NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY
(A Unit of Nitte Education Trust (R), Mangalore)
An Autonomous Institution, Approved by UGC/AICTE/ Govt. of Karnataka and
Accredited by NBA (Tier-I) and NAAC (Grade 'A'),
Affiliated to Visvesvaraya Technological University, Belagavi
P. B. No. 6429, Yelahanka, Bengaluru-560064

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS, SCHEME OF TEACHING AND EXAMINATION

FOR I TO VIII SEMESTER B.E. UG PROGRAMME
(AUTONOMOUS SCHEME)

2014 SCHEME
VISION OF THE INSTITUTE

To provide India and the World, technical manpower of the highest academic excellence and World class by shaping our youth through holistic and integrated education of the highest quality.

MISSION OF THE INSTITUTE

To develop Nitte Meenakshi Institute of Technology through Quality, Innovative and State-of-art educational initiatives into a centre of academic excellence that will turn out youth with well-balanced personality & commitment to rich cultural heritage of India and who will successfully face the scientific and technological challenges in the fast-evolving global scenario with a high degree of credibility, integrity and ethical standards.
NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY
(A Unit of Nitte Education Trust (R), Mangalore)
An Autonomous Institution, Approved by UGC/AICTE/Govt. of Karnataka and
Accredited by NBA (Tier-I) and NAAC (Grade 'A'),
Affiliated to Visvesvaraya Technological University, Belagavi
P.B.No. 6429, Yelahanka, Bengaluru-560064

DEPARTMENT OF MECHANICAL ENGINEERING

VISION OF THE DEPARTMENT

To educate and nurture students to be proficient mechanical engineers of academic excellence in their professional career, research and entrepreneurship to fulfill the global demands of society.

MISSION OF THE DEPARTMENT

To produce mechanical engineers with sound knowledge through quality teaching-learning process with well-designed curriculum and co-curricular activities, to induce critical thinking attitude, imbibe ethical values and inculcate the use of modern tools through inter-disciplinary research and to enable students to develop entrepreneurial skills with innovative ideas gained through industry-institute interaction.
PROGRAM OUTCOMES:

Program Outcomes (POs) as identified by National Board of Accreditation (NBA), India are what the graduates of an undergraduate engineering program should be able to do at the time of graduation. The POs are discipline non-specific.

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PROGRAM EDUCATIONAL OBJECTIVES (UG PROGRAM- BE MECHANICAL ENGINEERING):

As already mentioned earlier, the under graduate mechanical engineering programme at Nitte Meenakshi Institute of Technology aims at producing mechanical engineers with sound knowledge through quality teaching learning process and well-designed curriculum. During the course of the program, they will develop attributes such as critical thinking attitude, ethical values and entrepreneurial skills. The Program Educational Objectives are evolved through deliberation process involving major stake holders namely employers, students, alumni and faculty. The three Program Educational Objectives (PEOs) of the program under consideration are listed below.

PEO-1
Graduates of Mechanical Engineering will demonstrate leadership qualities, professional ethics, communication skills and adapt current technologies through engagement in lifelong learning to meet the societal requirements.

PEO-2
Graduates of Mechanical Engineering will pursue higher studies and excel in multi-disciplinary research activities.

PEO-3
Graduates of Mechanical Engineering will take up responsible roles in industry; will be outstanding in their professional career or as an entrepreneur.
PROGRAM SPECIFIC OUTCOMES (UG PROGRAM- BE MECHANICAL ENGINEERING):

**PSO-1**
Possess Skill Set to design and develop newer materials, Mechanical systems and processes through Multidisciplinary approach suitable for societal benefits.

**PSO-2**
Capability to apply the concepts learned and experience gained through Internships and Innovative Research projects in the execution of the projects for a range of emerging Industrial applications
**PROGRAM CURRICULUM**

**Detailed Process Flow of Developing the Program Curriculum:**

- **Inputs**

  - **DUGC** (Proposed Curriculum)
    - Comprising Senior faculty members from different streams
      - Identify the Relevant Course & its Contents

  - Develop Course Outcomes (CO) & Course Contents, Teaching Learning Process, Assessment Strategy

  - Course Instructors -> Stream Coordinator

  - Program Coordinator

  - **DUGC** (Proposed Curriculum)

  - Curriculum

  - Board of Studies (BoS)
    - APPROVED
    - Inputs: Industry Experts, Academicians (External), Alumni

  - Academic Council and Governing Council
    - APPROVED
    - REVISE CURRICULUM MODIFIED

  - **PROGRAMME CURRICULUM**
    - Curriculum Structure
    - Teaching-Learning Strategy
    - Assessment Strategy

  - Implementation
Process of revising the curriculum:

1. Analyze the attainment results of COs, POs, PSOs
2. Provide countermeasures to improve the attainment levels of COs, POs, and PSOs

Program Assessment Committee (PAC)
Comprising Program Coordinator and Senior faculty members from different streams

- DUGC, DAC & RoS
  - Approved
  - Modify
  - Approved

- Academic Council and Governing Council
  - Modify
  - Approved

Programme Curriculum
- Curriculum Structure
- Teaching Learning Strategy
- Assessment Strategy

Direct & Indirect Assessments
- CIE, SEE, Surveys

Attainment Results for COs, POs, PSOs

- Revise any of the following:
  1. Curriculum
  2. Teaching Learning process
  3. Assessment Strategy

- Result Satisfactory?
  - NO
  - YES

Implement and set higher target

- AICTE, UGC, Industry Requirement, Reputed Institutes (IISC, IITs, NITs)
- Professional Bodies such as ASME, JSME etc
- Vision & Mission, POs, PSOs, & PEDs
Various Committees Involved in Framing the Programme Curriculum and their Roles and Responsibilities (Steps involved in the development of the curriculum):

**Course Instructors**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Develop and review the course outcomes in consultation with stream co-ordinator.</td>
</tr>
<tr>
<td>2</td>
<td>Course outcomes mapping with program outcomes.</td>
</tr>
<tr>
<td>3</td>
<td>To evolve teaching and learning methods(\rightarrow)Delivery Methods, Assessment Methods, RUBRICS development etc</td>
</tr>
<tr>
<td>4</td>
<td>Get student feedback to improve the effectiveness of the teaching learning process.</td>
</tr>
<tr>
<td>5</td>
<td>To design and conduct the course exit survey.</td>
</tr>
<tr>
<td>6</td>
<td>To analyse the course attainment results in consultation with stream co-ordinators and provide the suggestions for continuous improvement</td>
</tr>
</tbody>
</table>

**Stream Co-Ordinator**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Co-ordinating the activities of the particular stream</td>
</tr>
<tr>
<td>2</td>
<td>Interact with course Instructors &amp; Program co-ordinators</td>
</tr>
<tr>
<td>4</td>
<td>To analyse the course attainment results in consultation with stream co-ordinators and provide the suggestions for continuous improvement</td>
</tr>
<tr>
<td>5</td>
<td>Interacting with DUGC, BOS, BOE and IQAC.</td>
</tr>
</tbody>
</table>

**Programme Co-Ordinator**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initiation of Program outcomes</td>
</tr>
<tr>
<td>2</td>
<td>Co-ordinating the activities of the particular program</td>
</tr>
<tr>
<td>3</td>
<td>Interact with Course Instructors &amp; Stream Co-ordinators</td>
</tr>
<tr>
<td>4</td>
<td>Designing the questionnaires for Alumni and Employer Survey.</td>
</tr>
<tr>
<td>5</td>
<td>Designing the questionnaires for Program Exit Survey.</td>
</tr>
<tr>
<td>6</td>
<td>Interacting with DUGC, BOS, BOE and IQAC.</td>
</tr>
<tr>
<td>7</td>
<td>To analyse the program attainment results and provide the measures for continuous improvement</td>
</tr>
</tbody>
</table>

**DUGC**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To monitor the conduct of all undergraduate courses of the department</td>
</tr>
<tr>
<td>2</td>
<td>To ensure academic standard and excellence of the courses offered by the department.</td>
</tr>
<tr>
<td>3</td>
<td>To oversee the evaluation of each of the students in a class, for each of the courses.</td>
</tr>
<tr>
<td>4</td>
<td>To develop the curriculum for undergraduate courses offered by the department and recommend the same to the BOS.</td>
</tr>
<tr>
<td>5</td>
<td>Moderation (only if and when found necessary) in consultation with the course instructor and approval of the finalized grades, before submission of the same to the office of the Dean</td>
</tr>
<tr>
<td>6</td>
<td>To consolidate the registration of the student and communicate to course Instructors &amp; Dean.</td>
</tr>
</tbody>
</table>
To conduct performance appraisal of course instructors.

To provide feedback of the performance appraisal to the course Instructor and concerned authorities.

To consider any matter related to the undergraduate programme of the Department.

In cases where a course is taught by more than one faculty member, or by different faculty members for different sections of students, DUGC shall coordinate (only in case of need) among all such faculty members regarding the teaching and evaluation of such courses.

To conduct at least two meetings each semester and send the Resolutions of the meeting to Dean, and also to maintain a record of the same in the department.

Any appropriate responsibility or function assigned by the AC or the Chairman of the AC or the BOS.

**Board of Studies (BOS)**

1. To consider the recommendations of the DUGC on matters relating to under-graduate Programme and to make suitable recommendations to the AC.

2. To approve curriculum framed/ revised by DUGC for the undergraduate courses of study.

3. To ensure that all norms and regulations pertaining to undergraduate programme are strictly followed.

4. To make periodic review of these Regulations pertaining to undergraduate Programme and to recommend to the AC any modifications thereof.

5. To review the academic performances and make suitable recommendations to the AC regarding declaration of results, award of degree etc.

6. To recommend to the AC, the award of stipends, scholarships, medals and prizes etc.,

7. To draw up general time table for the undergraduate course and finalise the UG academic calendar to be put up to the AC for approval.

8. To constitute a sub-committee for monitoring the implementation of the academic curriculum provided by the BOS and to provide guidance in curriculum assessment, evaluation process.

9. To conduct at least one meeting each semester and send the Resolutions to the Chairman of the AC, and also to maintain a record of the same in the office of the Dean.

10. Any appropriate responsibility or function assigned by the AC/GC or the Chairman of the AC/GC.

**Academic Council (AC)**

1. Scrutinize and approve the proposals, with or without modifications, of the Boards of Studies with regards to
   Courses of study,
   Academic regulations,
   Curricula,
   Scheme,
   Syllabi and modifications thereof,
   Instructional and evaluation arrangements,
   Methods,
   Procedures
   They shall have the right to return the matter for reconsideration to the Board of Studies concerned or reject it, after giving reasons to do so.

2. Adopt the Regulations regarding the admission of students consistent with University/Government norms to different programmes of study in the College.

3. Frame Regulations consistent with University norms for conduct of examinations and initiate measures for improving the quality of teaching, student’s evaluation and student advisory system in the College.
Programme specific requirements as mandated by professional bodies such as ASME & JSME:

Philosophy of Curriculum Design (Breadth v/s Depth):
Mechanical Engineering Streams:

Organizational chart of stream co-ordinators & course instructors:

- **Program Coordinator**: Dr. Desai Gowda (Professor)
- **Dr. P B Shetty**: Professor
- **Dr. Sudheer Reddy**: Professor & Head
- **Dr. Kiran Aithal S**: Professor
- **Course Instructors**
  - **(Thermal)**
    - Dr. Sekhar Majumdar
    - Dr. Madhusudan
  - **(Material)**
    - Dr. P G Mukunda
  - **(Manufacturing)**
    - Dr. Vijay Kumar R
    - Kabadi (Professor)
  - **(Management)**
    - Mr. Ravindranath
    - Asst Professor

**Course Instructors**

- Ramesh Babu
- Sunil Kumar
- Harish N
- Hamritha
- Chethan Reddy
- Hritesh Shetty
- Sandeep G M
- Mahadeva Prasad
- Chethan S
- Hritesh Shetty
- Kotresh
- Ravi Prakash
- Manjunath H N
- Chethan K S
- Arunkumar G L
- Pavan K N
- Krupa R
- Rachith S N
- Ojha H N
- Niveditha
- Harish Kumar L
- Muralidhara D M
- Girish Prasad M
- Dr. B K Muralidhara
- Srim Mukund
- Shri Pratap Singh
- Avinash L
- Praveen B A
- Nithan Aithal
- Pramod S
- Dr. Seetharam
- Hemanth Kumar N
- Surendra B S
- Prashanth N
- Suresh K R
- Rudramalk M
- Praveen Kumar S
- Sachin B
- Ms. Vadhavvini
- Vikram K
- Srikanth Prabhu
- Smruthi Rekha Sen
- Rashmi V
Weightage of streams based on their credits offered in the Department:

![Pie chart showing weightage distribution]

Percentage of Distribution of Course Components Based on Number of Credits:

