capillarity. Buoyancy and floatation – metacentre and metacentric height.
Flow characteristics: concepts of system and control volume, application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR PIPES

UNIT III DIMENSIONAL ANALYSIS
Dimension and units, dimensional homogeneity, applications of Buckingham’s π theorem, study about Renold’s number and significant for different fluids.

UNIT IV HYDRAULIC TURBINES

UNIT V HYDRAULIC PUMPS

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

COURSE OUTCOMES

1. Ability to use the measurement equipment’s for flow measurement
2. Ability to do performance trust on different fluid machinery

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump
6. Conducting experiments and drawing the characteristic curves of submersible pump
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of Mono block pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
10. Conducting experiments and drawing the characteristic curves of Francis turbine.
COURSE OBJECTIVE

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledgesystem.

COURSE OUTCOMES

Upon completion of the course, the students are expected to:
1. Understand the concept of Traditional knowledge and its importance
2. Know the need and importance of protecting traditional knowledge.
3. Know the various government acts and rules for protection of TK
4. Know the various enactments related to the protection of traditional knowledge.
5. Understand the concepts of Intellectual property to protect the traditional knowledge.
6. Know the traditional knowledge in different sectors like engineering, medicine etc.

UNIT I  INTRODUCTION
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT II  PROTECTION OF TK
Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III  GOVERNMENT ACTS
A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFRAct);

UNIT IV  INTELLECTUAL PROPERTY RIGHTS
Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT V  TK IN DIFFERENT SECTORS
Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK in air conditioning, TK in biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

SUGGESTED READINGS
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan, 2012.
4. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2
COURSE OBJECTIVES
The goal of this course is for students
1. To familiarize the various steps involved in the Design Process
2. To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
3. To learn to use standard practices and standard data
4. To learn to use catalogues and standard machine components

COURSE OUTCOME
Upon completion of this course, the students will be able to
1. Design components subjected to steady and variable stresses by considering stress concentration and able to apply various theories of failure
2. Design solid and hollow shafts based on strength, rigidity and critical speed, also able to design flange coupling and bush pin type coupling
3. Design bolted joints and welded joints subjected to axial and eccentric loading.
4. Design helical spring, leaf spring subjected to steady and variable loading, also be able to design rim type flywheel.
5. Design of ball bearings of rolling contact type and journal bearing;
6. Design of levers of type I, II and III.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS

UNIT II DESIGN OF SHAFTS AND COUPLINGS
Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knuckle joints.

UNIT III DESIGN OF FASTENERS AND WELDED JOINTS

UNIT IV DESIGN OF SPRINGS AND FLYWHEEL
Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs – Belleville springs – Design of flywheels involving stresses in rim and arm.

UNIT V DESIGN OF BEARINGS AND LEVERS
Selection of bearings – sliding contact and rolling contact types – Cubic mean load – Selection of journal bearings – McKees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of Levers.

(Permitted to use PSG design data book in the examination)

SUGGESTED READINGS
5. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam – Coimbatore
(i) THEORY

COURSE OBJECTIVES:
1. To impart knowledge on metallurgical aspects of metals.
2. To understand heat treatment processes on different grades of steel.
3. To familiarize on selection of ferrous and non-ferrous materials for various applications.
4. To learn about the strengthening mechanisms for Non-ferrous alloys.
5. To comprehend the significance of Non-Destructive Testing (NDT) methods.

COURSE OUTCOMES:
Learners should be able to
1. Identify the metallurgical aspects of metals.
2. Identify suitable heat treatment processes for various applications.
3. Select appropriate ferrous and non-ferrous materials for various applications.
4. Identify and select suitable non-metallic materials.
5. Identify suitable strengthening mechanisms for Non-ferrous alloys.
6. Work with non-destructive testing methods.

UNIT I — CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS

UNIT II — HEAT TREATMENT

UNIT III — FERROUS AND NON-FERROUS METALS

UNIT IV — NON-METALLIC MATERIALS
Polymers — types of polymer, commodity and engineering polymers — Properties and Applications of thermoplastics (PP, PVC, ABS, and PMMA) and thermosetting plastics (PF, UF, MF) — Engineering Ceramics.

UNIT V — TESTING OF MECHANICAL PROPERTIES AND INSPECTION
Mechanism of plastic deformation, slip and twinning — Types of fracture — Testing of materials under tension, compression and shear loads — Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep test, S-N curve.

NON Destructive Testing: Non Destructive Testing basic principles and testing method of Radiographic testing, Ultrasonic testing, Magnetic particle test and Liquid penetrant test, Eddy current testing.

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVES:
1. To impart knowledge on metallurgical aspects of metals.
2. To understand heat treatment processes on different grades of steel.
3. To familiarize on selection of ferrous and non-ferrous materials for various applications.

COURSE OUTCOMES:
Learners should be able to
1. Identify the metallurgical aspects of metals.
2. Identify suitable heat treatment processes for various applications.
3. Select appropriate ferrous and non-ferrous materials for various applications.
4. Identify and select suitable non-metallic materials.
5. Perform corrosion test

LIST OF EXPERIMENTS
1. Study and use of metallurgical microscope (Term Paper).
3. Microstructure of annealed pure metals-iron, copper, lead, zinc aluminium and use of specific etchants.
4. Macro etching and sulphur printing.
5. Electropolishing.
6. Comparative study of microstructure of annealed steel (Hypo eutectoid, Eutectoid, Hyper eutectoid) and variation of hardness.
10. Recovery, Recrystallisation and Grain growth of cold worked copper.
11. Galvanostatic polarization & determination of corrosion rate by Tafel’s Extrapolation
12. Potentiostatic Polarization, passivity & Passivity breakdown study
THEORY

COURSE OBJECTIVES

The goal of this course is for students:

1. To provide knowledge on various Metrological equipment’s available to measure the dimension of the components.
2. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1. Understand the basics of measurements and quality standards.
2. Perform linear measurements using various measuring instruments.
3. Perform the geometrical measurements of various components.
4. Measure the various dimensions of a screw thread.
5. Measure the dimensions of the simple spur gear.
6. Know the procedures involved in erecting machineries.

UNIT I BASICS OF MEASUREMENT, DEVICES AND QUALITY STANDARDS


UNIT II LINEAR MEASUREMENTS

Material length standards – line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators- mechanical, electrical, optical and pneumatic, optical projector.

UNIT III GEOMETRICAL MEASUREMENT

Angular measurement – plain Vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gauge, Taylor’s principle, three basic types of limit gauges, surface texture, reasons for controlling surface texture, parameters used, specification of surface texture, drawing and symbols, Tomilson surface meter.CMM.

UNIT IV METROLOGY OF MACHINE ELEMENTS

Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean room environment.

UNIT V MACHINE INSTALLATION AND TESTING

Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list.

TEXT BOOKS

LABORATORY

COURSE OBJECTIVE

The goal of this course is for students
To gain practical and hands on experience in measuring the mechanical components using various measuring instruments and devices.

COURSE OUTCOME

Upon completion of this course, the students will able to use the different measuring instruments to measure different measurements of given mechanical components.

