B.E. MECHANICAL ENGINEERING

CURRICULUM

(2020 AND ONWARDS)

(PART TIME 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

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(Deemed to be University)
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Pollachi Main Road, Eachanari Post, Coimbatore – 641 021. INDIA
FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING/TECHNOLOGY
PART TIME PROGRAMME
REGULATIONS 2020
CREDIT SYSTEM

These regulations are effective from the academic year 2020–2021 and are applicable to all candidates admitted into B. E./B. Tech. degree programme during the Academic year 2020–2021 and onwards.

1. ADMISSION

Candidates seeking admission to the first semester of B. E./B. Tech. (Part-time – Seven Semesters) degree programme should possess the Diploma in Engineering/Technology in the relevant branch of specialization awarded by the Directorate of Technical Education, Tamil Nadu or any other authority accepted by the Karpagam Academy of Higher Education as equivalent thereto.

2. BRANCHES, PROGRAMMES AND ELIGIBILITY FOR ADMISSION

The branches of study approved by the KAHE and the qualifications for admission are given below:

B. E./B. Tech. (Part-time – 7 Semesters) Programmes, Branches and Qualification for Admission

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Programme and Branch</th>
<th>Qualification for Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B.E. Mechanical Engineering</td>
<td>Diploma in Mechanical Engg. / Metallurgy/Automobile Engg. / Mechanical and Rural Engg. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engg. / Tool and Die Design.</td>
</tr>
</tbody>
</table>

3. MODE OF STUDY

3.1 Part-Time: In this mode of study, the candidates are required to attend classes only on the specified contact hours.

3.2 Change from part time mode of study to full time is not permitted.

3.3 Change from one programme to another is not permitted.
4. STRUCTURE OF THE PROGRAMMES

4.1 Every Programme shall have a curriculum comprising both theory and practical courses as detailed in the respective curriculum with well-defined syllabi approved by the KAHE. Each programme shall have core courses, elective courses and project work. The blend of different courses is so designed that the student would be trained not only in his / her relevant professional field but also would be molded as a socially conscious human being.

4.2 Each semester, curriculum shall normally have five theory courses. If practical component is included in any semester there will be only four theory courses in that semester. However, the total number of courses including practical per semester shall be five.

4.3 The medium of instruction, examinations and project report shall be English.

4.4 Each course is normally assigned certain number of credits.

| No. of credits per lecture period per week | 1 |
| No. of credits for 3 periods of laboratory per week | 2 |
| No. of credits for 3 periods of project work per week | 2 |

4.5 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>95 - 110</td>
</tr>
</tbody>
</table>

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. (Part Time)</td>
<td>7</td>
<td>14 for male</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 for female</td>
</tr>
</tbody>
</table>

5.2 Each semester shall normally consist of 90 working days or 270 hours.

6. Requirement to Appear for the End Semester Examinations (ESE)

A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a 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.

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 the 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 condemnation fees.

6.3 However, a candidate who has secured attendance between 50% and 64% in the current semester due to any reason shall not be permitted to appear for the End Semester Examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any, and continue the programme.

6.4 A candidate who has secured less than 50% of attendance in any semester will not be permitted to appear for the ESE. But he/she will be permitted to appear for his/her arrear examinations. The candidate has to redo the course by rejoining the semester in which attendance is less than 50% with the approval of the “Students’ Affairs Committee” and Registrar.

7. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

7.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks separately for each course. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the record of test marks and attendance. The Head of the Department shall sign with date after due verification. At the end of the semester, the record should be verified by the Dean who will keep this document in safe custody (for five years). Records of attendance and assessment of both current and previous semesters shall be submitted for inspection to the team appointed by the Karpagam Academy of Higher Education/any other approved body.

7.2 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:

**THEORY COURSES:**

<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>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>3.</td>
<td>Test – I #</td>
<td>15</td>
</tr>
<tr>
<td>4.</td>
<td>Test – II #</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>40</td>
</tr>
</tbody>
</table>

* The Assignments should be evaluated and marks should be entered in Automation software on or before 60th working day of the semester.
# The test scripts should be evaluated and marks should be entered in Automation software on or before 4th working day after the last test.
PATTERN OF TEST QUESTION PAPER:

<table>
<thead>
<tr>
<th>INSTRUCTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Marks</td>
<td>50</td>
</tr>
<tr>
<td>Duration</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Part - A</td>
<td>Consists of 10 questions, uniformly covering the two and half units of the syllabus. ((10 \times 2 = 20 \text{ Marks})).</td>
</tr>
<tr>
<td>Part- B</td>
<td>Consists of 5 questions of either or type covering two and half units of the syllabus. ((5 \times 6 = 30 \text{ 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>TOTAL</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records submitted.

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

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 and above</td>
<td>5</td>
</tr>
<tr>
<td>Less than 75</td>
<td>0</td>
</tr>
</tbody>
</table>

8.REQUIREMENTS FOR APPEARING FOR END SEMESTEREXAMINATION (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 and has registered for examination in all courses of the semester. Registration is mandatory for End Semester Examinations as well as arrear examinations failing which the candidate will not be permitted to 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.
9. 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.

PATTERN OF ESE QUESTION PAPER:

<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>15 Two mark Questions, covering all the five units. All the questions are to be answered. (15 x 2 = 30 Marks)</td>
</tr>
<tr>
<td>Part - B</td>
<td>5 Fourteen mark Questions, either or type. Covering all the five units. Student has to answer all the five questions. (5 x 14 = 70 Marks)</td>
</tr>
</tbody>
</table>

10. PASSING REQUIREMENTS

10.1 Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for End Semester Examination 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.

10.2 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 arrear 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.

10.3 If the candidate fails to secure a pass in a particular course 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 supplementary examination within the stipulated maximum duration of the programme (Clause 5.1).
11. AWARD OF LETTER GRADES

11.1 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>

11.2 GRADE SHEET

After results are declared, Grade sheets 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 will be excluded for calculating GPA and CGPA.

11.3 REVALUATION

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 Practical exams, Project Work and Supplementary exams.

12. 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 degree must be approved by the Board of Management of Karpagam Academy of Higher Education.

13. CLASSIFICATION OF DEGREE AWARDED
13.1 A candidate who qualifies for the award of the Degree (vide Clause 12) 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 8.0 shall be declared to have passed the examination in First Class with Distinction.

13.2 A candidate who qualifies for the award of the Degree (vide Clause 12) 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 a CGPA of not less than 6.5 shall be declared to have passed the examination in First Class. For this purpose the withdrawal from examination (vide Clause 14) will not be construed as an appearance. Further, the authorized break of study (vide Clause 15) will not be considered for the purpose of classification of degree.

13.3 All other candidates not covered in Clauses 13.1 and 13.2 who qualify for the award of the degree (vide Clause 12) shall be declared to have passed the examination in Second Class.

14. PROVISION FOR WITHDRAWAL FROM ENDEMERSEMER EXAMINATION
14.1 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. Withdrawal application is valid only if the candidate is otherwise eligible to write the examination.

14.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

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

14.3.1 Notwithstanding the requirement of mandatory ten days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 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 VII semester.

14.5 Withdrawal from the ESE is NOT applicable to supplementary exams.

14.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.
15. PROVISION FOR AUTHORISED BREAK OF STUDY

15.1 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, but not later than the last date for registering for the ESE of the semester in question, through the Head of the Department and Dean stating the reasons thereof and the probable date of rejoining the programme.

15.2 The candidate thus permitted to rejoin the programme after the break shall begoverned by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses if any, as per the curriculum and regulations in force at that period of time.

15.3 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 13). However, additional break of study granted will be counted for the purpose of classification.

15.4 The total period for completion of the programme 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 15.1) in order that he/she may be eligible for the award of degree.

15.5 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 ‘Withdrawal’ or ‘Break of Study’ (Clause 14 and 15 respectively).

16. SPECIAL SUPPLEMENTARY ESE: After the publication of VII semester results, if a student has an 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 a special supplementary examination.

17. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the KAHE and not to indulge in any activity which will tend to bring down the prestige of the KAHE. The erring student will be referred to the Disciplinary Committee constituted by the KAHE, to inquire into acts of indiscipline and recommend to the KAHE 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 KAHE from time to time.