![Pie chart showing component distribution]
### SEMESTER: III

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Type</th>
<th>Teaching Dept.</th>
<th>Teaching Hours/week</th>
<th>Examination Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14MAT31</td>
<td>Engineering Mathematics-III</td>
<td>BS</td>
<td>MAT</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>2</td>
<td>14ME32</td>
<td>Material Science and Metallurgy</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>3</td>
<td>14ME33</td>
<td>Basic Thermodynamics</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>4</td>
<td>14ME34</td>
<td>Mechanics of Materials</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>5</td>
<td>14ME35</td>
<td>Manufacturing Technology</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>6</td>
<td>14ME36</td>
<td>Computer Aided Machine Drawing</td>
<td>PC</td>
<td>MECH</td>
<td>2 - 4</td>
<td>50 50 100</td>
</tr>
<tr>
<td>7</td>
<td>14MEL37</td>
<td>Manufacturing Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
</tr>
<tr>
<td>8</td>
<td>14MEL38</td>
<td>Metallography &amp; Material Testing Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SEMESTER: IV

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Type</th>
<th>Teaching Dept.</th>
<th>Teaching Hours/week</th>
<th>Examination Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14MAT41</td>
<td>Engineering Mathematics-IV</td>
<td>BS</td>
<td>MAT</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>2</td>
<td>14ME42</td>
<td>Engineering Metrology and Measurements</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>3</td>
<td>14ME43</td>
<td>Applied Thermodynamics</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>4</td>
<td>14ME44</td>
<td>Theory of Machines-I</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>5</td>
<td>14ME45</td>
<td>Fluid Mechanics</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>6</td>
<td>14ME46</td>
<td>Advanced Manufacturing Technology</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
</tr>
<tr>
<td>7</td>
<td>14MEL47</td>
<td>Heat Power Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
</tr>
<tr>
<td>8</td>
<td>14MEL48</td>
<td>Metrology and Measurement Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER: V

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Type</th>
<th>Teaching Dept</th>
<th>Teaching Hours/week</th>
<th>Examination</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14ME51</td>
<td>Design of Machine Elements-I</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>14ME52</td>
<td>Theory of Machines-II</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>14ME53</td>
<td>Finite Element Methods</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>14ME54</td>
<td>Fluid Machinery</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>14ME55</td>
<td>CAD/CAM/CIM</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>14MEE56X</td>
<td>PROGRAM ELECTIVE-A</td>
<td>PE</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>14MEL57</td>
<td>Flow measurement &amp; Fluid Machinery Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>14MEL58</td>
<td>Machine Shop</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**TOTAL** 400 400 800 27

### SEMESTER: VI

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Type</th>
<th>Teaching Dept</th>
<th>Teaching Hours/week</th>
<th>Examination</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14ME61</td>
<td>Design of Machine Elements-II</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>14ME62</td>
<td>Mechanical Vibrations</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>14MEH63</td>
<td>Operations Research</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>14MEL64</td>
<td>Simulation Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 4</td>
<td>50 50 100</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>14MEE65X</td>
<td>PROGRAM ELECTIVE-B</td>
<td>PE</td>
<td>MECH</td>
<td>- - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>14MEO66X</td>
<td>OPEN ELECTIVE-C</td>
<td>OE</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>14MEL67</td>
<td>Design Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>14MEL68</td>
<td>Finite Element Analysis lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>14MEP69</td>
<td>Identification of project (Phase-I)</td>
<td>PP</td>
<td>MECH</td>
<td>- - 4</td>
<td>- - - -</td>
<td>-</td>
</tr>
</tbody>
</table>

**TOTAL** 400 400 800 24
### SEMESTER: VII

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Type</th>
<th>Teaching Dept.</th>
<th>Teaching Hours/week</th>
<th>Examination</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14ME71</td>
<td>Control Engineering</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>14ME72</td>
<td>Hydraulics &amp; Pneumatics</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>14ME73</td>
<td>Heat Transfer</td>
<td>PC</td>
<td>MECH</td>
<td>4 1 -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>14MEH74</td>
<td>Entrepreneurship development management &amp; IPR</td>
<td>HU</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>14MEE75X</td>
<td>PROGRAM ELECTIVE-D</td>
<td>PE</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>14MEO76X</td>
<td>OPEN ELECTIVE-E</td>
<td>OE</td>
<td>MECH</td>
<td>3 - -</td>
<td>50 50 100</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>14MEL77</td>
<td>CIM &amp; Automation Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>14MEL78</td>
<td>Heat Transfer Lab</td>
<td>PC</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>1.5</td>
</tr>
<tr>
<td>9</td>
<td>14MEP791</td>
<td>Internship</td>
<td>PP</td>
<td>MECH</td>
<td>- - 3</td>
<td>50 50 100</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>14MEP792</td>
<td>Project Preliminaries/ Seminar</td>
<td>PP</td>
<td>MECH</td>
<td>- - 2</td>
<td>50^ - -</td>
<td>-</td>
</tr>
</tbody>
</table>

^50 will be carried forward to major project as a CIE component for 8th semester

### TOTAL

<table>
<thead>
<tr>
<th>L#</th>
<th>T#</th>
<th>P#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

900  27

### SEMESTER: VIII

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Type</th>
<th>Teaching Dept.</th>
<th>Teaching Hours/week</th>
<th>Examination</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14ME81</td>
<td>Composite Materials</td>
<td>PC</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>14MEE82X</td>
<td>Program ELECTIVE-F</td>
<td>PE</td>
<td>MECH</td>
<td>4 - -</td>
<td>50 50 100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>14MEP84</td>
<td>Project Work</td>
<td>PP</td>
<td>MECH</td>
<td>- - 26</td>
<td>50+50^ 100</td>
<td>14</td>
</tr>
</tbody>
</table>

^50 will be carried forward to major project as a CIE component for 8th semester

### TOTAL

<table>
<thead>
<tr>
<th>L#</th>
<th>T#</th>
<th>P#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

400  22
### PROGRAM ELECTIVE-A

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SUBJECT CODE</th>
<th>SUBJECT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14MEE561</td>
<td>Theory of Elasticity</td>
</tr>
<tr>
<td>2</td>
<td>14MEE562</td>
<td>Internal Combustion Engines</td>
</tr>
<tr>
<td>3</td>
<td>14MEE563</td>
<td>Non-Traditional Machining</td>
</tr>
<tr>
<td>4</td>
<td>14MEE564</td>
<td>Energy Engineering</td>
</tr>
<tr>
<td>5</td>
<td>14MEE565</td>
<td>Welding Technology</td>
</tr>
<tr>
<td>6</td>
<td>14MEE566</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>7</td>
<td>14MEE567</td>
<td>Engineering Economics</td>
</tr>
<tr>
<td>8</td>
<td>14MEE568</td>
<td>Solar Energy</td>
</tr>
<tr>
<td>9</td>
<td>14MEE569</td>
<td>Industrial Engineering &amp; Management</td>
</tr>
<tr>
<td>10</td>
<td>14MEE570</td>
<td>Automotive Engineering-I</td>
</tr>
</tbody>
</table>

### PROGRAM ELECTIVE-B

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SUBJECT CODE</th>
<th>SUBJECT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14MEE651</td>
<td>Tool Design</td>
</tr>
<tr>
<td>2</td>
<td>14MEE652</td>
<td>Theory of Plasticity and Metal Forming Processes</td>
</tr>
<tr>
<td>3</td>
<td>14MEE653</td>
<td>Refrigeration &amp; Air Conditioning</td>
</tr>
<tr>
<td>4</td>
<td>14MEE654</td>
<td>Operations Management</td>
</tr>
<tr>
<td>5</td>
<td>14MEE655</td>
<td>Alternate Fuels</td>
</tr>
<tr>
<td>6</td>
<td>14MEE656</td>
<td>Total Quality Management</td>
</tr>
<tr>
<td>7</td>
<td>14MEE657</td>
<td>Statistical Quality Control</td>
</tr>
<tr>
<td>8</td>
<td>14MEE658</td>
<td>Renewable Energy Resources</td>
</tr>
<tr>
<td>9</td>
<td>14MEE659</td>
<td>Automotive Engineering-II</td>
</tr>
<tr>
<td>10</td>
<td>14MEE660</td>
<td>Industrial Robotics</td>
</tr>
</tbody>
</table>

### OPEN ELECTIVE-C

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SUBJECT CODE</th>
<th>SUBJECT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14MEO661</td>
<td>Smart Materials</td>
</tr>
<tr>
<td>2</td>
<td>14MEO662</td>
<td>Solar Energy</td>
</tr>
<tr>
<td>3</td>
<td>14MEO663</td>
<td>Industrial Engineering &amp; Management</td>
</tr>
<tr>
<td>4</td>
<td>14MEO664</td>
<td>Non-Destructive Testing</td>
</tr>
<tr>
<td>5</td>
<td>14MEO665</td>
<td>Automotive Technology</td>
</tr>
<tr>
<td>6</td>
<td>14MEO666</td>
<td>Project Management</td>
</tr>
<tr>
<td>7</td>
<td>14MEO667</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>8</td>
<td>14MEO668</td>
<td>Finite Element Method</td>
</tr>
<tr>
<td>9</td>
<td>14MEO669</td>
<td>Nano Technology</td>
</tr>
<tr>
<td>10</td>
<td>14MEO670</td>
<td>Innovative Product Design &amp; Development</td>
</tr>
<tr>
<td>11</td>
<td>14MEO671</td>
<td>Total Quality Management</td>
</tr>
</tbody>
</table>
# Scheme and Syllabus for I to VIII SEM BE Mechanical Engg - 2014 Scheme

## Program Elective-D

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SUBJECT CODE</th>
<th>SUBJECT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14MEE751</td>
<td>Design Drawing Technology</td>
</tr>
<tr>
<td>2</td>
<td>14MEE752</td>
<td>Tribology</td>
</tr>
<tr>
<td>3</td>
<td>14MEE753</td>
<td>Elements of Aeronautics</td>
</tr>
<tr>
<td>4</td>
<td>14MEE754</td>
<td>Biomass Energy Systems</td>
</tr>
<tr>
<td>5</td>
<td>14MEE755</td>
<td>Gas Turbines and Propulsion</td>
</tr>
<tr>
<td>6</td>
<td>14MEE756</td>
<td>Smart Materials</td>
</tr>
<tr>
<td>7</td>
<td>14MEE757</td>
<td>Project Management</td>
</tr>
<tr>
<td>8</td>
<td>14MEE758</td>
<td>Non-Destructive Testing</td>
</tr>
<tr>
<td>9</td>
<td>14MEE759</td>
<td>Computational Fluid Dynamics</td>
</tr>
<tr>
<td>10</td>
<td>14MEE760</td>
<td>Innovative Product Design &amp; Development</td>
</tr>
</tbody>
</table>

## Open Elective-E

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SUBJECT CODE</th>
<th>SUBJECT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14MEO761</td>
<td>Non-Traditional Machining</td>
</tr>
<tr>
<td>2</td>
<td>14MEO762</td>
<td>Organizational Behavior</td>
</tr>
<tr>
<td>3</td>
<td>14MEO763</td>
<td>Maintenance &amp; Reliability Engineering</td>
</tr>
<tr>
<td>4</td>
<td>14MEO764</td>
<td>Marketing Management</td>
</tr>
<tr>
<td>5</td>
<td>14MEO765</td>
<td>Statistical Quality Control</td>
</tr>
<tr>
<td>6</td>
<td>14MEO766</td>
<td>Renewable Energy Resources</td>
</tr>
<tr>
<td>7</td>
<td>14MEO767</td>
<td>Engineering Economics</td>
</tr>
<tr>
<td>8</td>
<td>14MEO768</td>
<td>Industrial Robotics</td>
</tr>
</tbody>
</table>

## Program Elective-F

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SUBJECT CODE</th>
<th>SUBJECT NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14MEE821</td>
<td>Aircraft Structures</td>
</tr>
<tr>
<td>2</td>
<td>14MEE822</td>
<td>Experimental Stress Analysis</td>
</tr>
<tr>
<td>3</td>
<td>14MEE823</td>
<td>Foundry Technology</td>
</tr>
<tr>
<td>4</td>
<td>14MEE824</td>
<td>Design for Manufacture</td>
</tr>
<tr>
<td>5</td>
<td>14MEE825</td>
<td>Introduction to Aerodynamics</td>
</tr>
<tr>
<td>6</td>
<td>14MEE826</td>
<td>Materials selection in mechanical design</td>
</tr>
<tr>
<td>7</td>
<td>14MEE827</td>
<td>Organizational Behavior</td>
</tr>
<tr>
<td>8</td>
<td>14MEE828</td>
<td>Micro Electro-Mechanical Systems</td>
</tr>
<tr>
<td>9</td>
<td>14MEE829</td>
<td>Marketing Management</td>
</tr>
<tr>
<td>10</td>
<td>14MEE830</td>
<td>Nano Technology</td>
</tr>
<tr>
<td>11</td>
<td>14MEE831</td>
<td>Maintenance &amp; Reliability Engineering</td>
</tr>
</tbody>
</table>
### 2014- Curriculum Structure (Suggested)