METROLOGY

1. Calibration of Vernier / Micrometre / Dialgauge
2. Checking dimensions of part using slip gauges
3. Measurement of gear tooth dimensions – addendum, dedendum, pitch circle diameter and tooth thickness
4. Measurement of taper angle using sine bar / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
8. Surface finish measurement
(i) THEORY

COURSE OBJECTIVES

The goal of this course is for students
1. To understand the basic concepts of heat transfer.
2. To comprehend the fundamentals of convective heat transfer.
3. To learn about different types of heat exchangers and its analysis.
4. To recognize the importance of radiation heat transfer.
5. To study about the basic concepts of mass transfer.

COURSE OUTCOMES

Upon completion of this course, the students will be able to
1. Formulate and analyze heat transfer problems involving any of the three modes of heat transfer.
2. Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical.
3. Describe the process involved in phase change heat transfer like condensation, evaporation.
4. Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.
5. Understand the concepts of radiation and radiation shields
6. Identify the analogy between heat and mass transfer and concepts of mass transfer.

UNIT I CONDUCTION


UNIT II CONVECTION


UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS


UNIT IV RADIATION


UNIT V MASS TRANSFER


(Permitted to use standard Heat and Mass Transfer Table in the examination)

SUGGESTED READINGS


(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students
1. To study the heat transfer phenomena and predict the relevant coefficient using experiments.

COURSE OUTCOME

1. Students will be able to conduct experiment and determine the heat transfer properties of respective materials.

HEAT TRANSFER

1. Heat transfer through a compositewall
2. Thermal conductivity measurement by guarded platemethod
3. Natural convection heat transfer from a verticalcylinder
4. Heat transfer from pin–fin (natural and forced convectionmodes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan–Boltzmannconstant
7. Determination of emissivity of a greysurface
COURSE OBJECTIVE

The goal of this course is for students
1. To understand the concepts of degrees of freedom and to differentiate the characteristics between mechanism, machine and structure.
2. To analyze the relative motion between machine elements of a mechanism.
3. To understand the basic concepts of gear terminologies and gear trains.
4. To understand the undesirable effects of unbalance forces in a mechanism.
5. To understand the effect of Dynamics due to undesirable vibrations.

COURSE OUTCOMES

Upon completion of this course, Students will be able to
1. Develop a 2D sketch for a planner mechanism and to analyze the degrees of freedom for the same.
2. Perform velocity and acceleration analysis for the simple mechanisms.
3. Specify the gear terminology and to select appropriate gear trains for engineering applications.
5. Describe the vibration phenomenon and its types along with the vibration terminologies.
6. Analyze the systems subjected to vibration

UNIT I MECHANISMS

UNIT II KINEMATIC ANALYSIS AND FRICTION

UNIT III GEARING AND CAMS
Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains - Determination of speed and torque- Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.

UNIT IV FORCE ANALYSIS AND BALANCING

UNIT V VIBRATION
SUGGESTED READINGS


(ii) LABORATORY

COURSE OBJECTIVES

The goal of this course is for students

1. To supplement the principles learnt in kinematics and Dynamics of Machinery.

COURSE OUTCOME

Upon completion of this course students will be able to

1. Determine the various parameters of governors, Cam & Gyroscopes
2. Determine the critical speed of a given shaft
3. Perform balancing of rotating and reciprocating parts
4. Determine the natural frequency of a given system
5. Determine the mass moment of inertia of a given component
6. Determine the damping coefficient of a single degree of freedom system

LIST OF EXPERIMENTS

1. Governors – Determination of sensitivity, effort, etc. for Watt, Porter, Proell, and spring controlled Governors
2. Cam – Determination of jump speed and profile of the cam.
5. Balancing of rotating and reciprocating masses.
7. Vibrating system – spring mass system – Determination of damping coefficient of single degree of freedom system
8. Determination of torsional frequencies for compound pendulum and flywheel system with lumped moment of inertia.
COURSE OBJECTIVES

1. To understand the concepts of geometrical dimensioning and tolerancing
2. To study the physical importance of them in industrial point of view
3. To know the various types of tolerancing, its measurement and design.

COURSE OUTCOMES

1. Ability to learn and apply geometric dimensioning and tolerance standards to communicate design intent
2. Ability to learn how the knowledge of certain processes can affect part design and documentation
3. Gain added insight on working in a team design environment

INTRODUCTION

FORM AND ORIENTATION TOLERANCE
Design considerations – Flatness and Circularity measurement concepts – Orientation tolerance specification and application design.

POSITION AND RUNOUT TOLERANCE
Profile of surface and line tolerance design and application – Location tolerance, Position, applied and material condition consideration – Coaxial controls and design – Concentricity, Symmetry – Measurement and application – Design considerations – Position, Composite tolerance concept, design and Measurement – Runout, Total Runout tolerances – Measurement and considerations.

SUGGESTED READINGS

4. STANDARDS - IS : 10714,10715,10716,10717,11669,10719,813,919,2709,8000 pt 1 to 10721,11158 and AWS/ISO
COURSE OBJECTIVES

The goal of this course is for students

1. To gain knowledge on the principles and procedure for the design of Mechanical power transmission components.
2. To understand the standard procedure available for Design of Transmission of Mechanical elements
3. To learn to use standard data and catalogues

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Design V–belts, Flat belts,
2. Design Wire ropes and chain drive.
3. Design spur gear and helical gear
4. Design bevel and worm gear
5. Design multispeed gearbox
6. Design clutches and brakes

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS

UNIT II DESIGN OF SPUR AND HELICAL GEARS

UNIT III DESIGN OF BEVEL AND WORM GEARS
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits – terminology – Thermal capacity, materials – forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT IV DESIGN OF GEARBOXES

UNIT V DESIGN OF CLUTCHES AND BRAKES
Design of plate clutches – axial clutches – cone clutches – internal expanding rim clutches – internal and external shoe brakes.

(Permitted to use PSG design data book in the examination)

SUGGESTED READINGS

5. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam – Coimbatore
COURSE OBJECTIVES
1. To provide a basic knowledge about measurement systems and their components
2. To learn about various measurements like displacement, temperature, pressure, level, flow, speed
3. To learn about control systems and its principles.

COURSE OUTCOME
Upon completion of this course, the Students will be able to
1. Understand the measurement systems, their accuracy & range.
2. Measure the quantities like displacement, temperature, pressure
3. Measure the quantities like level, flow and speed
4. Measure the quantities like strain, humidity and force
5. Measure the quantities like torque and power
6. Classify the various control methods and its application and do system models and perform response analysis

UNIT I INTRODUCTION

UNIT II MEASUREMENTS I

UNIT III MEASUREMENTS II

UNIT IV MEASUREMENTS III

UNIT V CONTROL SYSTEMS

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students
1. To familiarize the layout of steam power plant and its accessories.
2. To learn the working of gas turbine powerplant.
3. To understand the layout of nuclear and MHD power plant.
4. To impart the fundamentals of renewable energy.
5. To learn the various pollution control methods.

COURSE OUTCOMES
Upon completion of this course, the students can be able to
1. Select the accessories and layout required for a steam power plant depending upon the requirements.
2. Explain the working principles of various types of boilers.
4. Explain the working of nuclear and MHD powerplant.
5. Apply appropriate type of renewable energy technologies for generating electricity depending upon the application and availability.
6. Identify the type of pollution control method required for powerplant.