18. REVISION OF REGULATION AND CURRICULUM

The KAHE 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 Academy of Higher Education.
# B.E. (MECHANICAL ENGINEERING – PART TIME) COURSE OF STUDY AND SCHEME OF EXAMINATION (2020 Batch Onwards)

## SEMESTER I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PEO</td>
<td>PO</td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td>20PBEME101</td>
<td>Engineering Mathematics I</td>
<td>1</td>
<td>1,2,3,4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>20PBEME102</td>
<td>Engineering Mechanics</td>
<td>1</td>
<td>1,2,3,4,10,11</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>20PBEME103</td>
<td>Basic Electrical and Electronics Engineering</td>
<td>1</td>
<td>1,2,3,4,7,11</td>
<td>3</td>
<td>0</td>
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<tr>
<td>20PBEME104</td>
<td>Manufacturing Technology</td>
<td>1</td>
<td>1,2,3,6,8,9</td>
<td>3</td>
<td>0</td>
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</tbody>
</table>

**PRACTICAL**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20PBEME111</td>
<td>Computer Aided Design Laboratory</td>
<td>1</td>
<td>1,2,3,4,5,8,9</td>
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<td>0</td>
</tr>
</tbody>
</table>

Total: 12 1 3 15 200 300 500

## SEMESTER II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PEO</td>
<td>PO</td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td>20PBEME201</td>
<td>Engineering Mathematics II</td>
<td>1</td>
<td>1,2,3,4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>20PBEME202</td>
<td>Strength of Materials</td>
<td>1</td>
<td>1,2,3,4,10</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>20PBEME203</td>
<td>Theory of Machines</td>
<td>1</td>
<td>1,2,3,4,10</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>20PBEME204</td>
<td>Fundamentals of Computer Programming</td>
<td>1,2</td>
<td>1,2,3,5,9,10</td>
<td>3</td>
<td>0</td>
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</tbody>
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**PRACTICAL**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>20PBEME211</td>
<td>Strength of Materials Laboratory</td>
<td>1</td>
<td>1,2,3,4,10</td>
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</table>

Total: 12 1 3 15 200 300 500
### SEMESTER III

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PEO</td>
<td>PO</td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td>20PBEME301</td>
<td>Thermodynamics</td>
<td>1</td>
<td></td>
<td>1,2,3,4,10</td>
<td>3</td>
</tr>
<tr>
<td>20PBEME302</td>
<td>Engineering Materials and Metallurgy</td>
<td>1</td>
<td></td>
<td>1,2,3,4,10</td>
<td>3</td>
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<tr>
<td>20PBEME303</td>
<td>Industrial Metrology</td>
<td>1</td>
<td></td>
<td>1,2,3,4,10</td>
<td>3</td>
</tr>
<tr>
<td>20PBEME304</td>
<td>Fluid Mechanics &amp; Fluid Machines</td>
<td>1</td>
<td></td>
<td>1,2,3,4,10</td>
<td>3</td>
</tr>
</tbody>
</table>

**PRACTICAL**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PEO</td>
<td>PO</td>
<td>L</td>
<td>T</td>
</tr>
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xii
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</table>

**Programme Educational Objectives (PEO’s)**

- **1:** Graduates will more conscious about their profession with social awareness and responsibility.
- **2:** Graduates will be engineering experts, who would help solve industry's technological problems.
- **3:** Graduates will be engineering professionals, consultants or entrepreneurs engaged in technology development.
Programme Outcomes (PO’s)

1 - **Engineering Knowledge**: Ability to apply knowledge of mathematics, science and engineering fundamentals for solving the complex engineering problems.

2 - **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.

3 - **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.

4 - **Conduct investigations of complex Problems**: Ability to apply appropriate tools, technique and research knowledge to investigate complex engineering problems.

5 - **Modern tool usage**: To understand and apply modern techniques and IT tools for the design and analysis of mechanical systems.

6 - **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.

7 - **Environment and sustainability**: Understanding the mechanism of pollutant formation and its control techniques.

8 - **Ethics**: Understanding of human and ethical responsibilities towards the profession and society.

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

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

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

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

Programme Specific Outcomes (PSO’s)

1: students acquired theoretical and practical background of technical and managerial skill to make them employable graduate.

2: students beamed fundamentally and rural – time (physical) problem solving skills by the use of advanced materials research lab and advanced welding laboratory.
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<th>Programme Educational Objectives</th>
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Total number of credits: 104

L: Lecture Hour  T: Tutorial Hour  CIA: Continuous
Internal Assessment

P: Practical Hour  C: No. of Credits  ESE: End Semester
Examinations
COURSE OBJECTIVES
The objective of this course is
1. To familiarize the prospective engineers with techniques in calculus, and multivariate analysis.
2. To familiarize the prospective engineers with techniques in linear algebra.
3. To equip the students with standard concepts and tools at an intermediate to advanced level.
4. To equip the students will serve them towards tackling more advanced level of mathematics.
5. To make the students will serve them to find the useful applications in their disciplines.
6. To make the students to solve the real time problems using standard concepts and tools.

COURSE OUTCOMES
The students will learn:
1. To apply differential and integral calculus to notions of curvature and to improper integrals.
2. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
4. To deal with functions of several variables that are essential in most branches of engineering.
5. The essential tool of matrices and linear algebra in a comprehensive manner.
6. Students can solve real time problems using standard concepts and tools.

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

UNIT III DIFFERENTIAL EQUATIONS
Introduction to Ordinary differential equations: linear ordinary differential equations of second and higher order with constant coefficients.
Introduction to Partial differential equations – Linear partial differential equations of second and higher order with constant coefficients

UNIT IV ANALYTIC FUNCTIONS
Analytic functions – Necessary and Sufficient conditions for an analytic function (Without proof) Cauchy-Riemann equations - Harmonic-Properties of analytic functions- Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear transformation

UNIT V Z-TRANSFORM AND DIFFERENCE EQUATIONS

TOTAL 45 + 15 = 60 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To develop capacity to predict the effect of force and motion.
2. To understand the importance of free body diagram for complex machine structure.
3. To perform force analysis using law of mechanics.
4. To introduce the concepts of static equilibrium condition for particles and rigid bodies
5. To understand the concepts of kinematics of particles and friction.
6. To make the students conversant to solve the problems using equation of motions.

COURSE OUTCOMES
At the end of the course the students will be able to
1. Understand the basic concepts of force and laws of mechanics.
2. Develop free body diagram for complex machine structure and to perform force analysis.
3. Apply static equilibrium condition for particles and rigid bodies.
4. Locate the center of gravity and moment of inertia for planes and solids.
5. Understand the concepts of kinematics of particles and friction.
6. Solve the problems using equation of motions.

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
Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia – radius of gyration – mass moment of inertia of simple solids.

UNIT IV   KINEMATICS OF PARTICLES


UNIT V   KINETICS OF PARTICLES AND FRICTION

TOTAL   45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To provide an overview of various analog device
2. To provide an overview of Digital concepts
3. To learn working of amplifier and its application.
4. To understand the concept of RC-timing circuits.
5. To learn cellular concept and block diagram of GSM system.
6. To provide a review of communication system

COURSE OUTCOMES
At the end of the course the students will be able to
1. Understand the principles of semiconductor devices and their applications.
2. Understand the concept of voltage regulators
3. Design an application using Operational amplifier.
4. Understand the working of timing circuits and oscillators.
5. Understand logic gates, flip flop as a building block of digital systems.
6. Learn the basics of Electronic communication system.

UNIT I ELECTRIC CIRCUITS & MEASUREMENTS

UNIT II ELECTRICAL MACHINES

UNIT III MEASURING INSTRUMENTS
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS

UNIT V DIGITAL ELECTRONICS

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

1. To familiarize the students to apply suitable molding and casting methods for producing components.
2. To develop an understanding of types of metal joining processes.
3. To explain types of deformation processes.
4. To understand the concept of sheet metal operations and metal forming processes.
5. To provide an overview of various plastic component manufacturing processes for various applications.
6. To Study and acquire knowledge of process variables to manufacture defect free products.