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>BS. SC</th>
<th>ENGG. CORE</th>
<th>PROG. CORE</th>
<th>Prog. ELE</th>
<th>OPE. ELE</th>
<th>HUM</th>
<th>PROJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.5</td>
<td>13.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>13.5</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>23</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>13</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>15</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>27</td>
<td>99</td>
<td>16</td>
<td>6</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>SEM</td>
<td>Sl.No</td>
<td>Subject Title</td>
<td>Subject Code</td>
<td>Credits</td>
<td>Total Credits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>---------------</td>
<td>--------------</td>
<td>---------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I &amp; II</td>
<td>1</td>
<td>Elements of Mechanical Engineering &amp; Workshop</td>
<td>17ME14</td>
<td>5</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Computer Aided Engineering Drawing</td>
<td>17CED14</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>1</td>
<td>Engineering Mathematics-III</td>
<td>14MAT31</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Material Science and Metallurgy</td>
<td>14ME32</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Basic Thermodynamics</td>
<td>14ME33</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Mechanics of Materials</td>
<td>14ME34</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Manufacturing Technology</td>
<td>14ME35</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Computer Aided Machine Drawing</td>
<td>14ME36</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Manufacturing Lab</td>
<td>14ME37</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Metallurgy and material Testing Lab</td>
<td>14ME38</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
<td>Engineering Mathematics-IV</td>
<td>14MAT41</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Engineering Metrology and Measurements</td>
<td>14ME42</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Applied Thermodynamics</td>
<td>14ME43</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Theory of Machines-I</td>
<td>14ME44</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Fluid Mechanics</td>
<td>14ME45</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Advanced Manufacturing Technology</td>
<td>14ME46</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Heat Power Lab</td>
<td>14ME47</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Metrology and Measurement Lab</td>
<td>14ME48</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>1</td>
<td>Design of Machine Elements-I</td>
<td>14ME51</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Theory of Machines-II</td>
<td>14ME52</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Finite Element Methods</td>
<td>14ME53</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Fluid Machinery</td>
<td>14ME54</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>CAD/CAM/CIM</td>
<td>14ME55</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Flow measurement &amp; Fluid Machinery Lab</td>
<td>14MEL57</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Machine Shop</td>
<td>14MEL58</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>1</td>
<td>Design of Machine Elements-II</td>
<td>14ME61</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Mechanical Vibrations</td>
<td>14ME62</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Operations Research</td>
<td>14ME63</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Simulation Lab</td>
<td>14ME64</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Design Lab</td>
<td>14MEL67</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Finite Element Analysis lab</td>
<td>14MEL68</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Identification of project (Phase-I)</td>
<td>14MEP69</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>1</td>
<td>Control Engineering</td>
<td>14ME71</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Hydraulics &amp; Pneumatics</td>
<td>14ME72</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Heat Transfer</td>
<td>14ME73</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Entrepreneurship development &amp; IPR</td>
<td>14MEHT4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Non-Traditional Machining/ Organizational Behavior/ Maintenance &amp; Reliability Engineering/ Marketing Management/ Statistical Quality Control/ Renewable Energy Resources/ Engineering Economics/ Industrial Robotics</td>
<td>14MEO761/14MEO762/14MEO763/14MEO764/14MEO765/14MEO766/14MEO767/14MEO768</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>CIM &amp; Automation Lab</td>
<td>14MEL77</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Heat Transfer Lab</td>
<td>14MEL78</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Internship</td>
<td>14MEP791</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Project Preliminaries/ Seminar</td>
<td>14MEP792</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>1</td>
<td>Composite Materials</td>
<td>14ME81</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Aircraft Structures/ Experimental Stress Analysis/ Foundry Technology/ Design for Manufacturing/ Introduction to Aerodynamics/ Materials selection in mechanical design/ Organizational Behavior/ Micro Electro-Mechanical Systems/ Marketing Management/ Nano Technology/ Maintenance &amp; Reliability Engineering</td>
<td>14ME821/14ME822/14ME823/14ME824/14ME825/14ME826/14ME827/14ME828/14ME829/14ME830/14ME831</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Project Work</td>
<td>14MEP84</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

ELEMENTS OF MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
<th>Hours/Week</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Course type</th>
</tr>
</thead>
<tbody>
<tr>
<td>17EME14/24</td>
<td>05</td>
<td>4+0+2 (L+T+P)</td>
<td>50</td>
<td>50</td>
<td>Engg. Core</td>
</tr>
</tbody>
</table>

Course outcomes:

Students will be able to

1. Explain thermodynamic laws, steam properties, working principles of IC engines, refrigeration and air conditioning.
2. Describe energy conversion through turbo machinery and power transmission system.
3. Explain machine tools and its operations, do the joining and sheet metal operations.
4. Solve simple problems related to the steam properties, IC engines, and drives.
5. Distinguish characteristics of different robot configurations and various engineering materials.

UNIT I

10 hours

Thermodynamics: Basic concepts of thermodynamics, First and Second laws of thermodynamics, thermodynamic cycles (Carnot cycle, Rankine cycle, Otto cycle, Diesel cycle, Brayton cycle).

Steam: Formation, types, properties-Specific Volume, Enthalpy and Internal energy (Simple numerical on properties of steam).

UNIT II

10 hours


Internal Combustion Engines: Classification, I.C. Engines parts and terminology, principle and operation of 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines with P-V diagrams. Performance parameters: indicated power, brake power, friction power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, specific fuel consumption, simple numerical problems.

UNIT III

10 hours


UNIT IV

10 Hours


UNIT V

12 hours

Belt drives: Open & crossed belt drives, Definitions- slip, creep, velocity ratio, derivations for length of belt in open and crossed belt drive, ratio of tension in flat belt drives, advantages and disadvantages of V belts, simple numerical problems on length of belt, ratio of tension and power transmission.

Gear drives: Types--spur, helical, bevel, worm, and rack and pinion. Velocity ratio, advantages and disadvantages over belt drives, Simple numerical problems on velocity ratio.

Workshop Lab
Fitting: Two Fitting models.  

Development and sheet metal work: Models: Funnel, Tray, Transition Piece (Circular to hexagon/Pentagon, circular to square, square to a rectangle) (03 models).  

Welding: Soldering, Brazing and Welding: Definitions, classification and method of soldering, Brazing and welding. Differences between soldering, brazing and Welding 

Butt Joint, Lap joint, T-Joint, V-Joint (with edge preparations) models have to be prepared with Calculation of electrode length required for welding.

Demonstration:  
a) Lathe Operations  
b) Milling Operations  
c) Drilling, Reaming, Tapping  
d) Working principle of Pelton wheel  
e) Working principle of Francis Turbine  
f) Working principle of Compressor  
g) TIG Welding  
h) Performance of IC Engine  
i) Working principle car Air conditioner

Text Books:

Reference Books:

Assessment Method:  
CIE:  
1. Three internals tests (each 30 marks) are conducted, average of best two tests marks will be considered.  
2. Workshop to be evaluated for 20 marks

SEE:  
1. Two Questions are to be set from each unit, carrying 20 Marks each.  
2. Students have to answer 5 questions selecting one full question from each unit.

Course Articulation Matrix:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correlation Level

3 3 2 2 1
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

COMPUTER AIDED ENGINEERING DRAWING

Sub Code : 17CED14/24
Credits : 4
Hours/Week : 2+0+4 (L+T+P)
Total hours : 78
Exam Hours : 03
CIE Marks : 50
SEE Marks : 50
Course type : Engg. Core

Expected Course Outcomes:
1. Students will be able to apply the concept of theory of orthographic projection in solving problems of points and lines.
2. Students will be able to demonstrate and project the planes for different positions.
3. Students will be able to demonstrate and project the solids for different positions.
4. Students will be able to improve their visualization skills so that they can apply these skills to develop a sketch into an isometric and section the solids, draw the true shape of the section.
5. Students will be able to demonstrate and sketch the drawings using software.

UNIT 1
Introduction to Computer Aided Sketching: Introduction, Drawing instruments and their uses, BIS Conventions, Lettering, Dimensioning, geometrical constructions and freehand practicing.
Introduction to software, commands used for engineering drawing.

UNIT 2
Orthographic Projections
Introduction – Planes of projection, reference line, and conventions employed.
Projection of Points - in all the four quadrants.
Projection of straight Lines (First angle projection) - True and apparent lengths, true and apparent Inclinations to reference planes, application problems (Chimney, Tripod, Flag post, Room problems) Orthographic projection of Plane surfaces (First angle projection)
Introduction, projection of triangle, square, rectangle, pentagon, hexagon and circular lamina.

UNIT 3
Projections of Solids
Introduction, Projections of right regular prisms, pyramids, cylinder, cone and cube in different positions (Inclined to both HP and VP. No problems on octahedrons and combination of solids).

UNIT 4
Sections of Solids
Introduction to truncation and frustum, Section of solids like prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to HP and perpendicular to VP–true shapes of sections.
Isometric Projection
Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projections of Tetrahedron, hexahedron (cube), right regular prisms, Pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of two solids).

Text Books:

Reference Books:
Assessment Method:

CIE:
1. Three internals tests (each 30 marks) are conducted, average of best two test marks will be considered.
2. Submission of drawing sheets/printouts will carry 10 marks.
3. Two written Assignment / Assignment based tests / Surprise tests will be conducted and evaluated for 10 marks. The average of these two will be considered.

SEE:
1. SEE Question paper will consists of 3 parts
   - Part A – Unit 2 for 40 Marks – Only sketching.
   - Part B – Unit 3 for 40 Marks – Sketching (40% weightage) and Computer aided drafting(60% weightage)
   - Part C – Unit 4 for 20 Marks – Computer aided drafting

Course Articulation Matrix:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Students understand that any periodic function can be converted to harmonic using trigonometric series and also learn to trace different periodic functions.

2. Students learn the importance of integral transforms and their applications

3. Students will be able to understand importance of probability distributions

4. Students learn the concept and applications of calculus of variations

5. Students learn the concept of sampling and testing of hypothesis

UNIT-I

Calculus of Variation: Introduction, Functional, Euler’s equation, Solution to Euler’s equation, geodesics, isoperimetric problems, Rayleigh Ritz method, Galerkin’s method, Hamilton’s principles, Lagrange’s equations

UNIT-II

Fourier series: Euler’s formulae, Dirichlet’s conditions for Fourier series expansion, change of interval, Even and odd function, half range series. Practical harmonic analysis.

UNIT – III

Laplace Transforms: Definition, Transforms of standard functions, Transforms of \( e^{at} f(t), t^n f(t), \frac{f(t)}{t} \), Laplace transforms of derivatives and integrals, Laplace transforms of periodic functions, unit step function, Dirac delta function. Inverse Laplace transforms, convolution theorem, solutions of 1st and 2nd order ODE using Laplace transforms. 21.1-21.15 (Text book 1).

UNIT – IV

Probability distributions-
(Recap of Definition of probability, addition theorem, conditional probability, Baye’s theorem) Random variables – discrete and continuous, Probability distribution – continuous and discrete, probability density function, cumulative density function, mean, Expectation, variance.

UNIT – V

Sampling Theory – Population and sample, sampling with and without replacement, population parameters, sample statistics, Sampling distribution of means, proportions, sample mean and variance

Pre-requisites:
The student should have studied Maths I and Maths-II.

Course Assessment Method:
CIE -50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
MATERIAL SCIENCE AND METALLURGY

Sub Code : 14ME32
Credits : 03
Hours/Week : 4+0+0
CIE : 50
Total Hours : 38
SEE : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Identify the materials based on bravais lattices of metals.
2. Interpret the Binary phase diagrams of various metallurgical operations.
3. Analyze the creep and fatigue failure mechanisms in various materials.
4. Modify the properties of materials through an appropriate heat treatment operation.
5. Assess the mechanical behavior of materials by means of stress strain curves.

UNIT I
Materials: Classification crystals, crystal systems, bravais lattices of metals, indices of planes and directions. Atomic packing factor, defects in crystals.
Macro and Microstructure of cast metal. Solidification nucleation and growth of grains and crystals, grain size control.
Mechanical Behavior: Tensile testing, stress-strain diagrams of brittle and ductile materials, linear and non-linear elastic behavior. Mechanical properties of materials.
08 Hours

UNIT II
08 Hours

UNIT III
08 Hours

UNIT IV
06 Hours

UNIT V
08 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be
considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE- 50 Marks**
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

**Text Book**

**Reference Books**

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

BASIC THERMODYNAMICS

Sub Code : 14ME33
Hours/Week : 4+1+0
Total Hours : 48
Exam Hours : 03

Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Define the concepts of thermodynamic systems and state Gas laws and Laws of thermodynamics
2. Describe the meaning of thermodynamic properties and derive the heat and work expressions for various thermo mechanical systems-
3. Apply the laws of thermodynamics, concepts of entropy, availability and exergy to evaluate the performance of thermal systems.
4. Differentiate the real gases from ideal gases to calculate the properties of real, ideal gases and gas mixtures undergoing various thermodynamic processes.
5. Draw and interpret the properties of pure substances on various property diagrams such as P-V, P-T, T-S, H-S to explain the feasibility of a thermodynamic process.

UNIT I

Basic Concepts and Definitions:
Thermodynamics-definition and scope, engineering thermodynamics definition, applications of engineering thermodynamics, macroscopic and microscopic approaches, types of system-open, closed, isolated, homogeneous and heterogeneous systems, control volume, thermodynamic properties-definition, types-intensive and extensive properties, thermodynamic state- state point, state diagram, path and process-quasistatic process, cyclic and noncyclic processes, thermodynamic equilibrium-definition, thermal, mechanical and chemical equilibriums, adiabatic and diathermic walls. Zeroth law of thermodynamics, temperature concept, temperature measurement, international fixed points, scales, problems on temperature scales.