UNITI STEAM POWER PLANT

UNITII SOLAR AND WIND POWERPLANT

UNITIII NUCLEAR AND HYDEL POWERPLANTS

UNITIV DIESEL AND GAS TURBINE POWERPLANT

UNITV OTHER POWER PLANTS AND ECONOMICS OF POWERPLANTS

SUGGESTED READINGS
### SEMESTER – VI

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End Semester Exam :3Hours

COURSE OBJECTIVE

The goal of this course is for students

1. To gain practical experience in handling 2D drafting and 3D modeling softwaresystems.

COURSE OUTCOME

Upon completion of this course, the students can able to

1. use computer and CAD software's for modeling of mechanicalcomponents
2. use various options in SolidWorks for modeling of givencomponents
3. create assembly ofcomponents
4. prepare manufacturing drawings from the modelscreated
5. Use MAT Lab for simulating different systems like hydraulic and pneumaticcircuits
6. Use mat lab for performing various mathematicaloperations

COMPUTER AIDED DESIGN

1. 3D modeling of various machine elements using various options like protrusion, cut, sweep, draft, loft, blend,rib.
2. Assembly – creating assembly from parts – assemblyconstraints
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning.
4. Introduction to SurfaceModeling.
5. Introduction to File Import, Export – DXF, IGES, STL,STEP

Note: Any one of the 3D MODELING software's like SOLIDWORKS, CREO, CATIA, NX Software, AutoCADetc.

COMPUTER AIDED SIMULATION

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP usingSoftware
2. Simulation of Hydraulic / Pneumatic cylinder usingSoftware
3. Simulation of cam and follower mechanism usingSoftware
4. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and twovariables
5. Use of MATLAB to solve simple problems invibration
COURSE OBJECTIVE
The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

COURSE DESCRIPTION
The students may be grouped into maximum of 4 students and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible, with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.

UNITI SINGLE PHASE INDUCTION MOTOR

UNITII THREE PHASE INDUCTION MOTOR

UNITIII PUMPS
Pumps: Definition and Terminologies – classifications – Applications, Cavitation in pump – rotary pumps: working principles of gear and vane pumps, Trouble shooting.

SUGGESTED READINGS
(i) THEORY

COURSE OBJECTIVES:

The goal of this course is for students:
1. To understand the importance of automation in the field of machine tool-based manufacturing.
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC.
3. To understand the basics of product design and the role of manufacturing automation.

COURSE OUTCOMES:

Upon completion of this course, the students will:
1. Understand the basics and need for automation in manufacturing.
2. Describe the essential requirement of the computers in design.
3. Explain the importance of group technology and FMS.
4. Understand the essentiality of quality control.
5. Apply various inspection technologies to enhance the quality of the system.
6. Explain various manufacturing support systems.

UNIT I MANUFACTURING OPERATIONS


UNIT II AUTOMATED MANUFACTURING SYSTEMS


UNIT III GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS


UNIT IV QUALITY CONTROL SYSTEMS AND INSPECTION TECHNOLOGIES


UNIT V MANUFACTURING SUPPORT SYSTEM


SUGGESTED READINGS:

(ii) LABORATORY

COURSE OBJECTIVES

The goal of this course is for students
1. To study the features of CNC Machine Tool.
2. To expose students to modern control systems (Fanuc, Siemens etc.)
3. To know the application of various CNC machines like CNC lathe, CNC Vertical Machining center

COURSE OUTCOMES

Upon completion of this course, the students will be able to
1. Create manual part programming for various components using G and M codes
2. Create part programming involving different motions.
3. Understand the working of standard canned cycles.
4. Generate NC code using software’s

LIST OF EXPERIMENTS

1. MANUAL PART PROGRAMMING (Using G and M Codes) in CNC Machine.
2. Part programming for Linear, Circular interpolation, and Contour motions.
3. Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, and Boring.
4. NC code generation using software’s like Edge CAM, CREO etc.
5. CNC Controllers like FANUC, Siemens, and Hiedenhain etc.

(i) THEORY

Course Objectives:

The goal of this course is for students
1. To get the knowledge on CAD/CAM systems.
2. To introduce the students to various techniques in CAD and help them to gain proficiency in developing mathematical models and CNC programmes.
3. To understand the concept of finite element method for displacement and nodal forces.
4. To gain knowledge of numerical calculations and computer tools for validation.
5. To study the convergence of output results and validate through theoretical approach.

Course Outcomes:
Upon completion of this course, the students will
1. Understand geometric transformation techniques in CAD.
2. Develop mathematical models to represent curves and surfaces and model engineering components using solid modeling techniques.
3. Develop CNC programs to manufacture industrial components.
4. Apply core mechanical concept to provide preliminary results of nodal force and displacement using FEM.
5. Explain the coding behind working of finite element concept for validation of static structural and thermal analysis.
6. Interpret the results of finite element analysis and make an assessment results in terms of modeling Discretization.

UNIT I INTRODUCTION TO CAD/CAM AND GEOMETRIC MODELING

UNIT II CAM AND CNC

UNIT III INTRODUCTION TO FEM

UNIT IV ONE AND TWO DIMENSIONAL PROBLEMS

UNIT V AXISYMMETRIC AND ISOPARAMETRIC CONTINUUM
SUGGESTED READINGS:


(ii) LABORATORY

COURSEOBJECTIVES

The goal of this course is for students
1. To perform simple structural analysis and thermal analysis using simulation software’s.

COURSE OUTCOMES

Upon completion of this course, the Students will be able to

1. Perform structural analysis of bars and trusses
2. Perform structural analysis of beams and frames
3. Perform 2d analysis of plate and shells
4. Perform modal analysis of simple systems
5. Perform thermal analysis of simple systems
6. Perform fluid and failure analysis of simple systems

LIST OF EXPERIMENTS

(Simple Analysis using ANSYS Tool)

1. Structural Analysis (Static)
   1d and 2d analysis of
   • Bar and truss,
   • Beams and frames,
   • Plate and shell structures
2. Structural vibration analysis (Dynamic)
   • Modal analysis
   • Frequency response analysis
   • Transient response analysis
3. Thermal analysis – simple problems
4. Fluid Analysis – simple problems
5. Failure analysis – simple problems
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COURSE OBJECTIVE

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students in a group consisting of maximum of 4 students works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The project work carried out in this semester may be a standalone project or part of the work of project work –V carried out in the eighth semester.
COURSE OBJECTIVE

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students in a group consisting of maximum of 4 student’s works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
PROFESSIONAL ELECTIVE I  
COMPOSITEMATERIALS  
3 H – 3 C  

Instruction hours / week L : 3 T : 0 P: 0  
Marks: Internal : 40 External : 60 Total:100  
End Semester Exam : 3Hours

COURSE OBJECTIVES
1. To understand the fundamentals of composite material strength and its mechanical behavior.
2. Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
4. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

COURSE OUTCOMES
Learners should be able to
1. Select the various types of composite matrix required for an application.
2. Choose appropriate manufacturing process for polymer matrix composite.
4. Use the concepts of ceramic composites and its production techniques.
5. Identify the type of carbon-carbon composite for different industrial application.
6. Explain the various advances in composites.