COURSE OUTCOMES

Upon completion of this course, the students can able to
1. Apply suitable molding and casting methods for producing components.
2. Decide the type of metal joining processes.
3. Select the type of deformation processes.
4. Work with various sheet metal operations and metal forming processes.
5. Select the various plastic component manufacturing processes for various applications.
6. Identify the effect of process variables to manufacture defect free products.

UNIT I  FOUNDRY EQUIPMENTS AND MATERIALS  8
Patterns. Moulds-types of moulds, moulding sand characteristics and testing procedures. Core making, melting furnaces.

UNIT II  PRODUCTION OF CASTINGS  8

UNIT III  WELDING  9

UNIT IV  METAL FORMING PROCESSES  9
Cold and hot working, rolling, drawing, extrusion and forging, sheet metal cutting, bending. Drawing applications, defects. Types of presses.

UNIT V  SPECIAL FORMING METHODS  8
Explosive forming, electro magnetic forming, electro hydraulic forming, powder metallurgy process, composite mouldings.

INTRODUCTION TO SOFTWARE FOR MANUFACTURING APPLICATIONS (Not for exam)  3
Metal forming and flow analysis software (for metallic/plastic components).

TOTAL  45 PERIODS

SUGGESTED READINGS
5. Phillip F. Ostwald, Jairo Munoz, Manufacturing Processes and Systems, 9ed, John Wiley and Sons, 2005
20PBEME111  COMPUTER AIDED DESIGN LABORATORY         SEMESTER – I

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

COURSE OBJECTIVES
1. To gain practical experience in handling 2D drafting and 3D modeling softwaresystems.
2. To impart training on SOLID WORKS for modelling
3. To provide knowledge on assembly of components
4. To equip them with skills to Construct an assembly drawing using part drawings of machine components.
5. To equip them with skills to Construct an assembly drawing of machine components using 2D drafting.
6. To equip them with skills to Construct an assembly drawing of jigs and fixtures

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. use computer and CAD software's for modeling of mechanical components
2. use various options in Solid Works for modeling of given components
3. create assembly of components
5. Construct an assembly drawing of machine components using 2D drafting
6. Construct an assembly drawing of machine components of jigs and fixtures.

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 – assembly constraints
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning.
4. Introduction to Surface Modeling.
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, AutoCAD etc.

TOTAL 45 PERIODS
COURSE OBJECTIVES
The objective of this course is
1. To familiarize the prospective engineers with techniques in Multivariate integration.
2. To familiarize the concept of ordinary and partial differential equations and complex variables.
3. To equip the students to deal with advanced level of mathematics and applications.
4. To make the students to formulate and solve problems involving random variables.
5. To equip the students to understand the basic concepts of one- and two-dimensional random variables.
6. To understand the concept of testing of hypothesis for small and large samples in real life problems.

COURSE OUTCOMES
The students will learn:
1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.
4. Understand the basic concepts of one- and two-dimensional random variables and apply in engineering applications.
5. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.
6. Apply the concept of testing of hypothesis for small and large samples in real life problems.

UNIT I MULTIPLE INTEGRALS
Double integration – Cartesian coordinates – Polar coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integrals.

UNIT II 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

UNIT III FOURIER SERIES

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded).

UNIT V LAPLACE TRANSFORMS

TOTAL 45 + 15 = 60 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

1. To understand the concepts of stress and strain on deformation of solids.
2. To introduce the Concepts of safe working stresses and load carrying capacity of beams.
3. To enrich the understanding of deflection in beams and columns in engineering applications.
4. To understand the importance of the effect of torsion on shafts and springs.
5. To provide knowledge on principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. To provide knowledge on components subjected to various loadings with the help of various theories of failures.

COURSE OUTCOMES

Upon completion of this course, the students can able to
1. Determine stress and strain on deformation of solids.
2. Compute safe working stresses and load carrying capacity of beams.
3. Estimate the deflection in beams and columns in engineering applications.
4. Analyze the effect of torsion on shafts and springs.
5. Determine principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. Design the components subjected to various loadings with the help of various theories of failures.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

9
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

9
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

9

UNIT IV TORSION

9
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 ANALYSIS OF STRESSES IN TWO DIMENSIONS

9
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.

TOTAL 45 PERIODS

SUGGESTED READINGS

20PBEME203  THEORY OF MACHINES  SEMESTER – II

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 principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and cam mechanisms for specified output motions.
2. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
3. To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
4. To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
5. To expose students to vibration phenomenon and its types along with the vibration terminologies.
6. To understand the effect of Dynamics of undesirable vibrations.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Identify the type and mechanism and will be able to perform velocity and acceleration analysis
2. Classify the types of friction and understand the friction applications used in screw threads, clutches, brakes.
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  KINEMATICS
Surface contacts - Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives, Friction aspects in Brakes.

UNIT III  KINEMATICS OF CAM
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  GEARS

UNIT V  FRICTION IN DRIVES

TOTAL  45 PERIODS

SUGGESTED READINGS
4. Charles E. Wilson, Kinematics and Dynamics of Machinery, 3e, Pearson Education Ltd, 2008
5. Thomas Bevan, Theory of Machines, 3e, CBS Publishers and Distributors, New Delhi, 2005
## FUNDAMENTALS OF COMPUTER PROGRAMMING

### COURSE OBJECTIVES
1. To have knowledge on computer hardwares and softwares
2. To understand the various data representation techniques
3. To make the students to get knowledge on software engineering methodologies
4. To know the correct and efficient ways of solving problems
5. To learn to develop algorithm for simple problem solving
6. To learn to program in C

### COURSE OUTCOMES
1. Knowledge on computer hardwares and softwares
2. Understanding of various data representation techniques
3. To formulate simple algorithms for arithmetic and logical problems
4. To translate the algorithms to programs (in C language)
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach
6. To use arrays, pointers and structures to formulate algorithms and programs

### UNIT I  COMPUTER BASICS  9
Evolution of computers- Generations of computers- Classification of computers-Applications of computers- Computer Organization and Architecture- Computer Memory and Storage- Input Output Devices

### UNIT II  SOFTWARE, PROGRAMMING AND INTERNET  9
Algorithm- Flowchart- Pseudo code – Program control structures- Programming paradigms- Programming languages- Generations of Programming languages- Computer Software- Definition- Categories of Software- Internet- Evolution- Basic Internet terms- Internet-Applications

### UNIT III  C FUNDAMENTALS  9
Introduction to C- Constants- Variables- Data types- Operators and Expressions-Managing Input and Output operations- Decision Making and Branching- Looping

### UNIT IV  ARRAYS AND FUNCTIONS  9
Arrays- Character Arrays and Strings- User defined functions- Storage Classes

### UNIT V  STRUCTURES AND FILES  9
Structures- Definition- Initialization- Array of Structures- Structures within structures- Structures and Functions- Unions- File Management in C

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### SUGGESTED READINGS
2. ITL Education Solutions Ltd, Introduction to Information Technology, Pearson Education. Delhi, 2008
20PBEME211                  STRENGTH OF MATERIALS LABORATORY                  SEMESTER – II

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

COURSE OBJECTIVES
1. To perform different destructive testing
2. To learn the characteristic materials
3. To understand the stress and strain relationship.
4. To determine the shear force for various materials.
5. To determine the impact load for various materials.
6. To determine the hardness for various materials

COURSE OUTCOMES
1. Ability to perform different destructive testing
2. Ability to characteristic materials
3. Understand the stress and strain relationship.
4. Determine the shear force for various materials.
5. Determine the impact load for various materials.
6. Determine the hardness for various 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, Vicker 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.

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To understand the Model of physical systems into relevant thermodynamic system and apply energy balance equation for closed and open system.
2. To provide knowledge on entropy change in thermodynamic processes.
3. To study and acquire knowledge on various thermodynamic properties of pure substances in real time problems.
4. To establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. To facilitate the understanding of properties of air using psychometric chart.
6. To acquaint the student with the concepts and applications of the thermodynamics to the various real-life systems.

COURSE OUTCOMES
1. Model the physical systems into relevant thermodynamic system and apply energy balance equation for closed and open system.
2. Determine entropy change in thermodynamic processes.
3. Identify the various thermodynamic properties of pure substances in real time problems.
4. Establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. Calculate the properties of air using psychometric chart.
6. Explain the basic principles and applications of the thermodynamics to the various real-life systems.