Work and Heat:
Definition of work in mechanics and its limitations, thermodynamic definition of work, examples, sign convention, displacement work-displacement work for various thermodynamic processes through p-v diagrams, other forms of work- shaft work, electrical work, magnetization work, surface tension work, stretching work, and flow work. Heat-definition, units, sign convention, heat and work path functions, similarities and dissimilarities, problems.

10 Hours

UNIT II

First Law of Thermodynamics:
Joule’s experiment, equivalence if heat and work, statement of first law of thermodynamics applied to cyclic and non-cyclic processes, PMMK-I, energy as a property, modes of energy, enthalpy, specific heat-definition, specific heat at constant pressure and constant volume, particular and universal gas constants, first law applied to thermodynamics processes, problems.

Extension of first law to control volume, steady flow energy equation-applications, unsteady processes-filling and evacuation of vessels, problems.

10 Hours

UNIT III

Second Law of Thermodynamics:
Limitations of first law of thermodynamics, thermodynamic cycle, mechanical cycle, devices converting heat to work in thermodynamic and mechanical cycles, heat engine, devices converting work into heat in thermodynamic cycle, heat pump, COP, reversed heat engine, Kelvin-Planck and Clausius statements of II law of thermodynamics, PMMK-II, equivalence of two statements, reversible and irreversible processes, factors that make processes irreversible, Carnot cycle, corollaries of Carnot theorem, thermodynamic and absolute temperature scales, problems.

Entropy:
Clausius inequality, Clausius theorem, entropy-definition, a property, principle of increase of entropy, change in entropy for various thermodynamics, problems.

09 Hours
UNIT IV

Availability and Irreversibility:
Available and unavailable energy, maximum work, maximum useful work for a system and control volume, availability of a system and steady flow system, irreversibility, second law efficiency, problems.

Ideal and Real Gases:
Equation of state, perfect and semi perfect gases, evaluation of heat, work, dE, dH, dS for various thermodynamic processes, ideal gas mixture, Dalton’s law of partial pressures, Amagat’s law of additive volumes, evaluation of properties, analysis of various processes.
Real gases-Vander Waal’s equation and its constants in critical properties, law of corresponding states, compressibility factor, compressibility chart, problems.

09 Hours

UNIT V

Pure Substances:
Pure substance; definition, two property rule, vapour formation-P-V, P-T, P-V-T diagrams, critical and triple points, T-S and H-S diagrams, steam tables, dryness fraction, problems.
Vapour processes-evaluation of W, dE, Q, dH for various processes, problems.
Steam calorimeters-separating, throttling and combined calorimeters, problems.

10 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:
1. Basic and applied thermodynamics by P K Nag, Tata McGraw Hill.
2. Thermodynamics an engineering approach by Yunus A Cenegal, Tata McGraw Hill.

Reference Books:
3. Basic applied thermodynamics by Omakar Singh.

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

MECHANICS OF MATERIALS

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Course Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>14ME34</td>
<td>04</td>
<td>50</td>
<td>50</td>
<td>Program Core</td>
</tr>
</tbody>
</table>

Course Outcomes:

Students will be able to

1. Define the properties and response of the materials under different loading conditions
2. Select different geometric parameters of structures based on its application.
3. Apply the analytical or graphical methods to determine the forces, stresses, bending, moment, buckling and torsion with respect to bars, beams, columns and struts
4. Analyze the effect of load on structure and material
5. Utilize basic properties of materials such as elastic moduli and Poisson’s ratio to appropriately to solve problems related to isotropic elasticity.

UNIT I

Stresses and Strains:
Definition of Stress, types of stress, strain, types of strain, modulus of elasticity, true stress, true strain, simple problems, stress strain diagram of ductile, brittle, visco-elastic, linear & non-linear elastic materials, bars with varying sections, bars of composite sections, simple problems, thermal stresses, simple problems, elastic constants and its relation, volumetric stains, simple problems.

Compound Stresses:
Methods of determining stresses in oblique sections, principal planes and stresses, simple problems, construction of Mohr’s circle, simple problems.

10 Hours

UNIT II

Shear Force and Bending Moment Diagram:
Definition of shear force, bending moment, types of beams and loads, sign convention for shear force and bending moment, shear force and bending moment diagram for various beams. Relation between shear force and bending moment.

10 Hours

UNIT III

Bending Stresses and Shear Stress in Beams:
Definition of bend, pure bending and simple bending, expression of bending stress, neutral axis and moment of resistance, bending stress in symmetrical sections, section modulus, section modulus for various shapes of the beam section. Introduction to shear stress, shear stress distribution for different section.

09 Hours

UNIT IV

Deflection of Beams:
Definition of deflection and slope, finding deflection and slope of a beam subjected to various loads, relation between slope, deflection and radius of curvature, simple problems to be solved for the beams experiencing various loads.

Torsion of Shafts:
Definition of torsion, derivation of shear stress produced in a circular shaft subjected to torsion, expression of torque in terms of polar moment of inertia, power transmitted by shaft, simple problem.

09 Hours

UNIT V

Column and struts:
Definition of columns and struts, failure of a column, expression of crippling load when (a) both ends are hinged (b) one end of the column is fixed and the other end is free (c) both ends are fixed (d) one end is fixed and the other end is hinged. Simple problems to be solved used Euler’s formula and Rankine formula.
Thick and Thin cylinders:
Definition of thin and thick cylinders, thin cylinders subjected to internal pressure. Stresses in a thin cylinder subjected to internal pressure, expression of circumferential stress and hoop stress, simple problems.
Thick Cylinder: Lame’s theorem, stresses in a thick cylinder, simple problems to be solved.

10 Hours

Pre-requisites:
The student should have studied Engineering Mechanics.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:

Reference Books:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10  11  12</td>
<td>1  2</td>
</tr>
<tr>
<td>1</td>
<td>2  1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1  1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2  2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2  1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3  3  1</td>
<td>1</td>
</tr>
</tbody>
</table>
MANUFACTURING TECHNOLOGY

Course Outcomes:
Students will be able to

1. Recognize the various manufacturing principles and techniques
2. Interpret the cutting tool parameters in various machining processes
3. Describe moulding, patterns and moulding furnaces
4. Determine the appropriate parameters for different manufacturing processes.
5. Justify the most appropriate manufacturing process for a given product

UNIT I

Patterns: Definition, functions, materials used for pattern, various pattern allowances and their importance, classification of patterns, BIS colour coding of patterns.
Binder: Definition, types of binder used in sand moulding.
Additives: Need, types of additives used and their properties.
Sand Moulding: Types of base sand, requirement of base sand. Mouldingsand mixture ingredients for different sand mixtures. Method used for sandmoulding, such as green sand, dry sand and skin dried moulds.
Cores: definition, need, types. Method of making cores, binders used, core sand moulding.
Concept of Gating & Risers. Principle and types.
10 Hours

UNIT II

Fettling and Cleaning of Castings: Basic steps, casting defects, causes, features and remedies.
Moulding Machines: Jolt type, squeeze type, jolt & squeeze type and sand slinger.
Special Moulding Process: Study of important molding processes, no bakemoulds, flask less moulds, sweep mould, CO₂ mould, shell mould, investment mould.
Metal Moulds: Gravity die-casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixo-casting and continuous casting processes.
Melting Furnaces: Classification of furnaces. Constructional features & working principle of coke fired, oil fired and gas fired pit furnace, resistance furnace, coreless induction furnace, electric arc furnace and cupola furnace.
08 Hours

UNIT III

Cutting Tool Materials: Desired properties and types of cutting tool materials - HSS carbides, coated carbides, and ceramics.
10 Hours

UNIT IV

Turret and Capstan Lathe, Shaping and Planing Machines: Classification, constructional features of shaping machine, planing machine, driving mechanisms of lathe, shaping and planing machines, different operations on lathe, shaping and planing machines. Simple problems on machining time calculations.
Broaching process: Principle of broaching. Details of a broach. Types of broaching machines-constructional
details. Applications, advantages and limitations.

**Finishing and other Processes:** Lapping and Honing operations–principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

**10 Hours**

**UNIT V**

**Welding:** Arc Welding-Metal Arc Welding (MAW), Flux Shield Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG), Submerged Arc Welding (SAW), Friction Stir Welding (FSW) and Atomic Hydrogen Welding Processes(AHW).

**05 Hours**

**Non-traditional Machining Processes:** Need for non-traditional machining, principle, equipment & operation of laser beam, plasma arc machining, electro chemical machining, ultrasonic machining, abrasive jet machining, water jet machining, electron beam machining, and electron discharge machining.

**05 Hours**

**Course Assessment Method:**

**CIE –50 Marks**

1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE- 50 Marks**

1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

**TEXT BOOKS:**

2. *A Textbook Manufacturing Technology-I & II* by Dr P C Sharma, S CHAND & Company publications, 2008

**REFERENCE BOOKS:**


<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
Subject: COMPUTER AIDED MACHINE DRAWING

**Course Outcomes:**

*Students will be able to*

1. Students will be able to understand the concept and importance of limits fits and tolerance in the manufacturing drawing.
2. Students will be able to understand the thread terminologies, different types of fasteners, keys and joints and couplings used in machine parts.
3. Student will be able to perform both 2D and 3D drawings of any components using the software.
4. Students will be able to visualize and model different parts of a machine.
5. Students will be able to construct assemblies of various machines like screw jack, machine vice, tail stock of lathe from the concepts learnt using the software.

**UNIT I**

Introduction to GD&T:
12 Hours

**UNIT II**

Introduction to Riveted and Welded Joints:
Definitions of rivets, riveting and rivet heads. Classification of riveted joints. Welded joints and symbols, dimensioning of welds, edge preparation of welds, welding.
Blueprint Reading:
Introduction, blueprint reading of component drawings and assembly drawings.
12 Hours

**UNIT III**

Orthographic Projections and Sectional Views:
Conversion of 2D drawings to 3D parts (software only) of simple machine components. Full and half section of machine components.
16 Hours

**UNIT IV**

Thread Forms and Fasteners:
Thread terminology, sectional views of threads, ISO metric (Internal & External), BSW (Internal & External), square and ACME sellers thread, American standard thread. Hexagonal threaded bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.
12 Hours

**UNIT V**

Assembly Drawings (Part drawings should be given)
1. Drill Jig
2. Crane Hook
3. Screw Jack (Only Demo)
4. Clapper Block
5. Machine Vice (Only Demo)
6. Universal Coupling
7. Piston Of Petrol Engine
8. Milling Machine Tail Stock
9. Non-Return Valve
10. Plummer Block (Only Demo).

**26 Hours**

**Pre-requisites:**
The student should have knowledge of Computer Aided Engineering Drawing.

**Course Assessment Method:**

**CIE – 50 Marks**
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Drawing sheets from each chapter has to be submitted and it will be evaluated for 10 marks.
3. Minimum two assignments or surprise test to be given and evaluated through rubrics for 10 marks. Average of two will be considered.

**SEE- 50 Marks**
1. Two questions to be set from each unit (Unit-I carries 10 marks and Unit-II, Unit-III, Unit-IV & Unit-V carrying 10 marks each).
2. Students have to answer 4 questions selecting one full question from each unit.

**TEXT BOOKS:**

**REFERENCE BOOKS:**

All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4. All sheets must be submitted at the end of the class by taking printouts.

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
<td>10 11 12</td>
</tr>
<tr>
<td>1</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3 2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3 2</td>
<td>3</td>
</tr>
</tbody>
</table>
MANUFACTURING LAB

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>:14MEL37</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>:1.5</td>
</tr>
<tr>
<td>Hours/Week</td>
<td>:0+0+3</td>
</tr>
<tr>
<td>CIE Marks</td>
<td>:50</td>
</tr>
<tr>
<td>Total Hours</td>
<td>:39</td>
</tr>
<tr>
<td>SEE Marks</td>
<td>:50</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>:03</td>
</tr>
<tr>
<td>Course Type</td>
<td>: Program Core</td>
</tr>
</tbody>
</table>

Course Outcomes:
Students will be able to
1. Prepare sand specimens and conduct compression, shear, tensile and permeability test
2. Conduct sieve analysis, clay and moisture content test
3. Prepare moulds with and without patterns
4. Create models thru different forging operations
5. Write effective Report and Document.

UNIT I

Testing of Molding sand and Core sand:
1. Preparation of sand specimens and conduction of the following tests.
2. Compression, shear and tensile tests on universal sand testing machine.
3. Permeability test
4. Core hardness & mould hardness tests.
5. Grain fineness number test (Sieve Analysis test)
6. Clay content tests.
7. Moisture content tests.

UNIT II

Foundry Practice:
Use of foundry tools and other equipments. Preparation of molds using two molding boxes using patterns or without patterns.
Preparation of casting (Aluminum or cast iron) using sand mold, permanent mold, centrifugal casting, centrifuge casting.

Forging Operations:
Preparing minimum three forged models involving upsetting, drawing and bending operations.

Pre-requisites:
The student should have theoretical knowledge of manufacturing process

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva voce:05 marks
SEE - Final Exam: 50 Marks

Text Books:

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
<td>10 11 12 1 2</td>
</tr>
<tr>
<td>1</td>
<td>3 2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3 2</td>
<td>2 2</td>
</tr>
<tr>
<td>3</td>
<td>3 2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3 2</td>
<td>2 2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
METALLOGRAPHY AND MATERIAL TESTING LAB

Sub Code: 14MEL38
Credits: 1.5
Hours/Week: 0+0+3
Total Hours: 39
Exam Hours: 03
CIE Marks: 50
SEE Marks: 50
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Preparation of specimen for metallographic examination of different engineering materials and Identification of microstructures
2. conduct Tensile, shear, compression, bending and torsion tests of metallic and non-metallic specimens using a Universal Testing Machine.
3. conduct Izod and Charpy impact tests, wear tests
4. conduct Brinell, Rockwell and Vickers's hardness test
5. Students will be able to write Effective Report and Document.