UNIT I  INTRODUCTION TO COMPOSITES

UNIT II  POLYMER MATRIX COMPOSITES

UNIT III  METAL MATRIX COMPOSITES

UNIT IV  CERAMIC MATRIX COMPOSITES

UNIT V  RECENT ADVANCEMENT IN COMPOSITES

SUGGESTED READINGS
COURSE OBJECTIVES

The goal of this course is for students:

1. To understand the different energy resources and their impacts.
2. To provide knowledge on energy production from solar plants.
3. To impart knowledge on windmills, tide, and geo thermal energy conservations.
4. To provide basic knowledge on production of biomass energy.
5. To understand the economic analysis of an OTEC power plant.

COURSE OUTCOMES

Upon completion of this course, the students can able to:

1. Determine the impacts of harnessing different renewable energy.
2. Analyze and design solar cells so as to improve its performance.
3. Explain energy generation techniques in windmills, tide, and geo thermal power plant.
4. Understand the technique of harvesting energy from biomass and biowastes.
5. Perform economic analysis for OTEC power plants.
6. Get basic knowledge on fuel cells, solar cells, thermionic generators etc.

UNIT I ENERGY AND ENVIRONMENT


UNIT II SOLARENERGY


UNIT III WIND, TIDAL AND GEO THERMALENERGY

Energy from the wind – general theory of windmills – design aspects of horizontal axis windmills – applications, performance, and site selection of windmills. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants – power from geothermal energy – principle of working of geothermal power plants.

UNIT IV BIOENERGY

Energy from biomass and bio gas plants – pyrolysis, gasification, combustion and fermentation – various types – design principles of biogas plants – applications. Utilization of industrial and municipal wastes – energy from the agricultural wastes.

UNIT V OTHER RENEWABLE ENERGYSOURCES

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) – thermo electric generators – thermionic generators – fuel cells – solar cells – types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems.

SUGGESTED READINGS


WEB REFERENCES

1. https://nptel.ac.in/courses/121106014/
2. https://www.studentenergy.org/topics/renewable-energy
COURSE OBJECTIVES

The goal of this course is for students
1. To understand the anatomy, basic concepts and applications of robot.
2. To learn the drives and end effectors used in robot.
3. To study the various types of sensors used in robot.
4. To familiarize robot kinematics and robot programming
5. To impart knowledge on economic analysis of robots

COURSE OUTCOMES

Upon completion of this course, the students can able to
1. Identify the various types of robots.
2. Select appropriate drive systems and end effectors for industrial application.
3. Decide the types of sensors required according to the applications of robot.
4. To identify the different types of machine vision technologies
5. Develop simple offline robot program for different applications.
6. Calculate the economic analysis of robots.

UNIT I  FUNDAMENTALS OF ROBOT


UNIT II  ROBOT DRIVE SYSTEMS AND END EFFECTORS

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives
End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT III  SENSORS AND MACHINEVISION


UNIT IV  ROBOT KINEMATICS AND ROBOT PROGRAMMING

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems.
Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs

UNIT V  IMPLEMENTATION AND ROBOT ECONOMICS


SUGGESTED READINGS

COURSE OBJECTIVE

The goal of this course is for students
1. This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic machines, components and systems and their application in recent automation revolution.

COURSE OUTCOMES

At the end of the course, the students will be able to
1. Recognize symbols and fundamentals in fluid power generation and distribution.
2. Identify power source for hydraulic systems.
3. Select appropriate components used in various hydraulic systems.
4. Design hydraulic circuits for given applications
5. Distinguish the components used in pneumatic circuits.
6. Create the logic circuits for controlling electro-hydraulic/ pneumatic systems.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS

UNIT II HYDRAULIC POWER SOURCES AND ACTUATORS

UNIT III HYDRAULIC CONTROL VALVES AND COMPONENTS

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS

UNIT V DESIGN OF PNEUMATIC CIRCUITS
Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students
1. To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems

COURSE OUTCOMES
Learners should be able to
1. Calculate COP of various refrigeration cycles.
2. Choose appropriate refrigerants for various applications.
3. Identify the use of unconventional refrigerant system for industrial application.
4. Calculate the properties of air using psychrometric chart.
5. Calculate cooling load for a given system
6. Select the appropriate air conditioning system for industrial and domestic applications.

UNIT I REFRIGERATION CYCLE

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING

UNIT III PSYCHROMETRY
Psychrometric processes– use of psychrometric charts – – Grand and Room Sensible Heat Factors – bypass factor – requirements of comfort air conditioning – comfort charts – factors governing optimum effective temperature, recommended design conditions and ventilation standards

UNIT IV COOLING LOAD CALCULATIONS

UNIT V AIR CONDITIONING

SUGGESTED READINGS
COURSE OBJECTIVE
The goal of this course is for students
- To enhance specified concepts and skills regarding various processes including powder metallurgy and foundry techniques.
- To learn about wide range of welding process, which are currently used in the manufacturing industry.
- To acquire knowledge to understand the working concept of sheet metal and forming process.
- To learn about various machining process parameters, influence on performance and applications.
- To learn the concepts of rapid product development, apply acquired knowledge to meet global challenges in changing design in time compressed mode.

COURSE OUTCOME
Upon the completion of this course, the students will be able to
1. Understand the concepts and processing parameters of powder metallurgy process.
2. Different kinds of metal joining processes.
3. Explain various sheet metal making processes.
4. Summarize various hot working and cold working methods of metals.
5. Describe the constructional and operational features of modern machining processes.
6. Understand the importance of rapid prototyping in the product development.

UNIT I  POWDER METALLURGY AND FOUNDRY TECHNIQUES

UNIT II  ADVANCED WELDING PROCESSES

UNIT III  SHEET METAL AND FORMING PROCESS

UNIT IV  ADVANCED MACHINING PROCESS

UNIT V  RAPID PROTOTYPING

SUGGESTED READINGS

WEB REFERENCES
1. https://nptel.ac.in/courses/112107078/
COURSE OBJECTIVE
The goal of this course is for students
1. To understand the Fundamentals of Vibration and its practical applications
2. To understand the working principle and operations of various vibration Measuring instruments.
3. To understand the various Vibration control strategies

COURSE OUTCOMES:
At the end of the course, the student will be able to:
1. Define the terms involved in vibration system.
2. Describe the importance of vibration isolation
3. Explain the working nature of two degree of freedom systems
4. Solve mathematically a multi-degree freedom system & continuous system
5. List the various techniques used in vibration control
6. Explain the various experimental methods used for vibration analysis.

UNIT I   SINGLE DEGREE FREEDOM SYSTEM

UNIT II   TWO DEGREE FREEDOM SYSTEM
Introduction - Free Vibration of Undamped And Damped - Forced Vibration With Harmonic Excitation System – Coordinate Couplings And Principal Coordinates.

UNIT III  MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

UNIT IV   VIBRATION CONTROL

UNIT V   EXPERIMENTAL METHODS IN VIBRATION ANALYSIS

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students

1. This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.
2. To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.