UNIT I BASIC CONCEPTS AND FIRST LAW

UNIT II SECOND LAW AND ENTROPY

UNIT III THERMODYNAMIC AVAILABILITY AND RELATIONS

UNIT IV PROPERTIES OF PURE SUBSTANCE AND GAS MIXTURES

UNIT V PSYCHROMETRY
Psychrometry - Psychrometric charts - Property calculations of air vapour mixtures- Psychrometric process-Adiabatic mixing - Evaporative cooling

TOTAL 45 + 15 = 60 PERIODS

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

SUGGESTED READINGS
2. Cengel, Thermodynamics-An Engineering Approach, 8e, Tata McGraw-Hill, New Delhi, 2015
5. Kothandaraman C P andDomkundwar S, A Course in Thermal Engineering, Dhanpatrai& Sons, New Delhi, 2004
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 impart knowledge on non-metallic materials.
5. To learn about the strengthening mechanisms for Non-ferrous alloys.
6. 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
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
4. James F. Shackelford

TOTAL 45 PERIODS
COURSE OBJECTIVES

1. To understand the concept of measurements in practical applications.
2. To expose students to linear and angular measurements.
3. To facilitate the understanding of profile measurements in engineering components.
4. To study and acquire knowledge of measurements in practice using LASER and CMM.
5. To equip students with skills to perform measurements on mechanical and thermal quantities.
6. To equip students with skills to select suitable measuring methods for different applications.

COURSE OUTCOMES

1. Apply the concept of measurements in practical applications.
2. Measure linear and angular measurements.
3. Carry out profile measurements in engineering components.
4. Exhibit measurements in practice using LASER and CMM.
5. Perform measurements on mechanical and thermal quantities.
6. Select suitable measuring methods for different applications.

UNIT I BASICS OF MEASUREMENT, DEVICES AND QUALITY STANDARDS

Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe’s Principle, Principle of interferometry - flatness testing, optical interferometer, laser interferometer. Holography and speckle metrology.

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.

TOTAL 45 PERIODS

SUGGESTED READINGS

COURSE OBJECTIVES
1. To enrich the understanding of fluid properties
2. To make the students conversant with types of flow and calculate Major and minor loses in pipes.
3. To acquaint the student with the concepts of Buckingham’s π theorem.
4. To explain the working of different pumps
5. To explain the working of different turbines.
6. To equip students with skills to produce analytical solutions to various simple problems

COURSE OUTCOMES
1. Demonstrate basic knowledge of fluid properties
2. Find types of flow and calculate Major and minor loses in pipes.
3. Apply Buckingham’s π theorem for problem solving.
4. Understand the working of different pumps
5. Understand the working of different turbines.
6. produce analytical solutions to various simple problems

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 (definition only) 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, model and similitude, similarity laws.

UNIT IV HYDRAULIC TURBINES

UNIT V HYDRAULIC PUMPS

TOTAL 45 PERIODS

SUGGESTED READINGS
5. Fox and McDonald, Fluid Mechanics, 8e, John Wiley, 2015
Instruction Hours / Week: L: 0  T: 0  P: 3  Marks: Internal: 40  External: 60  Total: 100  End Semester Exam: 3 Hours

COURSE OBJECTIVES
1. To supplement the theoretical knowledge gained in Fluid Mechanics and Machinery with practical testing
2. To understand the concepts of coefficient of discharge for Orifice meter, Venturi meter and rotameter
3. To impart knowledge on the performance of various pumps and turbines
4. To introduce the concepts to Characterize and calibrate measuring devices.
5. To expose students to measuring taper angle straightness, flatness, surface finish and thread parameters.
6. To explain the limits of dimensional tolerances using comparators.

COURSE OUTCOMES
1. Calculate the coefficient of discharge for Orifice meter and Venturimeter.
2. Calibrate the Rotameter
3. Assess the performance of various pumps and turbines
5. Measure taper angle straightness, flatness, surface finish and thread parameters.
6. Examine the limits of dimensional tolerances using comparators.

LIST OF EXPERIMENTS

- FLUID MECHANICS
  1. Determination of the Coefficient of discharge of given Orifice meter.
  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 Gear pump.
  9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
10. Conducting experiments and drawing the characteristics curves of Francis turbine.

- METROLOGY
  1. Calibration of Vernier / Micrometer / Dial gauge
  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

TOTAL 45 PERIODS
Instructor Hours / Week: - L: 3  T: 1  P:0  
Mark: - Internal: 40  External: 60  Total: 100  
End Semester Exam: 3 Hours

COURSE OBJECTIVES

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.  
6. To introduce concepts of refrigeration and air conditioning 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  GAS POWER CYCLES AND IC ENGINES  

UNIT II  BOILER AND STEAM POWER CYCLES  

UNIT III  STEAM NOZZLES AND STEAM TURBINES  
Steam nozzles – flow through steam nozzles, effect of friction, critical pressure ratio, super saturated flow – Steam turbines– impulse and reaction turbine, compounding, velocity diagram, condition for maximum efficiency – multi stage turbines, cycles with reheating and regenerating heating – reheat factor, degree of reaction - governing of turbines.

UNIT IV  AIR COMPRESSORS  

UNIT V  REFRIGERATION AND AIR CONDITIONING  

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

TOTAL 45 + 15 = 60 PERIODS

SUGGESTED READINGS
5. Yunus A Cengel, Thermodynamics’ An Engineering Approach, 8e, Tata McGraw Hill, New Delhi, 2015
COURSE OBJECTIVES
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.
2. To understand the concepts of sensors and transducers.
3. To provide an overview of actuation systems.
4. To expose students to controller model for electrical, mechanical and thermal systems.
5. To provide knowledge about various types of controllers.
6. To facilitate the understanding of PLC program using ladder logic.

COURSE OUTCOMES
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 Mechatronics system.

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

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To understand the various types of stresses induced in different machine members.
2. To study and acquire knowledge on design shaft and couplings for effective transmission of power.
3. To study the features of welded joints and fasteners required for various industrial applications.
4. To give exposure to design springs and flywheels for various engineering applications.
5. To understand the importance of design bearings and levers for engineering applications.
6. To make the students conversant to implement design procedure for designing a machine.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Determine various types of stresses induced in different machine members.
2. Design shaft and couplings for effective transmission of power.
3. Select the type of welded joints and fasteners required for various industrial applications.
4. Design springs and flywheels for various engineering applications.
5. Design bearings and levers for engineering applications.
6. Implement design procedure for designing a machine.

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.

TOTAL 45 PERIODS

SUGGESTED READINGS

(Permitted to use PSGdesign data book in the examination)
COURSE OBJECTIVES
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.
4. To demonstrate proficiency in quantitative methods, qualitative analysis, and critical thinking.
5. To develop writing and oral communication needed to conduct high-level work as interdisciplinary scholars and / or practitioners.
6. To Learn about the systems concepts and methodologies to analyze and understand interactions.

COURSE OUTCOMES
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.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9
Definition, Scope and Importance – Need for public awareness -Forest resources: Use and over-exploitation, deforestation- Water resources-Use and over-utilization of surface and ground water, floods, drought, conflicts over water- Land resources-Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources- Food resources- World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture- Energy resources- Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources- role of an individual in conservation of natural resources.

UNIT II ECOSYSTEM 9
Chemistry and Environment- Environmental segments, Composition and Structure of atmosphere- Concept of an ecosystem- Structure, components and function of an ecosystem Energy flow in the ecosystem – Food chain, food web and ecological pyramids, Structure and function of Terrestrial ecosystem (Forest, Desert and Grassland ecosystem) and Aquatic ecosystem (Fresh water and Marine ecosystem)

UNIT III BIODIVERSITY 9
Introduction to biodiversity, Definition- Genetic diversity, Species diversity and Ecosystem diversity, Biogeographical classification of India, Importance of biodiversity-Value of biodiversity - Hot Spots of biodiversity-Threats to biodiversity - Endangered and Endemic Species of India – Conservation of biodiversity- In-Situ and Ex-Situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL POLLUTION 9
Definition – Causes, effects and control Measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution and Thermal pollution. Solid waste management- Causes, effects and control measures of urban and industrial wastes– Role of an individual in prevention of pollution–Disaster management:-earthquake, tsunami, cyclone and landslides.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To impart knowledge on valve timing diagram and port timing diagram for single cylinder four stroke diesel engine and two stroke petrol engines.
2. To understand the importance of mechanical efficiency of four stroke SI engine by Morse test.
3. To expose students to the flash and fire point of various fuel and various lubricants.
4. To acquaint the student with the concepts of heat transfer rate in free and forced convection environment.
5. To Study and acquire knowledge of grey surface and Stefan–Boltzmann constant.
6. To provide an overview of the effectiveness of parallel and counter flow heat exchanger.