UNIT I
2. To study the wear characteristics of ferrous and non-ferrous materials for different parameters.
3. Non-destructive test experiment.

UNIT II
2. Torsion tests.
3. Bending test on metallic and nonmetallic specimens.
4. Izod and Charpy tests on MS Specimen.

Pre-requisites:
The student should have basic theoretical knowledge of Material Science & Metallurgy

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva:05 marks
SEE - Final Exam: 50 Marks

Text Books:

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.
ENGINEERING MATHEMATICS IV*

Sub Code : 14MAT41
Credits : 04
Hours/Week : 4+1+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Basic Science

Course outcome:
1. Students learn the basics and method of obtaining solution of nonlinear equations and system of linear equations.
2. Students understand essentials of methods to obtain eigen values and Eigen vectors.
3. Students will be able understand the importance and limitations of numerical differentiation and integration
4. Students learn to obtain solution s of ordinary and partial differential equations numerically
5. Students learn to interpolate and extrapolate the given set of data

UNIT I

Errors and approximations – Introduction, Sources of errors, fixed and floating point numbers, Rounding off of numbers, Absolute and relative errors, approximation of series. (Chapter 2-1, 2.5, 11, 12,13,19.-text book 3).
Solution of algebraic and transcendental equations- Secant or regulafalsi method, Newton Raphson method for simple root, multiple root and complex roots, iteration method, Aitken’s Δ² method for acceleration of convergence. (2.3, 2.4, 2.5 Text Book 2).
Solution of system of equations- Gauss-Seidel method, LU decomposition method, Cholesky method, Thomas algorithm for tri-diagonal system (3.2, page 120-127, 3.4- page 150-152 Text book 12, 6.3.6, 6.3.8 text book 2).
10 Hours

UNIT II

Finite differences and interpolation –Forward, backward and central difference operators, construction of difference table, relation between differences and derivatives, Newton’s forward and backward difference interpolation, Sterling and Bessel central difference formulae, Newton’s divided difference and Lagrange’s interpolation formula, Bivariate interpolation using Lagrange’s and Newton’s interpolation, Spline interpolation (cubic splines only) , Numerical differentiation with Newton’s forward and backward difference interpolation (3.3.1-3.3.3,6.3.7.2,3.7.3, 3.9.1,3.10.1, 5.2.1 Text book 1), (4.2,4.4, 4.6, 4.7, 5.2, Text book 2).
10 Hours

UNIT III

Solution of ODE- Taylor series method, 4th order Runge - Kutta method, Milne’s predictor corrector method, shooting method and finite difference method for boundary value problems. (7.2, 7.5, 7.6,7.10 Text Book 1) (6.4, 7.2,7.3 Text book 2)
10 Hours

UNIT IV

Numerical integration- Newton Cotes formula, Trapezoidal, Simpson’s 1/3rd and 3/8th rule, Weddle’s rule, Gaussian Quadrature method, Double integration by Trapezoidal and Simpson’s formula (5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.7, 5.6, 5.10 Text book 2).
10 hours

UNIT V

Calculus of Variation:
Eigen values and Eigen vectors- Largest eigen value by Power method, Rutishauser’s method, Jacobi method for symmetric matrices, Given’s method to reduce symmetric matrix to tridiagonal matrix, QR algorithm. (3.7, 3.8, 3.9, 3.10, 3.11 Text Book 1).
08 Hours
Pre-requisites:
The student should have studied Maths –I, Maths-II and Maths-III.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book:
2. **Introductory methods of numerical analysis** by S SSastry, PHI India.

Reference Book:

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>
ENGINEERING METROLOGY & MEASUREMENTS

Sub Code: 14ME42  
Credits: 03  
Hours/Week: 4+0+0  
CIE Marks: 50  
Total Hours: 38  
SEE Marks: 50  
Exam Hours: 03  
Course Type: Program Core  

Course Outcomes:  
Students will be able to  
1. Recognize the need for measurement, to learn the concepts of measurements, measuring system and source of errors  
2. Demonstrate the skill of measuring force, torque, pressure, temperature, strain  
3. Illustrate the development and use of metrology standards  
4. Impart the knowledge of limits, fits, tolerance  
5. Assess the use of comparators and gauges  

UNIT I  
Introduction to Measurement System:  
Definition, requirements and significance of measurement system, methods of measurements, generalized measurement systems, definition and basic concepts of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, system response, delay, errors in measuring instruments, classification of errors.  
Transducers:  
Definition, classifications of transducers, mechanical transducers, electrical transducers, piezoelectric transducers, electronic transducers, advantages and disadvantages of each type of transducers.  
06 Hours  

UNIT II  
Measurement of Force, Torque and Pressure:  
Introduction, analytical balance, platform balance, proving ring, types of dynamometers, mechanical dynamometers, hydraulic dynamometers, fan brake dynamometers, electric dynamometers – eddy current and dc dynamometers, advantages of hydraulic dynamometers over mechanical dynamometers.  
Use of elastic members in pressure measurement, Mc Leod gauge, the Bridgeman gauge, thermal conductivity gauges - Pirani thermal conductivity gauge, thermocouple vacuum gauge.  
08 Hours  

UNIT III  
Temperature Measurements and Strain Gauge:  
Introduction, electrical resistance thermometer, thermoelectric effects, thermocouple, laws of thermocouples, thermocouple materials and construction, advantages and disadvantages of thermocouples, optical pyrometers and radiation pyrometers.  
Mechanical strain gauges, optical strain gauges, and electrical resistance strain gauges – bonded type, unbonded type and piezoresistive strain gauges preparation and mounting of strain gauges, gauge factor, strain measurement using wheat stone bridge, calibration of strain gauges.  
08 Hours  

UNIT IV  
Metrology Standards and Systems of Limits, Fits and Tolerances:  
Introduction, objectives of metrology, standards of length – International proto type meter, imperial standard yard, wavelength standard, subdivision of standards – line standard and end standard, calibration of end bars (numerical), slip gauges, wringing phenomena, Indian standards (m-81, m-112), numerical problems on building of slip gauges.  
Need for limit system, definition of limits, concept of limits of size and tolerance, definition of fit, types of fit and their designation, special types of fit. Definition of tolerance, unilateral and bilateral tolerance, concept of interchangeability and selective assembly, hole basis system and shaft basis system, brief concept of design of gauges (Taylor's principles), types of gauges and gauge materials.  
08 Hours
UNIT V

Comparators and Screw Thread Measurement:
Introduction, characteristics, classifications of comparators, mechanical comparators – Johansson microkator comparators, sigma comparators, dial indicator, optical comparators– Zeiss ultra-comparators, LVDT, pneumatic comparators, back pressure comparators, solex gauges.
Screw thread terminology, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2 wire method and 3 wire method, best size wire, autocollimator and optical flat.

08 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books
2. Mechanical measurements by R K Jain.
3. Industrial Instrumentation by Alsutko, Jerry D Faulk, Thompson Asia Pvt. Ltd.2002

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3 1 2</td>
<td>2 2 3</td>
</tr>
<tr>
<td>2</td>
<td>3 1 2</td>
<td>2 2 3</td>
</tr>
<tr>
<td>3</td>
<td>3 1 2</td>
<td>2 2 3</td>
</tr>
<tr>
<td>4</td>
<td>3 1 2</td>
<td>2 2 3</td>
</tr>
<tr>
<td>5</td>
<td>3 2</td>
<td>2 2 3</td>
</tr>
</tbody>
</table>
APPLIED THERMODYNAMICS

Sub Code: 14ME43
Credits: 04
Hours/Week: 4+1+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Course Type: Program Core

Course Outcomes:
Students will be able to

1. Identify and outline the basic concepts of thermodynamic systems, Laws of thermodynamics and its application
2. Describe the working principle and thermodynamic cycles of various power generating and absorbing systems- IC engines, air compressors, gas turbines, steam power plants, refrigerators and air conditioners using different property diagrams
3. Derive and correlate the mathematical expressions for energy transfer- heat supplied, heat rejected, net work output/input and thermal efficiency of different thermodynamic cycles.
4. Apply and calculate the performance parameters- thermal efficiency, work output/input, cop, relative efficiency etc of IC engines, air compressors, gas turbines, steam power plants, refrigerators and air conditioners at different operating conditions.
5. Optimize and Analyze and size of the IC engine and compressor cylinders for optimal energy conversion for complex problems and real time applications

UNIT I
Gas Power Cycles
Air standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, comparison of Otto, Diesel and Dual combustion cycles, problems.

Gas Turbines and Jet Propulsion
Classification of gas turbines, Joule’s cycle, thermal efficiency, optimum pressure ratio, analysis of open cycle and closed cycle gas turbines, advantages and disadvantages of closed cycle gas turbine, methods to improve thermal efficiency, jet propulsion and rocket propulsion, problems.
10 Hours

UNIT II
Combustion thermodynamics: Theoretical (Stoichiometric) air and excess air for combustion of fuels. Mass balance, actual combustion, exhaust gas analysis, A/F ratio, energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, combustion efficiency, adiabatic flame temperature.

Reciprocating Air Compressors
Working of single stage air compressor; work done, efficiencies, volumetric efficiency, effect of clearance on volumetric efficiency, multi-stage compressor; advantages, condition for optimum pressure ratio, work done, methods used to achieve isothermal compression, problems.
10 Hours

UNIT III
Vapour Power Cycles
Carnot cycle-working,draw backs, simple Rankine cycle-description, performance parameters, comparison of Carnot and Rankine cycles, actual vapour cycles, ideal and practical regenerative cycles, open and closed feed water heaters, reheat Rankine cycle, problems.
09 Hours

UNIT IV
Internal Combustion Engines
Testing of two stroke and four stroke SI and CI engines for performance related numerical problems, heat balance, motoring method, Willian’s line method, swinging field dynamometer, Morse test. Alternate Engine fuels and emissions and introduction to MFIS (multi-fuel injection system).
09 Hours

UNIT V
Refrigeration
Definition-TOR, COP, relative COP, refrigerant, properties. Classification, Description and working of Carnot, Air cycle, vapor compression and vapor absorption refrigeration systems, working of steam jet refrigeration, problem. Electrolux refrigeration system.

**Psychometry and Air Conditioning**
Definition, psychometric properties, dry bulb temperature, wet bulb temperature, dew point temperature, partial pressures, specific, absolute and relative humidity’s, degree of saturation, adiabatic saturation temperature, enthalpy of moist air, psychometric relations, psychometric processes, summer and winter air conditioning, problems.

10 Hours

**Pre-requisites:**
The student must have an extensive overview of Basic thermodynamics.

**Course Assessment Method:**
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

**Text Book:**
1. Basic and applied thermodynamics by P K Nag, Tata McGraw Hill.
2. Thermal Engineering by R K Rajput

**Reference Books:**
1. Engineering Thermodynamics by J B Jones, G A Hawkins, John Wiley and Sons
3. Basic and applied thermodynamics by Omakar Singh.

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
THEORY OF MACHINES I

Course Outcomes:
Students will be able to
1. Define different terminologies and elucidate fundamentals of kinetics, kinematics
2. Classify and select inversions, kinematic mechanisms, gear, gear trains, cams, for a given kinematic motion.
3. Determine the link velocity and acceleration through analytical and graphical method
4. Analyze and develop cam profiles and determine the link velocity and acceleration.
5. Distinguish higher and lower pair mechanisms for various kinematic applications

UNIT I

Fundamentals
Fundamentals of mechanisms: Kinematic, link, pair, constraint motion-definition and its classification, types of joints, kinematic chain, Grubbler’s criteria, mechanisms, machines and structures, degrees of freedom, simple problems.
10 Hours

UNIT II

Mechanisms
Inversions: Inversions of 4 bar chain, single slider and double slider crank chain, Pantograph, Geneva, Ratchet and Pawl mechanisms.
Steering Gear mechanism: Fundamental equation of correct gearing, Davis and Acramenn mechanisms.
Gear: Introduction, types of gears, terminology of gears, fundamental law of gearing, gear tooth forms. Involumetry, interference, determination of minimum number of teeth to avoid interference, simple problems.
10 Hours

UNIT III

Velocity and Acceleration Diagram
Velocity Diagram: Determination of link velocities by relative method, instantaneous method.
Acceleration Diagram: Determination of link acceleration by relative methods, Aoriolis method.
12 Hours

UNIT IV

Gear Train
Introduction, types of gear trains, sun and planet gear trains, epicyclic gear train, torques in gear train, simple problems.
08 Hours

UNIT V

CAMs:
Introduction, types of cams and followers, procedure for drawing cam profile. Follower motion: uniform velocity, uniform acceleration and deceleration, SHM and cycloidal motions, problems to be solved using the above said types of motions.
08 Hours
Course Assessment Method:

CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Books:
1. Theory of Machines by J K Guptha, S Chand Pvt Ltd.
2. Theory of Machines by Sadhu Singh, Pearson Education.