COURSE OUTCOMES
Upon completion of this course, the students will be able to

1. Understand the concepts of electric and hybrid electric vehicles
2. Describe about the various energy source available for the hybrid electric vehicles.
3. Explain the concepts of electric propulsion systems
4. Design series drive train for hybrid electric vehicles
5. Design parallel drive train for hybrid electric vehicles
6. Understand the concepts of electronic converters for battery charging of electric hybrid vehicles.

UNIT I ELECTRIC AND HYBRID ELECTRIC VEHICLES
Configuration of Electric Vehicles and its advantages, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains

UNIT II ENERGY STORAGE FOR EV AND HEV
Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Properties of Battery, Battery Efficiency, Battery pack design. Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Super Capacitors.

UNIT III ELECTRIC PROPULSION
EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives

UNIT IV DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES
Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design

UNIT V POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING
Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, Highfrequency transformer based isolated charger topology, Transformer less topology.

SUGGESTED READINGS
COURSE OBJECTIVES

The goal of this course is for students
1. To study the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

COURSE OUTCOMES

Upon completion of this course, the students will be able to,
1. Understand the importance of DFMA in industrialscenario
2. Implement the tolerances analysis.
3. Identify different types of tolerance allocation methods.
4. Practice the geometric dimensioning and tolerancethrough analysis.
5. Prepare tolerance chart.
6. Implement DFM concepts in practice.

UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka – Yoke principle; 6σ concept; Tolerance Analysis: Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normallaw.

UNIT II SELECTIVE ASSEMBLY

Interchangeable and selective assembly, deciding the number of groups, Model–I: group tolerances of mating parts equal; Model–II: total and group tolerances of shaft, control of axial play.

Datums Systems: Grouped datums systems–different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, and tongue–slot pair, computation of translational and rotational accuracy.

UNIT III TRUE POSITION TOLERANCING THEORY

Comparison between co–ordinate and convention method of feature location tolerancing and true position tolerancing, zero true position tolerance, virtual size concept, floating and fixed fasteners, projected tolerance zone, functional gauges, paper layout gauging, compound assembly, examples.

UNIT IV FORM DESIGN OF CASTINGS AND WELDMENTS

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

UNIT V TOLERANCE CHARTING

Tolerance Charting Technique: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining. Datum features – functional and manufacturing, component design–machining considerations, redesign for manufacture, examples.

SUGGESTED READINGS


TOTAL
COURSE OBJECTIVES

The goal of this course is for students
• To introduce Governing Equations of viscous fluid flows.
• To introduce numerical modeling and its role in the field of fluid flow and heat transfer.
• To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
• To create confidence to solve complex problems in the field of fluid flow and heat transfer.
• To understand basic properties of computational methods – accuracy, stability, consistency.

COURSE OUTCOMES

Upon completion of this course, the students can able
1. Identify, solve engineering problems by computational fluid dynamics.
2. Understand the importance of governing equations involved in CFD
3. Formulate and solve problems in the field of fluid flow and heat transfer.
4. Solve the heat conduction problems using finite differencemethod.
5. Analyze and provide solutions for convection and diffusion problems.
6. Develop continuity and momentum equations for different types of fluid flow.

UNITI GOVERNING EQUATIONS AND BOUNDARY CONDITIONS


UNITII DISCRETIZATION AND SOLUTION METHODOLOGIES

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNITIII FEM TECHNIQUES

FEM techniques in CFD, strong and weak Boundary Value problem, Weighted residual formulation, Gelerkin foundation, variational formulation, implementation of FEM.

UNITIV HEAT CONDUCTION, CONVECTION AND DIFFUSION

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems, Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power–law schemes – Discretization equations for two dimensional convection and diffusion.

UNITV CALCULATION OF FLOWFIELD


SUGGESTED READINGS

COURSE OBJECTIVES
The goal of this course is for students
1. To understand and analyze the energy data of industries
2. To carryout energy accounting and balancing of industrial boilers.
3. To conduct energy audit and suggest methodologies for energysavings of furnaces.
4. To learn energy conservation opportunities of electrical components.
5. To utilize the available resources in optimal ways

COURSE OUTCOMES:
At the end of the course, student will be able to
1. Understand the Environmental aspects of energy utilization
2. Perform combustion analysis
3. Explain the concepts of industrial boiler
4. understand how to work with the steam generated from the boilers in the industrial point of view
5. Explain the concepts of industrial furnaces
6. Perform Energy audit

UNIT I ENERGY SCENARIO
Present status, rate of growth, energy utilization (sector wise), concept of energy conservation, energy economics.

COMBUSTION: Fuel analysis, combustion calculations, air requirements, theoretical and excess air requirements, excess air control, flue gas analysis and measurement, types of draught, draught calculations, chimney size calculations. F.D and I.D fan draught requirements and power requirements, furnace pressure requirements.

UNIT II INDUSTRIAL BOILERS
Types and characteristics of industrial boilers, heat balance in boilers, efficiency trials in boilers, energy conservation opportunities in boilers operation and maintenance, water treatment requirements, soot blowing requirements, super heaters and superheat controls, waste heat recovery systems.

STEAM: Distribution requirements of steam and steamlines, efficient utilization of steam, steam trapping and air venting, flash steam recovery, condensate recovery, thermal insulation for systems including HVAC, steam balance calculations.

UNIT III INDUSTRIAL FURNACES
Furnace types and characteristics, heat balance in furnaces, furnace efficiency calculations, energy conservation opportunities in furnaces, refractories types and properties, waste heat recovery system, insulating refractories, ceramic fibers, heat loss reduction calculations, wall and stored heat loss reduction.

UNIT IV ENERGY CONSERVATION OF ELECTRICAL COMPONENTS

UNIT V ENERGY AUDIT AND APPLICATIONS
Types, methodology, questionnaire development, specific energy consumption (unit wise/section wise), identification of energy conservation measures/ technologies, economic and cost benefit analysis, case studies, Energy rating for thermal equipment, Energy saving measurement – Star status – National awards.

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students
1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

COURSE OUTCOMES
On completion of this course, students will be able to
1. Understand the need for additive manufacturing technology
2. Explain the process involved in Additive manufacturing technology
3. Get knowledge on software’s used in additive manufacturing technology
4. Describe the working of SLS and other techniques
5. Apply the additive manufacturing technology in medical field
6. Applications of additive manufacturing technology in biostream.

UNIT I INTRODUCTION

UNIT II CAD & REVERSE ENGINEERING

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
Classification – Liquid based system – Stereo lithography Apparatus (SLA) - Principle, process, advantages and applications - Solid based system – Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING
Customized implants and prostheses: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

SUGGESTED READINGS
PROFESSIONAL ELECTIVE IV

20BE7E05 GAS DYNAMICS AND JET PROPULSION 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 Marks: Internal : 40 External : 60 Total:100
End Semester Exam :3 Hours

COURSE OBJECTIVES
The goal of this course is for students
1. To understand the basic difference between incompressible and compressible flow.
2. To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Analyze various conditions of compressible fluid flows.
2. Calculate mass flow rate in flow through variable area ducts.
4. Perform performance analysis of combustors, afterburners and exhaust nozzles.
5. Understand the working of various types of rocket engines
6. Use thrust equation for rocket propulsion system.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS

UNIT II FLOW THROUGH DUCTS
Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties – Isothermal flow with friction in constant area ducts – Use of tables and charts – Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION

UNIT V ROCKET PROPULSION

(Permitted to use standard Gas Tables in the examination)

SUGGESTED READINGS
COURSE OBJECTIVE
The goal of this course is for students
1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

COURSE OUTCOME
Upon completion of this course, the students can able to
1. Implement the concepts of sensors and transducers.
2. Design the actuation systems.
3. Develop the controller model for electrical, mechanical and thermal systems.
4. Explain about various types of controllers
5. Create the PLC program using ladder logic.
6. Design Mechatronic systems.