COURSE OUTCOMES
1. Sketch the valve timing diagram for four stroke diesel engine and petrol engines.
2. Evaluate the performance of four stroke single cylinder CI engine.
3. Measure the flash and fire point of various fuel/lubricants.
4. Measure heat transfer rate in free and forced convection environment.
5. Determine the grey surface and Stefan–Boltzmann constant.
6. Measure the effectiveness of parallel and counter flow heat exchanger.

LIST OF EXPERIMENTS
I C ENGINES AND FUELS
2. Performance Test on 4–stroke Diesel Engine.
4. Retardation Test to find Frictional Power of a Diesel Engine.
6. Determination of Flash Point and Fire Point.

HEAT TRANSFER
1. Heat transfer through a composite wall
2. Thermal conductivity measurement by guarded plate method
3. Natural convection heat transfer from a vertical cylinder
4. Heat transfer from pin–fin (natural and forced convection modes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan–Boltzmann constant
7. Determination of emissivity of a grey surface

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To Study and acquire knowledge on heat transfer for conduction.
2. To introduce the concepts of heat transfer coefficients for natural and forced convection for different fluid flows.
3. To understand the performance of heat exchanger.
4. To study the features of radiation heat transfer between the surfaces.
5. To give exposure to mass transfer.
6. To make the students conversant to solve complex problems where heat and mass transfer takes place.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Determine the rate of heat transfer for conduction.
2. Evaluate heat transfer coefficients for natural and forced convection for different fluid flows.
4. Estimate the radiation heat transfer between the surfaces.
5. Calculate the coefficient of mass transfer.
6. Solve complex problems where heat and mass transfer take place.

UNIT I  CONDUCTION

UNIT II  CONVECTION

UNIT III  PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

UNIT IV  RADIATION

UNIT V  MASS TRANSFER

TOTAL 45 + 15 = 60 PERIODS

PERMITTED TO USE STANDARD HEAT AND MASS TRANSFER TABLE IN THE EXAMINATION

SUGGESTED READINGS
COURSE OBJECTIVES
1. To Formulate and solve engineering and managerial situations as LPP.
2. To understand the Engineering and Managerial situations in Transportation.
3. To Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
4. To give exposure to inventory in industry.
5. To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
6. To provide an overview of various tools in various sections of industries like marketing, material handling etc.

COURSE OUTCOMES
At the end of the course, student will be able to understand the
1. Formulate and solve engineering and managerial situations as LPP.
2. Solve Engineering and Managerial situations in Transportation.
3. Give Engineering and Managerial solutions in Assignment and scheduling problems.
4. Manage inventory in industry.
5. Select better sequence to perform operation among various alternatives.
6. Apply the various tools in various sections of industries like marketing, material handling etc.

UNIT I   INTRODUCTION TO OPERATIONS RESEARCH

UNIT II   TRANSPORTATION PROBLEMS
Least cost method, North west corner rule, Vogel’s approximation method, modified distribution method, optimization models, unbalance and degeneracy in transportation model.

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, GAME THEORY, 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

TOTAL  45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

1. To Study and acquire knowledge on design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. To Study and acquire knowledge on design spurs and parallel axis helical gears.
3. To give exposure to dimensions for bevel and worm gears.
4. To provide an overview of design procedures of gear boxes for industrial applications.
5. To provide an overview of clutches and brakes for engineering applications.
6. To make the student acquire sound knowledge of mechanical system.

COURSE OUTCOMES

Upon completion of this course, the students will able to

1. Design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. Design spurs and parallel axis helical gears.
3. Estimate the dimensions for bevel and worm gears.
4. Practice the design procedures of gear boxes for industrial applications.
5. Design clutches and brakes for engineering applications.
6. Design a mechanical system.

UNIT I  DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS  9

UNIT II  DESIGN OF SPUR AND HELICAL GEARS  9

UNIT III  DESIGN OF BEVEL AND WORM GEARS  9
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 GEAR BOXES  9

UNIT V  DESIGN OF CLUTCHES AND BRAKES  9
Design of plate clutches –axial clutches–cone clutches–internal expanding rim clutches–internal and external shoe brakes.

TOTAL 45 PERIODS

PERMITTED TO USE PSG DESIGN DATA BOOK IN THE EXAMINATION

SUGGESTED READINGS

5. 10e, McGraw–Hill International Editions, New Delhi, 2015
20PBEME5E-- PROFESSIONAL ELECTIVE - I SEMESTER – V3H: 3C
COURSE OBJECTIVES
1. To perform simple structural analysis and thermal analysis using simulation software’s.
2. To perform structural analysis of bars and trusses.
3. To perform structural analysis of beams and frames.
4. To perform 2D analysis of plates and shells.
5. To perform modal analysis of simple systems.
6. To perform thermal analysis of simple systems.

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 plates 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.

COMPUTER AIDED MANUFACTURING (CAM)
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. CNC Controllers like FANUC, Siemens, and Hiedenhain etc.

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To enable students to understand the fundamental economic concepts applicable to engineering
2. To learn the techniques of incorporating inflation factor in economic decision making.
3. To understand the measures of national income, the functions of banks and concepts of globalization
4. To apply the concepts of financial management for project appraisal
5. To understand accounting systems and analyze financial statements using ratio analysis
6. To understand financial planning, economic basis for replacement.

COURSE OUTCOMES
1. Evaluate the economic theories, cost concepts and pricing policies.
2. Understand the market structures and integration concepts.
3. Understand the measures of national income, the functions of banks and concepts of globalization.
4. Apply the concepts of financial management for project appraisal.
5. Understand accounting systems and analyze financial statements using ratio analysis.
6. Understand the impact of inflation, taxation, depreciation. Financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and project-management problems.

UNIT 1  FUNDAMENTALS OF ENGINEERING ECONOMICS 9

UNIT II  COMMERCIAL BANKING 9

UNIT III  CAPITAL MARKET 9

UNIT IV  FINANCIAL CONCEPTS 9

UNIT V  COST ANALYSIS AND BREAK EVEN ANALYSIS 9

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES:
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
4. To provide an overview of importance of group technology and FMS
5. To provide knowledge on various inspection technologies to enhance the quality of the system
6. To enrich the understanding of various manufacturing support systems

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 INTRODUCTION

UNIT II COMPUTER AIDED DESIGN

UNIT III COMPUTER AIDED MANUFACTURING
Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control

UNIT IV LOW COST AUTOMATION
Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

UNIT V MODELING AND SIMULATION
Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

TOTAL 45 PERIODS

SUGGESTED READINGS:
<table>
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<tr>
<th>Course Code</th>
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<th>Semester</th>
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<td>20PBEME6E--</td>
<td>PROFESSIONAL ELECTIVE -II</td>
<td>VI3H: 3C</td>
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<td>20PBEME6E--</td>
<td>PROFESSIONAL ELECTIVE -III</td>
<td>VI3H: 3C</td>
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20PBEME611 COMPUTER AIDED ANALYSIS LABORATORY SEMESTER – V13H: 2C

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

COURSE OBJECTIVES
1. To gain practical experience in handling 2D drafting and 3D modeling software systems.
2. To impart training on SOLID WORKS for modelling
3. To provide knowledge on assembly of components
4. To facilitate the understanding of manufacturing drawings from the model created
5. To understand the importance of MAT Lab for simulating different systems
6. To acquaint the student with the concepts of mat lab for performing various mathematical operations

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. use computer and CAD software's for modeling of mechanical components
2. use various options in Solid Works for modeling of given components
3. create assembly of components
4. prepare manufacturing drawings from the models created
5. Use MAT Lab for simulating different systems like hydraulic and pneumatic circuits
6. Use mat lab for performing various mathematical operations

LIST OF EXPERIMENTS
Simple Analysis using ANSYS Tool
1. Stress analysis of rectangular L bracket
2. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
3. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
4. Harmonic analysis of a 2D component
5. Thermal stress analysis of a 2D component
6. Modeling a 3D component. (Single point cutting tool, I beams, etc.)