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
FLUID MECHANICS

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
<th>Hours/Week</th>
<th>CIE Marks</th>
<th>Course Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>14ME45</td>
<td>04</td>
<td>4+1+0</td>
<td>50</td>
<td>Program Core</td>
</tr>
<tr>
<td>Total Hours</td>
<td>48</td>
<td>Exam Hours</td>
<td>SEE Marks</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

Students will be able to:

1. Describe the fundamental concepts of fluid statics, fluid kinematics and fluid dynamics.
2. Analyze the fluidic system and derive the expressions for fluid and flow properties.
3. Interpret general governing equations of fluid mechanics for viscid and inviscid flows to compute unknown parameters.
4. Examine energy losses in pipe transitions, sketch energy gradient lines and evaluate pressure drop in pipe flow using Hagen-Poiseuille’s equation for flow in a pipe.
5. Outline the concepts of boundary layer for different fluid flows, compressibility and aerodynamics terminologies like coefficient of lift and drag.

UNIT I

Fluid Statics: Introduction, types of fluid, properties of fluid- viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure. the fluid pressure at a point, Pascal’s law, pressure variation in a static fluid; absolute, gauge, atmospheric and vacuum pressures; measurement of pressure using simple and differential manometers. Total pressure and center of pressure on submerged horizontal, vertical, inclined plane surfaces and curved surfaces.

10 Hours

UNIT II

Buoyancy: Archimedes principle, center of buoyancy, metacenter and metacentric height; conditions of equilibrium of floating and submerged bodies-determination of metacentric height by experimental and theoretical methods.

Fluid Kinematics: Introduction, scalar and vector variables, fluid motion –Lagrangian vs Eulerian Concept, steady vs unsteady and uniform vs. non uniform flow, continuity equation in Cartesian 2D and 3D coordinates, velocity and acceleration in fluid motion, distinction between stream lines, path lines and streak lines in a fluid, distinction amongst viscous, inviscid and irrotational flow, definition of velocity potential function, stream function – both satisfy laplace equation for irrotatational flows.

09 Hours

UNIT III

Fluid Dynamics: Introduction, general equations of motion representing conservation of mass, momentum and energy for a viscous fluid flow, Euler’s equation of motion for inviscid flow Bernoulli’s equation from first principles and also deduced from Euler’s equation, limitations of Bernoulli’s equation. The impulse momentum principle- forces on pipe bends

Measurement of Fluid Flow: Venturimeter, orifice-meter, Pitot - static tube, V-Notch and rectangular weirs

09 Hours

UNIT IV

Flow through pipes: Major loss due to friction in flow through pipes – computing head loss due to skin friction using Darcy’s and Chezy’s equation for head loss due to friction in pipes. HGL (Hydraulic Grade Line) and TEL (Total Energy Line).

Dimensional Analysis: Introduction, fundamental units, dimensions of physical quantities, dimensional homogeneity, Rayleigh’s method, Buckingham-π theorem, dimensionless numbers, similitude-geometric, kinematic and dynamic.

08 Hours

UNIT V

External Flow past Immersed Bodies:

Reynolds Number – definition and physical importance, concept of boundary layer, laminar flow past a flat plate, concept of displacement, momentum and energy thickness, laminar vs turbulent flow, phenomenon of transition and turbulence, expression for lift and drag coefficients, concept of compressibility, importance of pressure wave propagation and velocity of sound in a compressible fluid, Mach number, Mach cone, wind tunnels – applications in measurement of fluid-body interaction for flow past immersed bodies, introduction to aerodynamics terminologies like coefficient of lift and drag.
Internal Flow in Ducts: Concept of critical Reynolds number, entrance length, fully developed laminar flow through a circular pipe – Hagen Poiseuille’s equation, laminar flow between parallel and stationary plates (Couette flow).

12 Hours

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE- 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

TEXT BOOKS:

REFERENCE BOOKS:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

ADVANCED MANUFACTURING TECHNOLOGY

Subject Code: 14ME46
Credits: 04
Hours/week: 4+0+0
Total Hours: 48
Exam Hours: 03
CIE Marks : 50
SEE Marks: 50
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Understand the concepts of various metal working processes and the presence of various stresses, strains in the processes
2. Select the appropriate metal forming process among forging, rolling, drawing, extrusion, sheet metal forming operations for different applications and to evaluate the pressure, force and power required for these processes
3. Analyze parameters affecting the metal working processes and analyze the cause of defects and to suggest remedial solutions.
4. Select a suitable equipment/machinery for various metal working processes
5. Understand high energy forming processes, powder metallurgy techniques and rapid prototyping, tooling and manufacturing techniques.

UNIT I
Effects of Parameters: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, deformation zone geometry and workability of materials, residual stresses in wrought products.
10 Hours

UNIT II
10 Hours

UNIT III
Drawing: Drawing equipment & dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, tube drawing and classification of tube drawing, simple problems.
Extrusion: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, extrusion of seamless tubes. Extrusion variables, simple problem
10 Hours

UNIT IV
High Energy Rate Forming Methods: Principles, advantages and applications, explosive forming, electro hydraulic forming, electromagnetic forming.
10 Hours
UNIT V

Powder Metallurgy: Basic steps in powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.

Introduction to Rapid prototyping: Brief discussion on rapid tooling and manufacturing.

08 Hours

Pre-requisites:
The student must have studied the concepts of manufacturing technology.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE - 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit.

TEXT BOOKS:

REFERENCE BOOKS:
HEAT POWER LAB

Sub Code : 14MEL47
Hours/Week : 0+0+3
Total Hours : 39
Exam Hours : 03
Credits : 1.5
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:
Students will be able to
1. Operate instruments and measurement systems to determination of flash point & fire point, viscosity of lubricating oil and caloric value of all types of fuels.
2. Draw the valve timing diagram for an IC engine.
3. Use a planimeter to determine the area of an arbitrary two-dimensional shape.
4. Function effectively as an individual and as member to conduct experiments and determine the performance parameters of single and multi cylinder I.C. Engines.
5. Write effective report and document.

UNIT I
1. Determination of flash point and fire point of lubricating oil using Abel Pensky and Pensky apparatus.
2. Determination of calorific value of solid, liquid and gaseous fuels.
3. Determination of viscosity of lubricating oil using redwoods, Saybolts and torsion viscometers.
5. Use of planimeter.

UNIT II
Performance Tests on I.C. Engines, Calculations of IP, BP, thermal efficiencies, SFC, FP, heat balance sheet for
(a) Four stroke diesel engine.
(b) Four stroke petrol engine.
(c) Multi cylinder diesel/petrol engine (Morse test).
(d) Two stroke petrol engine.
(e) Variable compression ratio I.C. Engine.

Pre-requisites:
The student should have studied Applied Thermodynamics.

Course Assessment Method:
CIE - Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

Text Books:

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.
METROLOGY & MEASUREMENTS LAB

Sub Code : 14MEL48
Credits : 1.5
Hours/Week : 0+0+3
CIE Marks : 50
Total Hours : 39
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:

Students will be able to

1. Quote the applications of various measuring instruments.
2. Select a suitable measuring instrument for specific measurement.
3. Operate & calibrate measuring instruments in the shop floor.
4. Use lathe tool dynamometers to measure the cutting tool force.
5. Determine the moduli of elasticity of materials, pressure, temperature, gear and thread parameters and surface roughness.

UNIT I

MECHANICAL MEASUREMENTS

1. Calibration of pressure gauge.
2. Calibration of thermocouple
3. Calibration of LVDT.
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

UNIT II

METROLOGY

1. Measurements using optical projector / toolmaker microscope.
5. Measurements of Screw thread Parameters using two wires or three-wire method.
7. Measurements of gear tooth profile using gear tooth vernier / gear tooth micrometer.

Pre-requisites:
Knowledge of metrology and measurements is a must.

Course Assessment Method:
CIE - Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

Text Books:
2. Mechanical Measurements, 6/E 01-Sep-2007 by Beckwith, Pearson Education India,

Scheme of Examination: Student will be asked to conduct one experiment from each unit.
DESIGN OF MACHINE ELEMENTS I

Course Outcomes:

Students will be able to

1. "Recognize the design considerations for various mechanical metal forming processes and machine elements
2. Determine different stress by applying failure theories in design of machine components
3. Analyze strength of various machine components subjected to static, variable and impact loading.
4. Solve problems on stress concentration and different permanent joints
5. Solve complex problems on couplings power screws and shafts.

UNIT I

Basics:

Design for Static Loading:
Introduction: Stresses in members subjected to axial, shear, Bending, Torsional & Eccentric loading. Stress tensor, Uniaxial, Biaxial & Triaxial stress state, Principal Stresses in members subjected to combination of static loads.

Theories of Failure & Stress Concentration:
Failure Criterion & problems - Maximum Normal Stress theory, Maximum Shear stress theory, Distortion energy theory.

UNIT II

Stress Concentration:
Definition, Reason for occurrence, Methods to reduce, Stress concentration factor. Design of stress concentrated members subjected to various loads.

Design for Variable Loading:
Types of variable/Cyclic loads Mean & amplitude Stresses, Fatigue Failure, Endurance Limit & Strength, S-N Diagram. Goodman and Soderberg criterion, Modifying factors: Size effect, surface effect, Reliability, stress concentration effects etc. Problems on design of members for finite & infinite life in members subjected to individual & combined loading. Cumulative damage in fatigue.

UNIT III

Shafts:
Types, Design of solid & hollow shaft on strength and rigidity basis with steady loading subjected to pure torsion. Design of shafts carrying pulleys & gears (Combined loading). ASME Code for shaft design.

Cotter & Knuckle Joints: Design procedure

UNIT IV

Couplings:
Types, Design of Flange, Bush & Pin type flexible coupling.

Riveted Joints: Types, Design of longitudinal & circumferential joint for various types, Simple Riveted Brackets.

UNIT V

Impact Strength:
Introduction, Impact stress due to axial, Bending and Torsional loads
Power screws:
Forms of threads, terminology, Torque in lifting & lowering the load, self-lockings crew, efficiency of screw (Square, ACME, self-locking), Design of screw & Nut for power screw.

Welded joints:
Types, Strength of Butt, parallel, transverse welds, eccentrically loaded welded joint subjected to torsion & Bending moment.

08 Hours

Pre-requisites:
The student would have to be well-versed with mechanics of materials and engineering mechanics

Course Assessment Method:
Test : 30 marks
Assignment : 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Design Data Hand Books:
3. PSG Design Data hand Book by PSG College of Technology, Coimbatore.

Reference Books
4. Engineering Design by G.E. Dieter

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10 11 12</td>
<td>1  2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3  3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3  3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3  3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3  3</td>
<td>2</td>
</tr>
</tbody>
</table>
THEORY OF MACHINE II

Sub Code : 14ME52
Hours/Week : 4+1+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Core

Course Outcomes:

Students will be able to
1. Analyze the reaction forces on 2D bodies subjected to static and dynamic loads
2. Identify and elucidate different types of governors, gyroscope, fly wheel, belt drives and their terminologies.
3. Interpret and solve balancing of rotating masses under static and dynamic loading
4. "Solve problems on different types of governors and gyroscopes, subjected to various loading
5. "Solve problems on different types of fly wheels and belt drives subjected to various loadings

UNIT I

Static & Dynamic Force Analysis:
Members with two forces and torque, free body diagrams, principle of virtual work. Static force analysis of four bar mechanism.
Dynamic Force Analysis:
D’Alembert’s principle, Inertia force, inertia torque, Dynamic force analysis of four-bar mechanism and slider crank mechanism.
08 Hours

UNIT II

Friction and Belt Drives:
Definitions: Types of friction: laws of friction, Belt drives: Flat belt drives, ratio of belt tensions, centrifugal tension power transmitted.
Flywheel
Turning moment diagrams Fluctuation of Energy. Determination of size of flywheels.
10 Hours

UNIT III

Balancing of Rotating Masses:
Static and dynamic balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.
10 Hours

UNIT IV

Governors:
Types of governors; force analysis of Watt, Proell, Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power. (Only definitions).
10 Hours

UNIT V

Gyroscope:
Vectorial representation of angular motion, basic definitions, Gyroscopic couple. Effect of gyroscopic couple on a plane disc, a boat, an aero plane, a naval ship, stability of two wheelers and four wheelers.
10 Hours

Pre-requisites:
The student needs to possess knowledge of theory of machines-I

Course Assessment Method:
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book


Reference Books:

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
FINITE ELEMENT METHODS

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>14ME53</td>
<td>04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours/Week</th>
<th>CIE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+1+0</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Hours</th>
<th>SEE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exam Hours</th>
<th>Course Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Program Core</td>
</tr>
</tbody>
</table>

Course Outcomes:

**Students will be able to**

1. Recognize the importance of FEM and its concepts
2. Analyze different variational methods to solve the problem
3. Interpret the importance of shape functions, stiffness matrix and their techniques
4. Evaluate the effect of load on structures and determine stress, strain and reaction forces
5. To solve temperature and heat transfer problems

**UNIT I**

Overview of Finite Element Method: Basic Concept, Historical background, General and Engineering applications of the FEM, Finite Element Method vs Classical Method, FEM vs FDM, Force Vs Displacement method in FEM


Discontinuity: Geometry, Load, Boundary, Material, Types of Symmetry, Aspect Ratio, Banded Matrix.