UNIT I MECHATRONICS SENSORS AND TRANSDUCERS

UNIT II ACTUATORS AND SYSTEM MODELS
Introduction to system models – Building block of Mechanical, Electrical, Fluid and Thermal Systems.

UNIT III MICROPROCESSORS IN MECHATRONICS

UNIT IV CONTROLLERS

UNIT V DESIGN OF MECHATRONIC SYSTEMS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies.
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

COURSE OUTCOMES
On completion of this course, students will learn about
2. Understand the need for inventory management.
3. Apply the need for value of information in SCM.
4. Describe about the various strategic alliances.
5. Explain about the various issues in the international SCM.
6. Get knowledge in information technology involved in SCM.

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT
Definition, global optimization, Objectives of SCM. Logistics networks– data collection, model and data elevation, solution techniques.

UNIT II INVENTORY MANAGEMENT
Introduction, single warehouse, Inventory examples, economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.

UNIT III VALUE OF INFORMATION

UNIT IV STRATEGIC ALLIANCES
Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor–integration, procurement and out servicing strategies.

UNIT V INTERNATIONAL ISSUES IN SCM
Introduction, risks and advantages– design for logistics, supplies integration into to new product development, mass customization. Issues in customer value.
Information technology for SCM: Goals, standardization, infrastructure, DSS for supply chain management.

SUGGESTED READINGS
COURSE OBJECTIVE
1. To provide knowledge and training in finding optimal solutions under limited resources for the engineering and business problems.

COURSE OUTCOMES
At the end of the course, student will be able to
1. Understand the concepts of Linear programming technique.
2. Apply LPP technique of Transportation models.
3. Understand the techniques of scheduling and sequencing.
4. Acquire knowledge in Inventory control and Queuing theory.
5. Perform network analysis for a project.
6. Understand the concept of replacement models.

UNIT I  INTRODUCTION TO OPERATIONS RESEARCH

UNIT II   TRANSPORTATION PROBLEMS
Least cost method, North west corner rule, Vogel’s approximation method, modified distribution method, unbalance and degeneracy in transportation model, shortest route algorithm – dijekstra algorithm.

UNIT III  ASSIGNMENT MODELS AND SCHEDULING
Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing two jobs through ‘m’ machines, processing n jobs through m machines.

UNIT IV  INVENTORY CONTROL AND QUEUING THEORY
Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi item deterministic model.
Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

UNIT V  PROJECT MANAGEMENT AND REPLACEMENT MODELS
Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing – Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement

SUGGESTED READINGS
PROFESSIONAL ELECTIVE V  
20BEME7E09 DESIGN OF JIGS, FIXTURES AND PANN STOOLS  3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0  Marks: Internal : 40  External : 60  Total:100

End Semester Exam : 3 Hours

COURSE OBJECTIVES
1. To understand the functions and design principles of Jigs, fixtures and presstools
2. To gain proficiency in the development of required views of the final design.

COURSE OUTCOMES
Upon the completion of this course the students will be able to
1. Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
2. Design and develop jigs
3. Design and development of fixtures for given component
4. Discuss the press working terminologies and elements of cutting dies
5. Distinguish between Bending and Drawing dies.
6. Design Bending and Drawing dies

UNIT I  PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES

UNIT II  JIGS

UNIT III  FIXTURES
General principles of boring, lathe, milling and broaching fixtures – Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures – Modular fixtures, Quick change fixtures. Design and development of fixtures for given component.

UNIT IV  PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAYOUT

UNIT V  DESIGN AND DEVELOPMENT OF DIES

SUGGESTED READINGS
COURSE OBJECTIVES

1. To understand the underlying principles of operation of different IC Engines and components.
2. To provide knowledge on pollutant formation, control, alternate fuel etc.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Explain the construction and operation of internal combustion engine.
2. Identify parts, terminology and fuel supply system of internal combustion engine.
3. Recognize the component used in cooling and lubrication systems of IC engines.
4. Describe the function of combustion, knocking and super charging of internal combustion engines.
5. Implement strategies for pollution control.
6. Know about the recent trends associated with IC engines

UNIT I SPARK IGNITION AND COMPRESSION IGNITION ENGINES

UNIT II ENGINES

UNIT III POLLUTANT FORMATION AND CONTROL

UNIT IV ALTERNATIVE FUELS
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V RECENT TRENDS

SUGGESTED READINGS

COURSE OBJECTIVE
1. To provide in-depth knowledge on various techniques of non-destructive testing

COURSE OUTCOME
Student will be able to
1. Understand the codes, standards and specifications related to NDT
2. Classify the destructive and non-destructive tests and state their applications
3. Develop NDT techniques for various products.
4. Acquire skills needed for selection of appropriate NDT technique(s) for new inspection jobs
5. Acquire sound knowledge of established NDE techniques and basic familiarity of emerging NDE techniques.
6. Make use of standards application area of NDET

UNIT I INTRODUCTION
Properties of Materials – Characteristics of Ferrous, Non-ferrous and Alloys. Destructive testing and Non-destructive testing – Classification – Uses and applications. Codes, Standards and Specifications (ASME, ASTM, AWS etc.).

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION
Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - An Illustration of Penetrant Testing, Advantages of Penetrants Testing, Disadvantages of Penetrant Testing. Introduction to Magnetic Particle Inspection - An Illustration of Magnetic Particle Inspection, Advantages of Magnetic Particle Crack Detection, Disadvantages of Magnetic Particle Crack Detection

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION

UNIT IV EDDY CURRENT AND ELECTRO-MAGNETIC METHODS

UNIT V NON-DESTRUCTIVE INSPECTION (NDI) AND ITS APPLICATIONS
Inspection of Raw Products, Inspection For In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Aircraft Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

SUGGESTED READINGS
COURSE OBJECTIVE
1. To provide in-depth knowledge on various techniques of non-destructive testing

COURSE OUTCOME
At the end of the course, student will be able to
1. Understand the need and awareness of the safety concepts
2. Understand the various safety techniques involved in industrial sector
3. Record and investigate the accident zone and prepare reports related to it.
4. Conduct basic safety inspections using strategies that they have developed
5. Identify and demonstrate working of safety monitoring
6. Train about the education and training based on safety

UNIT I CONCEPTS OF SAFETY ENGINEERING
Evolution of modern safety concept - Safety policy - Safety Organization - line and staff functions for safety - Safety Committee - budgeting for safety.