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To introduce the concepts of essentiality of quality.
2. To understand the importance of various TQM principles.
3. To introduce the concepts of the various TQM principles.
4. To understand the techniques for quality management.
5. To introduce the standard quality systems in industries.
6. To familiarize the students to understand the various techniques to improve the quality in industries

COURSE OUTCOMES
1. Understand the essentiality of quality.
2. Summarize various TQM principles.
3. Understand the various TQM principles.
4. Understand the techniques for quality management.
5. Implement standard quality systems in industries.
6. Apply various techniques to improve the quality in industries.

UNIT I ESSENTIALS OF TQM
Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES

UNIT III TQM TOOLS
The new seven management tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma – APQP.

UNIT IV TQM TECHNIQUES

UNIT V QUALITY AND ENVIRONMENT SYSTEMS

TOTAL 45 PERIODS

SUGGESTED READINGS
1. Dale H. Besterfiled, Total Quality Management, 4e, Pearson Education, Delhi, 2015
### Course Objectives

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 of 3 to 4 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. 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.

**TOTAL 135 PERIODS**
PROFESSIONAL ELECTIVES

20PBEME5E01 EMERGING MATERIALS SEMESTER - V

Brittle to Toughening: End Semester Exam: 3 Hours

Instruction Hours / Week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

COURSE OBJECTIVES
1. To describe various processing techniques of different engineering materials.
2. To analyse the Phase diagram and Microstructure using Microscope for different type of Stainless-steel materials.
3. To describe the metallurgical aspects of aluminium, magnesium and titanium alloys.
4. To get basic knowledge on super alloys and its applications
5. To get basic understanding of nano materials, shape memory alloys and biomaterials.
6. To select the material for Biological, Nuclear, Space and Cryogenic service applications.

COURSE OUTCOMES
Upon completion of this course, the students can
1. Describe various processing techniques of different engineering materials.
2. Analyse the Phase diagram and Microstructure using Microscope for different type of Stainless-steel materials.
3. Describe the metallurgical aspects of aluminium, magnesium and titanium alloys.
4. Get basic knowledge on super alloys and its applications
5. Get basic understanding of nano materials, shape memory alloys and biomaterials.
6. Select the material for Biological, Nuclear, Space and Cryogenic service applications.

UNIT I
Techniques of rapid solidification. Production of metallic glasses, atomic arrangement, comparison with crystalline alloys - mechanical, electrical, magnetic, superconducting and chemical properties and applications

UNIT II
Phase diagrams of ferritic, martensitic and austenitic stainless steels, duplex stainless steels, precipitation hardenable stainless steels, mechanical and metallurgical properties of stainless steels, HSLA steels, micro-alloyed steels

UNIT III
Aluminium alloys, magnesium alloys and titanium alloys; metallurgical aspects, mechanical properties and applications

UNIT IV
Development of super alloys-iron base, nickel base and cobalt base - properties and their applications; materials for cryogenic service, materials in nuclear field, materials used in space

UNIT V
Carbonaceous materials - including nano tubes and fullerenes; shape memory alloys, functionally gradient materials, high temperature super conductors - bio materials

TOTAL 45 PERIODS

SUGGESTED READINGS
Institution Hours / Week: L: 3  T: 0  P:0

COURSE OBJECTIVES
1. To explain importance of renewable energy resources.
2. To understand the importance of basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
3. To understand the importance of principles of energy conversion from alternate sources.
4. To understand the importance of wind, geothermal, ocean, biomass, biogas and hydrogen.
5. To study the features of design principles of biogas plants.
6. To understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Understand the importance of renewable energy resources.
2. Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
3. Understand principles of energy conversion from alternate sources.
4. Understand the importance of wind, geothermal, ocean, biomass, biogas and hydrogen.
5. Implement design principles of biogas plants.
6. Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources – world energy resources – Indian energy scenario – energy cycle of the earth – environmental aspects of energy utilisation, CO₂ emissions and Global warming – renewable energy resources and their importance.
Potential impacts of harnessing the different renewable energy resources.

UNIT II SOLAR ENERGY

UNIT III WIND, TIDAL AND GEO THERMAL ENERGY
Energy from the wind – general theory of windmills – types of windmills – design aspects of horizontal axis windmills – applications. 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 BIO ENERGY

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

SUGGESTED READINGS

TOTAL 45 PERIODS
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 underlying principles of operation of different IC Engines and components.
2. To provide knowledge on pollutant formation, control, alternate fuel etc.
3. To Study and acquire knowledge to Identify parts, terminology and fuel supply system of internal combustion engine
4. To introduce the concepts of cooling and lubrication systems of IC engines
5. To make the student acquire sound knowledge on combustion, knocking and super charging of internal combustion engines
6. To expose students to recent trends associated with IC engines

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 ENGINES

UNIT II      COMPRESSION IGNITION 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

TOTAL    45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To recognize symbols and fundamentals in fluid power generation and distribution.
2. To identify power source for hydraulic systems.
3. To select appropriate components used in various hydraulic systems.
4. To design hydraulic circuits for given applications.
5. To distinguish the components used in pneumatic circuits.
6. To create the logic circuits for controlling electro-hydraulic/ pneumatic systems.

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 SYSTEM AND COMPONENTS

UNIT III DESIGN OF HYDRAULIC CIRCUITS

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.

TOTAL 45 PERIODS

SUGGESTED READINGS
4. Anthony Lal, Oil hydraulics in the service of industry, Allied publishers, New Delhi, 1982
COURSE OBJECTIVES

1. To make the student acquire sound knowledge on the types of vehicle structures, cooling and lubrication systems required.
2. To acquaint the student with the concepts of type of engines to be used for modern automobiles.
3. To familiarize the students to Distinguish between the manual transmissions systems with automatic transmission systems.
4. To provide knowledge on appropriate transmission systems for the optimal power transmission.
5. To provide knowledge on steering, brakes and suspension systems for effective functioning.
6. To acquaint the student with advanced technologies in automotive Engineering.

COURSE OUTCOMES

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

1. Identify the types of vehicle structures, cooling and lubrication systems required.
2. Determine the type of engines to be used for modern automobiles.
3. Distinguish between the manual transmissions systems with automatic transmission systems.
4. Select appropriate transmission systems for the optimal power transmission.
5. Select steering, brakes and suspension systems for effective functioning.
6. Implement the advanced technologies in automotive.

UNIT I AUTOMOBILE ARCHITECTURE AND PERFORMANCE

Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

UNIT II TYPES OF ENGINE

Types of engine, multi valve engine, in-line engine, vee-engine, Petrol engine-direct, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles.

UNIT III TRANSMISSION SYSTEMS

Clutch : Types-coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling.

UNIT IV WHEEL AND TYRES AND SUSPENSION SYSTEM

Types of wheels, construction, wired wheels, Tyres- construction, Radial, bias & belted bias, slip angle, Tread patterns, Tyre retreading cold & hot, Tubeless tyres
Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems– Balancing of Wheels

UNIT V STEERING SYSTEM AND BRAKING SYSTEM

Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.
Breaking System - Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes anti lock braking system.

TOTAL 45 PERIODS

SUGGESTED READINGS

COURSE OBJECTIVES
1. To impart knowledge on the principles of locating and clamping devices in machining process.
2. To familiarize the students to understand design of jigs for a given component.
3. To Study and acquire knowledge on design fixtures for a given component.
4. To make the student acquire sound knowledge on appropriate type of press tool for a given component.
5. To expose students to drawing die for a given component.
6. To give exposure to the use computer aids for sheet metal forming analysis

COURSE OUTCOMES
Upon the completion of this course the students will be able to
1. Summarize the principles of locating and clamping devices in machining process.
2. Design jigs for a given component.
3. Design fixtures for a given component.
4. Design an appropriate type of press tool for a given component.
5. Develop a drawing die for a given component.
6. Use computer aids for sheet metal forming analysis

UNIT I  PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES 9

UNIT II  JIGS 9

UNIT III  FIXTURES 9
General principles of boring, lathe, milling and broaching fixtures– Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures– Modular fixtures. Design and development of fixtures for given component.