Interpolation Models: Introduction, Polynomial form of interpolation function, Simplex, Complex, and Multiplex elements, Interpolation polynomial in terms of nodal DOF, Selection of the order of the interpolation polynomial, Convergence requirements, coordinate systems.


Basic Equations in Elasticity (No questions will be asked for MSE or SEE): Introduction, Stresses in a Typical Element, Equations of Equilibrium, Strains, Strain Displacement Equations, Linear Constitutive Law.

10 Hours

**UNIT II**


Techniques of saving memory: Use of symmetry and banded nature, Partitioning of matrix (Frontal solution), Skyline storage.

Coordinate Systems: Local, Global, Area.

Shape Functions: Derivation of Shape Functions Using Polynomials, Finding Shape Functions Using Lagrange Polynomials, Shape Functions for Serendipity Family Elements, Hermite Polynomials as Shape Functions.

10 Hours

**UNIT III**


10 Hours

**UNIT IV**

Beams: 2-noded beam element: Finite element formulation, load vector-point load, UDL, shear force and bending moment, Problems

1D-Steady state Heat Transfer: Straight uniform fin analysis, convection loss from end surface of fin.
Problems on composite wall and thin fins.

08 Hours

UNIT V

Isoparametric formulation: Basic theorems of Isoparametric concept, Uniqueness of mapping, isoparametric sub and super parametric elements, Numerical Integration-Gauss quadrature formula!D: One, two and three point formula, 2D:two point
2D-CST: Area coordinates Isoparametric representation, Jacobianmatix, Strain-displacement matrix, Element stiffness, force term. Problems
10 Hours

Pre-requisites:
The student should have studied Matrices and Mechanics of materials.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Case Study / Seminar / Mat lab programing / C programming for 10 marks.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book:
2. Finite Element Analysis by Bhavikatti, S S New age International, 3rd Edition 2015,

Reference Book:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
FLUID MACHINERY

Subject Code : 14ME54
Credits : 04

Hours/Week : 4+1+0
CIE Marks : 50

Total Hours : 48
SEE Marks : 50

Exam Hours : 03
Course Type : Program Core

Course Outcomes:

Students will be able to

1. Outline & interpret the working principle & energy transfer of various turbo machines.
2. Analyze & Evaluate various parameters by using velocity triangles for various turbo machines.
3. Compute the Energy transfer and maximum efficiency in different stages of various turbo machines.
4. Design and analyze the performance of various turbo machines with dimensional analysis, and steady flow energy equations.
5. Outline the conditions of working fluid for various turbo machines, for effective performance.

UNIT I

Introduction: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynold’s number, Unit and specific quantities, model studies on Turbo machines. Efficiencies of turbo machines. Problems.

Thermodynamics of fluid flow: Static and Stagnation States-Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process.

08 Hours

UNIT II

Energy exchange in Turbo machines: Euler’s turbine equation, Alternate form of Euler’s turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

General Analysis of Turbo machines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

10 Hours

UNIT III

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons’s turbine, condition for maximum utilization factor, reaction staging. Problems.

10 Hours

UNIT IV


Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Problems.

10 Hours

UNIT V

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems.

Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.
(Note: Since dimensional analysis is covered in Fluid Mechanics subject, questions on dimensional analysis may not be given. However, dimensional parameters and model studies may be given more weightage.

10 Hours

Pre-requisites:
The student should have in-depth understanding of fluid mechanics, applied thermodynamics and basic thermodynamics.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE - 50 Marks
1. Two questions to be set from each unit, carrying 20 marks each.
2. Students have to answer 5 questions selecting one full question from each unit

TEXT BOOKS:

REFERENCE BOOKS:
5. Turbo machinery by ValanArsu, A , vikas publishing house, New delhi, 2001

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3 3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3 3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3 1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3 1</td>
<td></td>
</tr>
</tbody>
</table>
CAD/CAM/CIM

Sub Code : 14ME55  Credits : 04
Hours/Week : 4+0+0  CIE Marks : 50
Total Hours : 48  SEE Marks : 50
Exam Hours : 03  Course Type: Program Core

Course Outcomes:

Students will be able to

1. Recognize the techniques for minimizing the production time and cost.
2. "Interpret the cycle, lead, mean time to repair, mean time between failures and total utilization of various machining centers in a shop floor production."
3. Implement the suitable automation Identification techniques in shop floor control.
4. Develop the effective automation systems for various industrial applications.
5. Compare the material handling & storage system with flexible manufacturing systems.

UNIT I

Introduction to CAD/CAM: Computers in Industrial Manufacturing, Product cycle

Computer Graphics: Raster scans graphics coordinate system, database structure for graphics modeling, transformation of geometry, 2D transformations, mathematics of projections, clipping, hidden surface removal.

Geometric modeling: Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling, constraint based modeling.

10 Hours

UNIT II

Fundamentals of Manufacturing and Automation:
Automation, Reasons for automation, Manufacturing Industries, Types of production, Functions in Manufacturing, Organization and information processing in manufacturing, Plant layout, Production concepts and Mathematical models, Automation strategies Detroit type Automation: Automated flow lines, Methods of work part transport, transfer mechanisms, Buffer storage, Automation for machining operations

10 Hours

UNIT III

Analysis of automated flow lines:
General terminology and analysis, Analysis of transfer line without storage, with storage, partial automation.

Assembly Systems and Line Balancing:
The assembly process, Assembly systems, manual assembly systems, Line balancing, design of automated assembly, types, parts feeding devices, analysis of multistation assembly machines and single station assembly machine.

08 Hours

UNIT IV

Material Handling and Storage:
Functions, types of material handling, analysis of material handling, design of system, AGVs, storage system performance, AS/RS, Carousel storage system, work-in-process storage, interfacing handling and storage with manufacturing.

Group Technology and Flexible Manufacturing Systems:
Part families, Parts classification and coding, production flow lines, machine cell design, Benefits of Group technology, FMS workstation, Material handling and storage system, computer control systems, Planning the FMS.

Computerized Manufacturing planning systems:
CAPP, types, Computer integrated production planning systems, MRP, capacity planning.

10 Hours

UNIT V

Shop Floor control and automation Identification techniques:
shop floor control, factory data collection system, automation identification systems, bar code technology, automated data collection system

Quality control and Automated Inspection:
Inspection and testing, SQC, Automated inspection principles and methods, coordinate measuring machines, other contact inspection methods, Machine vision, other optical inspection methods, non contact inspection methods.

10 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Books:
1. Automation, Production System & Computer Integrated Manufacturing, M. P. Groover”
1. CAD/CAM by Zeid, Tata McGraw Hill.

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
THEORY OF ELASTICITY

Sub Code: 14MEE561  
Credits: 04

Hours/Week: 4+0+0  
CIE Marks: 50

Total Hours: 48  
SEE Marks: 50

Exam Hours: 03  
Course Type: Program Elective

Course Outcomes:

Students will be able to

1. Analyze strain and stress tensors at a point in structures subjected to normal, shear and torsional loads in both Cartesian and Cylindrical Co-ordinates.
2. Identify and correlate the relationships between elastic constants of different types of materials and its respective stress-strain relations and check for Airy’s stress function compatibility for simple beam problems.
3. Compute for critical loads that a component can withstand by applying suitable energy evaluation methods and to distinguish between various theorems.
4. Analyze asymmetrical bending problems, compute for shear centre and shear stresses in thin walled hollow sections.
5. Compute types of crack, crack lengths for suitable different modes of fracture, fracture toughness, SIF and illustrate the capability to design a component for a specified fatigue life, providing innovative solutions to elastic structural engineering problems to meet stress engineer capacities.

UNIT I

Analysis of Stress in Cartesian Co-ordinates:

12 Hours

UNIT II

Analysis of Stress in Cylindrical Co-ordinates:  Equations of equilibrium in cylindrical coordinates, Axis symmetric case and plane stress case.
Analysis of Strain:  Introduction, deformation, change of length, strain at a point, interpretation of shear strain components, change in direction of linear element, cubical dilation, principal axis of strain, principal strains, plane state of strain, compatibility conditions, strain deviators and its invariants.

10 Hours

UNIT III

Stress strain relationship:  Generalized statement of Hooke’s law, isotropic materials, modulus of rigidity, bulk modulus, young’s modulus and Poisson’s ratio. Relationship between elastic constants, displacement equation of equilibrium.
Airy’s function:  Investigation of Airy’s stress function for simple Beam Problems.

08 Hours

UNIT IV

Bending of beams:  Introduction, Asymmetrical bending, Euler Bernoulli hypothesis, shearcentre, shear
stresses in thin walled open sections: shear centre.

10 Hours

UNIT V

Torsion: Introduction, generalized prismatic bar of solid section- circular and elliptical bar, equilateral triangular, rectangular bar, membrane analogy, torsion of thin walled tubes, torsion of thin walled multiple cell closed sections.


08 Hours

Pre-requisites:
The student should have studied Material Science, Mechanics of Materials and Design of Machine Elements -1.

Course Assessment Method:
CIE –50 Marks
1 Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2 Two assignments / one course project- evaluated through rubrics for 10 marks. For assignments average of two will be considered.
3 Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Books:

Reference Books:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
INTERNAL COMBUSTION ENGINES

Sub Code : 14MEE562  Credits : 04
Hours/Week : 4+0+0  CIE Marks : 50
Total Hours : 48  SEE Marks : 50
Exam Hours : 03  Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Depict the various thermodynamic cycles for fuel-air and actual air standard cycles by applying the principles of thermodynamics and combustion.
2. Analyze different types of fuels, fuel injection systems, cooling systems and various inlet boosting devices.
3. Interpret and apply the suitable systems for the optimum engine performance.
4. Compare the effects of various engine variables and their performance in spark-ignition and compression-ignition engines.
5. Analyze the engine performance of internal combustion engines by studying the engine exhaust emissions and their control methods.

UNIT I
Fuel – Air Cycles and their Analysis:
10 Hours

UNIT II
Carburetion and Combustion Process in SI engines:
08 Hours

UNIT III
Combustion in CI Engines:
Combustion Chambers:
12 Hours

UNIT IV
Fuel Injection: Requirements of fuel injection systems. Types of fuel injection systems. Fuel pump, fuel atomizer and Injector. Electronic injection systems for CI engines for ECU-system (Electronic Central Unit), Injector system, injection pump, fuel injection system, multi-sparking in SI engines.
Cooling System: Necessity of engine cooling. Air Cooling, water cooling-Thermo Syphon cooling, forced circulation system.
10 Hours
UNIT V


08 Hours

Pre-requisites:
The student should have studied the concepts of basic thermodynamics and applied thermodynamics.

Course Assessment Method:

CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Two assignments / one course project- evaluated through rubrics for 10 marks. For assignments average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Books:

Reference Books:
NON – TRADITIONAL MACHINING

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>14MEE563</td>
<td>04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours/Week</th>
<th>CIE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+0+0</td>
<td>50</td>
</tr>
<tr>
<td>Total Hours</td>
<td>SEE Marks</td>
</tr>
<tr>
<td>48</td>
<td>50</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>Course Type</td>
</tr>
<tr>
<td>03</td>
<td>Program Elective</td>
</tr>
</tbody>
</table>

Course Outcomes:

Students will be able to

1. Recognize a process suitable for a particular application and infer the same
2. Apply the knowledge to unconventional machining process in industry
3. Analyze the concept, mechanism of material removal and their influence on the machining process.
4. To indicate the merits, demerits and applications of various non-traditional machining processes
5. Ability to compare the various nontraditional machining process with respect to process parameters.

UNIT I

Mechanical Process:

Ultrasonic machining (SUM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Magnetostriction assembly, Tool cone (Concentrator), Exponential concentrator of circular cross section & rectangular cross section, Hallow cylindrical concentrator. Mechanics of cutting - Theory of Miller & Shaw., Effect of parameter: Effect of amplitude and frequency and vibration, Effect of grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, standoff distance Applications, advantages & Disadvantages of AJM.

10 Hours

UNIT II


08 Hours

UNIT III

Chemical Machining (CHM):

Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: ;material removal rate accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

10 Hours

UNIT IV

Thermal Metal Removal Processes:

Electrical discharge machining (EDM) introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear , EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode, machining time. Flushing pressure flushing suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy
surface finish, Heat affected Zone. Machine tool selection, Application EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

10 Hours

UNIT V

Plasma Arc Machining (PAM):

Laser Beam Machining (LBM):
Introduction, equipment of LBM mechanism at metal removal, LBM parameters, Process characteristics, Applications, Advantages Limitations.

Electron Beam Machinery (EBM):
Principles, equipment, operations, applications, advantages and limitation of EBM.

10 Hours

Pre-requisites:
The student should have studied Manufacturing Technology and Advanced Manufacturing Technology.