UNIT II TECHNIQUES OF SAFETY ENGINEERING
Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING
Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role - Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNIT IV SAFETY PERFORMANCE MONITORING
Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT V SAFETY EDUCATION AND TRAINING

SUGGESTED READINGS
PROFESSIONAL ELECTIVE VI

20BEME8E01 QUALITY CONTROL AND RELIABILITY ENGINEERING 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0 Marks: Internal : 40 External : 60 Total:100

End Semester Exam : 3 Hours

COURSE OBJECTIVES

1. To introduce the concept of SQC
2. To understand process control and acceptance sampling procedure and their application.
3. To learn the concept of reliability

COURSE OUTCOMES

Upon the completion of this course the students will be able to
1. Summarize the concept of Quality
2. Apply Process control for variables
3. Apply the process control for attributes
4. Explain the concept of sampling and to solve problems
5. Explain the concept of Life testing
6. Explain the concept of Reliability and techniques involved

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost – Variation in process – factors – process capability – process capability studies and simple problems – Theory of control chart – uses of control chart – Control chart for variables – X chart, R chart and σ chart.

UNIT II PROCESS CONTROL FOR ATTRIBUTES

Control chart for attributes – control chart for proportion or fraction defectives – P chart and NP chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

UNIT III ACCEPTANCE SAMPLING


UNIT IV LIFE TESTING – RELIABILITY


UNIT V QUALITY AND RELIABILITY


Note: Permitted to use approved statistical table in the examination.

SUGGESTED READINGS


WEB REFERENCES

1. https://nptel.ac.in/courses/110105039/
2. https://www.qualitygurus.com
COURSE OBJECTIVES

1. To study the significance of waste heat recovery systems and carry out its economic analysis
2. To know the concepts of cogeneration, its types and probable areas of applications

COURSE OUTCOMES

The student will be able to

1. Understand the various methods of cogeneration.
2. Apply knowledge of thermodynamics, heat transfer, and fluid mechanics principles to design and analysis of this emerging technology.
3. Have thorough understanding, operational issues and challenges in cogeneration technologies.
4. Understand the impact of this technology in waste heat recovery systems
5. Get the knowledge over various systems involved in waste heat recovery process
6. Begin a career as an engineer in an organization, can analyze the economics.

UNIT I INTRODUCTION

UNIT II COGENERATION TECHNOLOGIES

UNIT III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES

UNIT IV WASTE HEAT RECOVERY SYSTEMS

UNIT V ECONOMIC ANALYSIS

SUGGESTED READINGS

COURSE OBJECTIVE
1. To gain knowledge in sequence of process planning and cost estimation of various products.

COURSE OUTCOME
Upon completion of this course, the student can able to
1. Apply the various standards and conventions used in a drawingsheet
2. Perform dimensional and tolerance analysis
3. Understand the manufacturing drawings
4. Apply their knowledge in re-dimensioning and tolerance charting
5. Prepare process chart for a given component
6. Estimate the cost of a given component

UNIT I  STANDARDS AND CONVENTIONS
Current international standards (ISO) and Indian Standards (IS)- types of lines - principles of presentation - dimensioning - conventional representation of threaded parts, springs, and gears.

UNIT II  DIMENSIONAL AND FORM TOLERANCES
Limits and fits IT system of tolerances, deviation of fit - geometric tolerance-tolerancing of form, orientation, location and runout - datums and Datum systems-Dimensioning and tolerancing of profiles

UNIT III  MANUFACTURING DRAWINGS
Surface texture indication on drawing - welds symbolic representation of drawings. Given a sub-assembly/assembly to prepare manufacturing drawings of components, Sample exercises on CAD-preparation of manufacturing Drawings.

UNIT IV  RE-DIMENSIONING AND TOLERANCE CHARTING
Introduction to re-dimensioning to suit manufacturing requirements-manufacturing datum-functional datum. Introduction to tolerance charting

UNIT V  COST ESTIMATION
Preparation of Process chart for a given component-estimation of setting time and machining time-estimation of material cost, labour cost and overhead cost based on supplied data.

SUGGESTED READINGS
### COURSE OBJECTIVE

The goal of the course is:
- To learn various energy storage systems used for Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV).
- To learn about design and operation of solid-state Li-ion battery.
- To gain knowledge on the high temperature application of battery.
- To learn various technology for recycling used batteries.
- To understand the battery electrical and thermal management systems using active and passive cooling system.

### COURSE OUTCOMES

At the end of the course the student would be able:
1. To understand the performance and driving cycles of EVs.
2. To apply their knowledge to manufacture various types of Li-ion batteries.
3. To apply knowledge on use of Li-ion battery in large scale grid and space crafts.
4. To understand Techno-economic aspects of battery recycling and environmental safety.
5. To understand battery cooling system and safety precautions for high voltage battery.

### UNIT – I ENERGY STORAGE SYSTEMS

General background on alternative energy sources and sustainability, Introduction to electric-based transportation, Overview of on-road vehicle electrification, EVs configuration, Energy and power requirements for various HEVs and EVs Vehicle performance and driving cycles.

### UNIT – II LITHIUM BATTERIES

Li-ion batteries - Principle of operation, Battery components and design Electrode, cell and battery fabrications, Building block cells, battery modules and packs and applications. All solid-state batteries and future developments, Li-Sulphur battery, Li-Air battery, Sodium-battery, Magnesium battery, Aluminium battery, Silicon battery.

### UNIT – III HIGH TEMPERATURE BATTERIES FOR BACK-UP APPLICATIONS

Advance Ni-MH batteries for transportation, Future prospects of Ni-MH batteries vs. lithium ion batteries, Zebra cell, Li-iron sulphide cells, Vanadium and iron-based batteries, Semi-fluid flow batteries for large scale grid application, Ni-H2 cells for space applications.

### UNIT – IV FUEL CELLS AND BATTERY RECYCLING TECHNOLOGY

Introduction to fuel cells, Proton-exchange membrane and alkaline fuel cells for transportation, Solid oxide fuel cells, Technology and economic aspects of battery recycling, Environmental effect and controlling of poisonous chemicals contamination.

### UNIT – V BATTERY MANAGEMENT

Fundamentals of battery management systems and controls, Battery Thermal Management - Passive cooling, Active cooling - Liquids & air systems.

Regulations and Safety Aspects of High Voltage Batteries, Code and Standards, Safe handling of Lithium Batteries, Safety of high voltage battery.

### SUGGESTED READINGS


### WEB REFERENCES

1. https://nptel.ac.in/courses/108/103/108103009/
OPEN ELECTIVES
COURSES OFFERED BY OTHER DEPARTMENTS

20BE SHOE** SOLID WASTE MANAGEMENT

<table>
<thead>
<tr>
<th>Instruction hours / week L : 3 T : 0 P:0</th>
<th>Marks: Internal : 40 External : 60 Total:100</th>
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<td><strong>3 H – 3 C</strong></td>
<td>End Semester Exam : 3Hours</td>
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COURSE OBJECTIVES
1. To make the students conversant with basics of Solid wastes and its classification.
2. To make the student acquire sound knowledge of different treatments of solid wastes.
3. To acquaint the student with concepts of wastedisposals.
4. To develop an understanding of the basic concepts of Hazardous wastemanagements.
5. To acquaint the students with the basics of energy generation from wastematerials.