UNIT IV  PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT 9

UNIT V  DESIGN AND DEVELOPMENT OF DIES 9

SUGGESTED READINGS

TOTAL 45 PERIODS
COURSE OBJECTIVES
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
3. To introduce the concepts on use of unconventional refrigerant system for industrial application
4. To expose students to properties of air using psychrometric chart
5. To provide knowledge on cooling load for a given system
6. To know the application of air conditioning system for industrial and domestic purpose

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 AIRCONDITIONING

TOTAL 45 PERIODS

SUGGESTED READINGS
1. Manohar Prasad, Refrigeration and Air Conditioning, New Age International Ltd, New Delhi, 2011
5. StoeckerN.F and Jerold W.Jones, Refrigeration and Air Conditioning, McGraw Hill, New Delhi, 1986
COURSE OBJECTIVES
1. To provide knowledge on different aspects of powder metallurgy parameters.
2. To understand the importance of principle of advanced welding processes and its application.
3. To understand the importance of advanced forming processes and its application.
4. To familiarize the students to advanced manufacturing process for processing of different materials.
5. To acquaint the student to apply the suitable rapid prototyping mechanism for industry need.
6. To provide knowledge on optimum parametric for advanced manufacturing process.

COURSE OUTCOMES
Upon the completion of this course, the students will be able to
1. Understand different aspects of powder metallurgy parameters.
2. Understand basic principle of advanced welding processes and its application.
3. Understand basic principle of advanced forming processes and its application.
4. Select the best suitable advanced manufacturing process for processing of different materials.
5. Apply the suitable rapid prototyping mechanism for industry need.
6. Select the optimum parametric for advanced manufacturing process.

UNIT I  POWDER METALLURGY PROCESS

UNIT II  ADVANCED WELDING PROCESSES

UNIT III  SHEET METAL AND FORMING PROCESS

UNIT IV  ADVANCED MACHINING PROCESS
Modern machining process: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Electro chemical Machining, Electro chemical Grinding, Electro Discharge Machining, wire cut EDM, Electron Beam Machining, plasma arc machining, Laser Beam Machining. Ultrasonic Machining, High speed machining process – deep hole drilling process.

UNIT V  RAPID PROTOTYPING

SUGGESTED READINGS

TOTAL  45 PERIODS
COURSE OBJECTIVES

1. To provide foundations on design of experiments and statistical analysis of experimental data obtained from laboratory and/or industrial processes.
2. To understand the important concepts of single factorial designs
3. To Study and acquire knowledge on various methodologies involved in single factorial designs
4. To know the application of testing of factorial experiment
5. To enrich the understanding of special experimental designs
6. To impart knowledge on basic concepts of Taguchi method in parameter design

COURSE OUTCOMES

Upon successful completion of the course, students will be able to:
1. Understand the knowledge of various techniques for experimental planning
2. Understand the concepts of single factorial designs
3. List the various methodologies involved in single factorial designs
4. Apply the concept of testing of factorial experiment
5. Solve the partial and ordinary differential equations special experimental designs
6. Apply the basic concepts of Taguchi method in parameter design

UNIT I INTRODUCTION

UNIT II SINGLE FACTOR EXPERIMENTS
ANOVA rationale - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel’s test, Duncan’s Multiple Range test, Latin Square Design, Graeco-Latin Square Design, Balanced incomplete design.

UNIT III FACTORIAL EXPERIMENTS
Main and interaction effects –Two and three Factor full factorial Designs, 2 k deigns with Two and Three factors- Unreplicated design- Yate’s Algorithm

UNIT IV SPECIAL EXPERIMENTAL DESIGNS
Blocking in factorial design, Confounding of 2k design, nested design-Response Surface Methods.

UNIT V TAGUCHI TECHNIQUES
Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

TOTAL 45 PERIODS

SUGGESTED READINGS

COURSE OBJECTIVES

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.
3. To impart knowledge on various energy source
4. To provide knowledge on concepts of electric propulsion systems
5. To expose students to various drive trains for hybrid electric vehicles
6. To facilitate the understanding of the concepts of electronic converters

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  9
Configuration of Electric Vehicles, 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  9
Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Super Capacitors.

UNIT III  ELECTRIC PROPULSION  9
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  9
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  9
Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High frequency transformer based isolated charger topology, Transformer less topology.

TOTAL  45 PERIODS

SUGGESTED READINGS

2. Iqbal Husain Electric and Hybrid Vehicles: Design Fundamentals CRC Press 2010
COURSE OBJECTIVES

1. To understand the importance of the DFM approach and guidelines
2. To enrich the understanding of the selective assembly and Datum systems
3. To introduce the concepts of demonstrate true Position tolerancing theory.
4. To develop an understanding of the standard techniques and redesigning cast members using weldments and plastic component manufacturing.
5. To equip them with skills on Tolerance Charting Technique.
6. To Study and acquire knowledge of 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 DFM approach and guidelines
2. Understand the selective assembly and Datum systems
3. Demonstrate true Position tolerancing theory.
4. Understand redesigning cast members using weldments and plastic component manufacturing.
5. Demonstrate the Tolerance Charting Technique.
6. Know the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

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 normal law.

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. Datum Systems: Grouped datum 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 45 PERIODS
COURSE OBJECTIVES
1. To introduce Governing Equations of viscous fluid flows
2. To introduce numerical modeling and its role in the field of fluid flow and heat transfer
3. To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
4. To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.
5. To equip them with skills to solve convection and diffusion problems
6. To understand the importance continuity and momentum equations for different types of fluid flow

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 difference method.
5. Analyze and provide solutions for convection and diffusion problems.
6. Develop continuity and momentum equations for different types of fluid flow.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS

UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES
Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT III HEAT CONDUCTION
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

UNIT IV CONVECTION AND DIFFUSION
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.

UNIT V CALCULATION OF FLOW FIELD

TOTAL 45 PERIODS

SUGGESTED READINGS
5. BoseT.K. Jain, Numerical Fluid Dynamics, Narosa publishing House, New Delhi, 2005
COURSE OBJECTIVES
1. To give exposure to accessories and layout required for a steam power plant depending upon the requirements.
2. To study performance of steam power plant.
3. To make the student acquire sound knowledge of working of nuclear and hydel power plant.
4. To study the features of gas turbine power plant.
5. To make the student acquire sound knowledge of economics of the power plant.
6. To make the student acquire sound knowledge on renewable energy technologies and availability.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Select the accessories and layout required for a steam power plant depending upon the requirements.
2. Compute performance of steam power plant.
3. Explain the working of nuclear and hydel power plant.
5. Calculate the economics of the power plant.
6. Apply appropriate type of renewable energy technologies depending upon the application and availability.

UNIT I
INTRODUCTION TO POWER PLANTS AND BOILERS

UNIT II
STEAM POWER PLANT
Layout of Steam Power Plant - Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught – different types, Surface Condenser Types, Cooling Towers

UNIT III
NUCLEAR AND HYDEL POWER PLANTS

UNIT IV
DIESEL AND GAS TURBINE POWER PLANT

UNIT V
OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS
Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants.

TOTAL 45 PERIODS

SUGGESTED READINGS
1. Arora S.C and Domkundwar S, A course in Power Plant Engineering, Dhanpatrai Publishers, New Delhi, 2014
4. Morse Frederick T, Power Plant Engineering, Prentice Hall of India, New Delhi, 1998
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.
3. To introduce process involved in Additive manufacturing technology.
4. To understand the importance of knowledge on software’s used in additive manufacturing technology.
5. To enrich the understanding of the working of SLS and other techniques.
6. To provide an overview of additive manufacturing technology in medical field and bio stream.

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 bio stream.

UNIT I INTRODUCTION

UNIT II CAD & REVERSE ENGINEERING

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
Classification – Liquid based system – Stereolithography 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 prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TOTAL 45 PERIODS

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.
3. To explain basics of SCM and logistics
4. To impart knowledge need for inventory management
5. To expose students to value of information in SCM
6. To understand the concept of information technology involved in SCM

COURSE OUTCOMES
On completion of this course, students will learn about
1. Basics of SCM and logistics
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.