COURSE OUTCOMES
1. Outline the basic principles of Solid waste and separation of wastes
2. Identify the concepts of treatment of solid wastes
3. Identify the methods of wastedisposals.
4. Examine the level of Hazardousness and its management.
5. Examine the possible of the energy production using wastematerials.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology.

UNIT I SOLID WASTE

UNIT II WASTE TREATMENT
Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III WASTE DISPOSAL

UNIT IV HAZARDOUS WASTE MANAGEMENT

UNIT V ENERGY GENERATION FROM WASTE

SUGGESTED READINGS
COURSE OBJECTIVES
1. To make the students conversant about the green chemistry
2. To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
3. To acquaint the student with concepts of green technology.
4. To develop an understanding of the basic concepts of renewable energy resources.
5. To acquaint the students with the basics information on catalysis.

COURSE OUTCOMES
1. Outline the basic principles of green chemistry
2. Examine the different atom efficient process and synthesis elaborately
3. Apply the concepts combustion of green technology
4. Identify and apply the concepts of renewable energy
5. Apply the concepts of green catalysts in the synthesis
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I INTRODUCTION TO GREEN CHEMICAL PRINCIPLES
Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and flouro solvent, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II ATOM EFFICIENT PROCESSES
Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis

UNIT III BIOTECHNOLOGY AND GREEN CHEMISTRY
Bio technology and its applications in environmental protection-Bioinformatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV RENEWABLE RESOURCES
Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion

UNIT V CATALYSIS IN GREEN CHEMISTRY
Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

SUGGESTED READINGS
COURSE OBJECTIVES
1. To make the students conversant with the information on electrochemical material.
2. To make the student acquire sound knowledge of conducting polymers.
3. To acquaint the student with concepts of Energy storage devices.
4. To develop energy storage devices.

COURSE OUTCOMES
1. Outline the basic principles of chemistry in electrochemical material
2. Examine the properties of conducting polymers
3. Apply the concepts of electrochemistry in storage devices.
4. Identify the concepts of storage devices and its applications.
5. Apply the suitable materials for the manufacturing of storage devices.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I METALFINISHING

UNIT II CONDUCTING POLYMERS ANDELECTROCHEMICALS
Electropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers-poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNIT III BATTERIES AND POWERSOURCES-I
Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV BATTERIES AND POWERSOURCES-II
Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V ELECTROCHEMICAL MATERIALSCIENCE
Solar cells- Preparation of CdS/Cu2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

SUGGESTED READINGS
COURSE OBJECTIVES

1. To understand the basic concepts of electric hybrid vehicle.
2. To gain the knowledge about electric propulsion unit.
3. To understand and gain the knowledge about various energy storage devices.

UNIT I  INTRODUCTION
History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II  HYBRID ELECTRIC DRIVE-TRAINS
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION UNIT
Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV  ENERGY STORAGE
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V  ENERGY MANAGEMENT STRATEGIES
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

SUGGESTED READINGS

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010
COURSE OBJECTIVES

1. To gain the knowledge about environmental aspects of energy utilization.
2. To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
3. To understand the basic principles fuel cell, Geo thermal powerplants.
4. To gain the knowledge about hydroenergy.

UNIT I INTRODUCTION

UNIT II SOLAR ENERGY

UNIT III WIND ENERGY

UNIT IV HYDRO ENERGY
Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES
Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

SUGGESTED READINGS
COURSE OBJECTIVE
To provide the basic terms of housing programmes, planning and designing of housing projects, construction techniques and cost effective materials and housing finance and project appraisal techniques.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Know the Importance of basic housing policies and building byelaws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
Understand Construction as well as managing techniques

UNIT I INTRODUCTION TO HOUSING
Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES
Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS
Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS
New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL

SUGGESTED READINGS
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 2001
3. CMA, Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002
4. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000
COURSE OBJECTIVE
To provide the basic knowledge and information on concepts of drawings, symbols and sign conventions, masonry bonds, building drawings and pictorial view buildings.

COURSE OUTCOMES
The students will be able to
1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Plan and design structures

UNIT I INTRODUCTION
Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT II SYMBOLS AND SIGN CONVENTIONS
Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

UNIT III MASONRY BONDS
English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

UNIT IV BUILDING DRAWING
Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

UNIT V PICTORIAL VIEW
Principles of isometrics and perspective drawing. Perspective view of building.

List of Drawing Experiments:
1. Buildings with load bearing walls including details of doors and windows.
2. Single storey RCC building
3. Multistorey RCC building

SUGGESTED READINGS
3. Sham Tickoo Swapna D (2009), “AUTOCAD for Engineers and Designers”, Pearson Education,
COURSE OUTCOMES

After completion of the course, students are able to

1. Examine the constituents of waste water and its effects.
2. Separate the contaminants from the effluent for treatability.
3. Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
4. Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries.
5. Develop process flow diagram for water reuse and sludge disposal.

UNIT I INTRODUCTION TO WASTE WATER ENGINEERING

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

UNIT II OPERATIONS AND UNIT PROCESS

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization

UNIT III FUNDAMENTALS OF BIOLOGICAL TREATMENT

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation, Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons.

UNIT IV WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES


UNIT V WATER REUSE

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening, degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration.

SUGGESTED READINGS

COURSES OFFERED TO OTHER DEPARTMENTS

20BEMEOE01   COMPUTER AIDED DESIGN

Instruction hours / week L : 3 T : 0 P:0   Marks: Internal : 40 External : 60 Total:100

End Semester Exam : 3 Hours

COURSE OBJECTIVE
1. To provide an overview of how computers are being used in mechanical component design
2. To study about the various computer graphics concepts
3. To get basic knowledge on geometric modeling
4. To study about the basics of parametric design and object representation
5. To get basic knowledge in product design and development.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Give the overview of the CAD systems and its importance
2. Explain the ideas and principles behind the computer graphics
3. Explain the process involved in graphic transformations
4. Understand the operations involved in the geometric modeling.
5. Describe the concepts of parametric design
6. Understand the basics of the product design and development.

UNIT I OVERVIEW OF CAD SYSTEMS
Conventional and computer aided design processes - advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHIC TRANSFORMATIONS

UNIT III GEOMETRIC MODELING

UNIT IV PARAMETRIC DESIGN AND OBJECT REPRESENTATION

UNIT V PRODUCT DESIGN AND DEVELOPMENT
Automated 2D drafting - basics, mating conditions – Types of translators (IGES, STEP, ACIS and DXF). Mass property calculations.

SUGGESTED READINGS
COURSE OBJECTIVE
To provide in-depth knowledge on various techniques of non-destructive testing

COURSE OUTCOME
At the end of the course, student will be able to
1. Understand the need and awareness of the safety concepts
2. Understand the various safety techniques involved in industrial sector
3. Record and investigate the accident zone and prepare reports related to it.
4. Conduct basic safety inspections using strategies that they have developed
5. Identify and demonstrate working of safety monitoring
6. Train about the education and training based on safety

UNIT I CONCEPTS
Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety - Safety Committee - budgeting for safety.

UNIT II TECHNIQUES
Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING
Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNIT IV SAFETY PERFORMANCE MONITORING
Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT V SAFETY EDUCATION AND TRAINING

SUGGESTED READINGS
## VALUE ADDED COURSES

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