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
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.
3. To introduce the concepts of various conditions of compressible fluid flows
4. To Study and acquire knowledge on performance analysis of subsonic and supersonic inlets, combustors, afterburners and exhaust nozzles
5. To understand the concept of working of various types of rocket engines
6. To study the features of working of various types of rocket engines

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

TOTAL 45 PERIODS

(Permitted to use standard Gas Tables in the examination)

SUGGESTED READINGS
2. Rathakrishnan.E, Gas Dynamics, Prentice Hall of India, New Delhi, 2017
COURSE OBJECTIVES
- To impart knowledge of need for planning and control in various aspects.
- To develop an understanding of the standard techniques in various work study methodologies.
- To familiarize the students to understand the product and process plan.
- To introduce the concepts of a production schedule based on different facets.
- To enrich the understanding of the level of inventory
- To understand the importance the recent advancements in production planning and control.

COURSE OUTCOMES
Student will be able to
- Indicate the need for planning and control in various aspects.
- Understand various work study methodologies.
- Construct product and process plan.
- Prepare a production schedule based on different facets.
- Estimate the level of inventory
- Understand the recent advancements in production planning and control.

UNIT I INTRODUCTION

UNIT II WORK STUDY

UNIT III PRODUCT PLANNING AND PROCESS PLANNING

UNIT IV PRODUCTION SCHEDULING

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control– Purpose of holding stock– Effect of demand on inventories– Ordering procedures.
Two bin system – Ordering cycle system– Determination of Economic order quantity and economic lot size– ABC analysis– Recorder procedure– Introduction to computer integrated production planning systems– Elements of JIT Systems– Fundamentals of MRP and ERP, KANBAN system

TOTAL 45 PERIODS

SUGGESTED READINGS
1. Martand Telsang, Industrial Engineering and Production Management, S.Chand and Company, New Delhi, 2006
COURSE OBJECTIVE

1. To gain knowledge in design and material selection of various machine tools.
2. To provide an overview of regulation of speeds and feeds
3. To study the features of machine tool structures
4. To understand the importance of constructional features of machine tool structures
5. To expose students to design in machine tool structures, guide ways, power screws and spindles
6. To expose students to design spindles and spindle supports

COURSE OUTCOMES:

Upon the completion of this course the students will be able to
1. Discuss the basics machine tool drives and mechanisms
2. Get knowledge on regulation of speeds and feeds
3. Understand the importance of machine tool structures
4. Explain the constructional features of machine tool structures
5. Design in machine tool structures, guide ways, power screws and spindles
6. Design spindles and spindle supports

UNIT I INTRODUCTION TO MACHINE TOOL DRIVES AND MECHANISMS
9
Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT II REGULATION OF SPEEDS AND FEEDS
9
Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT III DESIGN OF MACHINE TOOL STRUCTURES
9

UNIT IV DESIGN OF GUIDEWAYS, POWER SCREWS AND SPINDLES
9

UNIT V DESIGN OF SPINDLES AND SPINDLE SUPPORTS
9

TOTAL 45 PERIODS

SUGGESTED READINGS
2. Chernov N, Machine Tools, Mir publishers Moscow, 1984
3. N.K. Mehta, Machine Tool Design and Numerical Control, 3e, TMH, New Delhi, 2012
COURSE OBJECTIVES
1. To understand the application of computers in various aspects of Manufacturing viz., Design, proper planning, Manufacturing cost, Layout & Material Handling system.
2. To know the application of principles of group technology in computer aided process planning.
3. To impart knowledge on working of the shop floor control
4. To Study and acquire knowledge on data collection system in FMS.
5. To familiarize the students to understand CIM architecture for practical application.
6. To expose students to generate database for computer integrated manufacturing processes.

COURSE OUTCOMES
Upon completion of this course, the student can able to
1. Implement computer integrated manufacturing concepts in industries.
2. Apply the principles of group technology in computer aided process planning.
3. Understand the working of the shop floor control
4. Implement automated data collection system in FMS.
5. Develop CIM architecture for practical application.

UNIT I INTRODUCTION

UNIT II GROUP TECHNOLOGY
Group technology– part families – Classification and coding – Approaches to computer aided process planning –variant approach and generative approaches

UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION

UNIT V OPEN SYSTEM AND DATABASE FOR CIM
Open systems–open system inter connection – manufacturing automations protocol and technical office protocol (MAP /TOP).

TOTAL 45 PERIODS

SUGGESTED READINGS
4. Radhakrishnan P and Subramanyan S , CAD/CAM/CIM, 2e, New Age International (P) Ltd, New Delhi, 2011
COURSE OBJECTIVES
1. To enable the students to gain competence in various Welding Technologies and to have in depth understanding of the weldability of metals.
2. To expose students to identify suitable reinforcement and matrix materials for preparation of composites using friction stir processing.
3. To understand the basic principle of electron beam and laser beam processes and its application.
4. To understand the weldability of cast iron and high carbon steel.
5. To provide knowledge on welding power sources.
6. To facilitate the understanding of grain growth mechanism and related properties.

COURSE OUTCOMES
At the end of the course, the student will be able to:
1. Understand solid state welding processes and applications.
2. Identify suitable reinforcement and matrix materials for preparation of composites using friction stir processing.
3. Understand basic principle of electron beam and laser beam processes and its application.
4. Understand weldability of cast iron and high carbon steel.
5. Select welding power sources.
6. Understand the importance of grain growth mechanism and related properties.

UNIT I SOLID STATE WELDING
Solid state welding: classification of solid state welding processes, Adhesive bonding, advantages and applications.

UNIT II FRICTION AND FRICTION STIR WELDING
Friction welding: Friction welding process variables, welding of similar and dissimilar materials, Defective analysis of friction welded components, Friction welding of materials with inter layer.
Friction stir welding: Processes parameters, tool geometry, welding of Aluminium alloys, Friction stir welding of Aluminum alloys and Magnesium alloys.

UNIT III ELECTRON BEAM WELDING

UNIT IV LASER BEAM WELDING
Laser Beam welding (LBW): Laser Beam welding process parameters, atmospheric effect and Laser Beam welding of steels.

UNIT V SELECTION POWER SOURCE AND WELDABILITY
Selection power source: Constant voltage and constant current power sources. Weldability of cast iron and steel: weldability studies of cast iron and steel

TOTAL 45 PERIODS

SUGGESTED READINGS
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.
5. To introduce the concepts of carbon-carbon composite for different industrial application
6. To impart knowledge on various advances in composites

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  ADVANCES IN COMPOSITES

TOTAL  45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

- To Understand the concept of SQC.
- To enrich the understanding of control charts to analyze for improving the process quality.
- To familiarize the students to understand different sampling plans
- To Understand the importance of need and types of life testing.
- To introduce the reliability of a system.
- To introduce the concepts of quality control and reliability techniques in industries.

COURSE OUTCOMES

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

- Understand the concept of SQC.
- Use control charts to analyze for improving the process quality.
- Describe different sampling plans
- Understand the need and types of life testing.
- Improve the reliability of a system.
- Implement quality control and reliability techniques in industries.

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


TOTAL 45 PERIODS

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

SUGGESTED READINGS

2. Srinath L.S., Reliability Engineering, Affiliated East west press New Delhi, 2002
COURSE OBJECTIVES
1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To provide an overview of destructive and non-destructive tests and state their applications
3. To study the features of NDT techniques for various products.
4. To expose students to skills needed for selection of appropriate NDT technique(s) for new inspection jobs
5. To understand the established NDE techniques and basic familiarity of emerging NDE techniques.
6. To facilitate the understanding of standard application area of NDET

COURSE OUTCOMES
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.

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To acquaint the student with the need and awareness of the safety concepts
3. To understand the importance of various safety techniques involved in industrial sector
4. To introduce the concepts of accident zone and prepare reports related to it.
5. To equip them with skills to conduct basic safety inspections using strategies that they have developed
6. To develop an understanding of safety monitoring

COURSE OUTCOMES
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

TOTAL 45 PERIODS

SUGGESTED READINGS
**Course Objectives**

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 provide knowledge on simple offline robot program.
6. 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**


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 Machine Vision**


**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**


**Total 45 Periods**

**Suggested Readings**