Course Assessment Method:

CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments evaluated through rubrics for 10 marks. Average of two will be considered. (or) Students have to give seminar on the selected topic and have to submit a report, which can be considered for 10 marks. (or) Students have to submit a mini project with report, which can be considered for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book
1. New Technology by BHATTACHARAYA 2000
2. Modem Machining Process”, P .C Pandy & H.S. Shan

Reference Book
1. Production Technology, by HMT TATA McGraw Hill. 2001
2. Modern Machining Process by ADITYA. 2002
4. “Modem Machining Processes”, K . Mishra

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Programme Outcomes</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2</td>
</tr>
</tbody>
</table>
ENERGY ENGINEERING

Sub Code : 14MEE564
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Student will be able to
1. Identify and interpret the different components and explain the working principles of power plants.
2. Explain the working principles and elements of various power plants.
3. Estimate the economic and performance parameters of various power plants.
4. Analyze the estimation of power plant based on various factors of power plants.
5. Compute the draught systems and evaluate various data curves of power plant

UNIT I
Steam Power Plant:
Different types of fuels used for steam generation, Equipment for burning coal in lump form, stokers, different types, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures, A brief account of Benson, Velox, Schmidt steam generators.

Chimneys:
Natural, forced, induced and balanced draft, Calculations involving height of to produce a given draft.
Cooling towers and Ponds: Classification and working principles of various towers and ponds.

10 Hours

UNIT II
Diesel Engine Power Plant:
Applications of Diesel Engines in Power field. Method of starting diesel engines, cooling and lubrication system for the diesel engine. Filters, centrifuges, Oil heaters, Intake and exhaust system, Layout of diesel power plant.

Gas Turbine Power Plant:
Advantages and disadvantages of the gas turbine plant, open and closed turbine plants with the accessories.

10 Hours

UNIT III
Hydro-Electric Plants:
Storage and pondage, flow duration and mass curves, hydrographs, low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks, gates and valves, power house general layout. A brief description of some of the important Hydel Installations in India.

08 Hours

UNIT IV
Nuclear power Plant:

10 Hours

UNIT V
Power station estimation:
Choice of site for power station, load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor, effect of variable load on power plant, selection of the number and size of units.
Economics:
Cost of energy production, selection of plant and generating equipment and operating characteristics of power plants, tariffs for electrical energy.

10 Hours

Pre-requisites:
The student should have studied Elements of Mechanical Engineering, Basic thermodynamics, Applied thermodynamics.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
WELDING TECHNOLOGY

Sub Code: 14MEE565
Credits: 04

Hours/Week: 4+0+0
CIE Marks: 50

Total Hours: 48
SEE Marks: 50

Exam Hours: 03
Course Type: Program Elective

Course Outcomes:

Students will be able to

1. Select a particular method of welding for different joining processes and select an appropriate technique according to a specific requirement.
2. Apply the various welding parameters and their effects on various welding processes related to the quality of weldment
3. Determine the various weld defects and its causes on weld quality and remedies to reduce the defects to greater extent.
4. Inspect and Test of weldments through various destructive and Nondestructive tests and also able predict the life of welds through residual life assessment.
5. Design different welded joints and to understand importance of computer systems and Software’s in various welding techniques.
6. Ability to write reports, make presentations and work in a team

UNIT I

Introduction:

Arc Welding:
Types, Working, advantages, disadvantages and applications of Shielded Metal Arc Welding(SMAW), Submerged Arc Welding(SAW), Metal Inert Gas Welding (MIG), Tungsten Inert Gas welding (TIG), Plasma Arc Welding (PAW), Electro stage and Electro gas welding.
10 Hours

UNIT II

Resistance Welding:
Working, advantages, disadvantages and application of spot welding, projection, seam flash, butt, percussion welding.

Solid Phase Welding:
Working, advantages, disadvantages and applications of friction welding, pressure welding, ultrasonic and explosive welding.

08 Hours

UNIT III

Defects in Welds:
Introduction, Cracks, Distortion and types of distortion, Incomplete Penetration, Inclusions, Porosity and blow holes or gas pockets, Poor Fusion, Poor Weld bead appearance, spatter, Undercutting and over lapping, Causes and remedies of defects.

Inspection and Testing of Welds: Stages of Weld inspection and testing, Inspection before, during and after Welding.

Testing and impaction of welds: tensile test, Hardness tests and Bend tests, Nondestructive inspection of welds: X-ray and Gamma ray radiography, Magnetic Particle Inspection, Dye Penetrant test.
10 Hours

UNIT IV

Life Prediction and Residual Life Assessment:
Life predictions of welding Structures, Residual life assessment, Nature of damage in service,
Involvement of External agencies in FES and RLA, Weld failure.

**Welding Symbols:** Need for representing the Welds, Basic Weld symbols, Local of Weld, Supplementary Symbols, Dimensions of Welds, and Examples.


**10 Hours**

**UNIT V**

**Under Water Welding:**
Introduction, Problems encountered in underwater welding, Types of underwater welding, Characteristics of a good underwater welding processes, Underwater welding processes, salinity of sea water, Applications of underwater welding.

**New developments and Computers in welding:**
Computers systems, Software for Welding engineers, Programming language, Magdata, Preheat, Weldcost, Weldselector, Weldbest and Turbo-IX.

**10 Hours**

**Pre-requisites:**
The student should have studied Manufacturing Technology.

**Course Assessment Method:**
- Test : 30 marks
- Assignment : 10 marks
- Seminar/Surprise: 10 marks
- SEE - Final Exam: 50 Marks

**Text Book**
1. **Welding Technology** by O P Khanna, Dhanpat Rai Publications
2. **Welding Science & Technology** by Prof. Md. Ibrahim Khan, New age International Publishers

**Reference Book**
1. **Welding Processes and Technology** by Dr. R S Parmar, Khanna Publishers.
2. **Advanced Welding Technology** by Dr. S P Tewari, WATSON Press.
3. **Welding Technology for Engineers** by Dr. Baldev Raj, ASM Publishers

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2 2 2 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2 2 2 2 2 1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2 2 2 2 1 1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2 2 1 2</td>
<td></td>
</tr>
</tbody>
</table>
MECHATRONICS

Sub Code : 14MEE566
Hours/Week : 4+0+0
Total Hours : 48
Credits : 04
CIE Marks : 50
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:

Students will be able to

1. Define & outline the development of Mechatronic systems, concept of concurrent & sequential engineering, Sensors, Actuators and Signal conditioners.
2. Illustrate & summarize the working principle of Microprocessor & Microcontrollers Based Mechatronics Systems.
3. Interpret the fundamentals of signal processing for electrical systems.
4. Analyze the importance of data conversions, processing and storage in the microprocessor.
5. Compile an assembly language program to perform various arithmetic operations using 8085A microprocessor.

UNIT I

Introduction of Mechatronics:
Introduction of Mechatronic systems, Evolution on Mechatronics, Measurement system, control systems, microprocessor based controllers, Mechatronics system design approach Automatic washing machine, automatic camera and Engine management system, Mechatronics approach and their associated problems. Examples and discussion on typical systems.
09 Hours

UNIT II

Transducers & Sensors:
Introduction of Transducers, Classifications, Potentiometer, Capacitive Sensor, Eddy current proximity sensor, Hall effect sensor ,Temperature sensor, light sensors, selection of sensors, inputting data by switches, Strain gauge & Wheat Stone Bridge.
08 Hours

UNIT III

Electrical actuation systems:
Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits.

Signal Conditioning:
Introduction to signal conditioning. The operational amplifier, Protection, Filtering, Wheatstone bridge, and Digital signals Multiplexers, Data acquisition, Introduction to Digital system processing Pulse-modulation.
10 Hours

UNIT IV

Introduction to Microprocessors:
Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors. Review of concepts – Boolean algebra, Logic Gates and Gate Networks, Binary &Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real numbers, floating point notation ,representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.

Logic function, Data word representation:
Basic elements of control systems 8085A processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers.
Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.

12 Hours

UNIT V

Organization & Programming of Microprocessors:
Introduction to organization of INTEL 8085-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

Central Processing Unit of Microprocessors:
Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085.

09 Hours

Pre-requisites:
Prior knowledge of Basic Electronics is required.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book:

Reference Book:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

ENGINEERING ECONOMICS

Sub Code : 14MEE567
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Demonstrate problem solving and decision making process based on economic concepts like law of returns, interest factors, cash flow diagrams etc.
2. Evaluate alternative proposals for investment based on economic methods.
3. Apply the methods to find rate of return, depreciation of capital items for decision making.
4. Utilize the process of estimating and costing for analyzing the economic feasibility.
5. Evaluate financial healthiness of a company by calculating and analyzing various financial ratios and asses the budgets for future activities.

UNIT I
Introduction:
09 Hours

UNIT II
Equivalent Annual Worth Comparisons: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, difference between tangible and intangible assets, Exercises Problems.
10 Hours

UNIT III
Rate of Return Calculations and Deprecation: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, and corporate income tax.
10 Hours

UNIT IV
Introduction, Scope of finance, Finance functions:
09 Hours

UNIT V
Financial and Profit Planning: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting.
10 Hours
Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - to familiarize students with the use of Compound interest tables as directed towards interest calculations, Present and future worth comparisons. - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.
SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
SOLAR ENERGY

Sub Code: 14MEE568  Credits: 04
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 48  SEE Marks: 50
Exam Hours: 03  Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Identify the main energy sources and explain the same with the special reference to the Indian context.
2. Classify the various solar measuring devices, thermal radiation devices, solar concentrators and describe their working principles and performance parameters.
3. Interpret the various system components and technologies for thermal energy collection, conversion and utilization.
4. Determine the different sun earth angles and the solar radiation flux on a given location for optimum performance of the solar systems.
5. Analyze the effect of various parameters on the performance of photo-voltaic systems, liquid flat plate collectors and concentrators.

UNIT I
Introduction:
Energy source, renewable energy sources, renewable energy potential and achievements in India, Sustainable energy: The engine of sustainable development Solar energy: General characteristics of solar energy; the Sun, solar spectrum, spectral solar impedance.

Solar Radiation at the Earth Surface:
09 Hours

UNIT II
Solar radiation geometry:
Flux on a plane surface, Sun earth angles-latitude, declination, hour angle, zenith, solar altitude angle, surface azimuth angle, solar azimuth angle, Local apparent time, solar time, apparent motion of sun, day length, some numerical examples. Solar radiation on a inclined surface-Beam, diffuse, reflected radiation on a tilted surface, expression for flux on a tilted surface, monthly average daily radiation on slopped surface, numerical examples.

Solar Thermal Radiation Devices:
Liquid flat plate collectors, solar air heaters, concentrating collectors like cylindrical, parabolic, evacuated tubular collectors. Storage devices: Sensible heat storage, latent heat storage. Application of solar energy: water heating, space heating, space cooling, active and passive cooling, systems, power generation various methods, Refrigeration, Distillation, solar ponds, theory, working principle, operational problems (Sketches, principle of working).
10 Hours

UNIT III
Solar Photovoltaic System:
Introduction, Description, principles of working of solar cell:-Doping, Fermi level, p-n junction, photovoltaic effect. Photovoltaic Material: Single crystal solar cell, Polycrystal solar cell, thin film solar cell, I-V characteristic, limits to cell efficiency, Cell temperature, Current status and Future potential of P.V.
Performance Analysis of Liquid Flat Plate Collectors:
General description, collector geometry, selective surface (qualitative discussion), basic energy – balance
equation, stagnation temperature, transmissivity of the cover system, transmissivity-absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss-coefficient, problems (all correlations to be provided).

10 Hours

UNIT IV

Temperature Distribution:
Between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor mean plate temperature, instantaneous efficiency (all expression to be provided). Effect of various parameters on the collector performance: Collector orientation, selective surface, fluid inlet temperature, number covers, dust.

Solar Concentrators:
Introduction, characteristic parameters: -Aperture area, Acceptance angle, absorber area, geometric concentration ratio. Local concentration ration or brightness concentration ratio, Intercept factor, optical efficiency, thermal efficiency. Concentration ratio.

10 Hours

UNIT V

Concentrators, Types, Classification, Tracking:

09 Hours

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book
INDUSTRIAL ENGINEERING & MANAGEMENT

Sub Code: 14MEE569
Credits: 04
Hours/Week: 4+0+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Recognize the motivational behavior of employees in an organization.
2. Identify various methods of improving overall productivity in an organization.
3. Improve the processes to help the industries to compete in global market.
4. Apply techniques of decision making, customer involvement, work-study, incentive schemes and process improvement.
5. Relate role of technology in management.

UNIT I
Introduction:
Historical perspective, contribution of Taylor, Henry Fayol, Gilbert, Charles Babbage, HL Gantt and others to the evolution of management science in the Indian context. Ownership of Industries Proprietorship, partnership, joint stock companies, public and private undertakings, co-operative organizations.

Management Functions:
Planning: corporate objectives, policies, strategies need for planning, responsibilities and types of plans, modern type of planning, selection of alternatives and process of decision making, case studies.
Organization: Basic requirement, types, structures and merits, Departmentation, vertical and horizontal growth, span of control, authority and responsibility, centralization and decentralization, formal and informal organizations, case studies.

UNIT II
Staffing:
Appraisal of needs, executive development schemes, performance appraisal and managerial mobility.
Directing: Types of instructions and characteristics of good order, communication flow of instructions motivation and leadership.
Controlling: process of control, requirements of effective controlling, controlling techniques.

Work study, Incentives, Health and Safety:
Method study and time study, Foundations of work study, Job evaluation systems, Multi skilling, Incentive schemes, Training and Development, Safety Regulations and safe practices.

UNIT III
Management and Behavioral Approach:
Contribution of Elton Mayo and skinner and others to behavior sciences. Skills of a manager at various levels in an organization and inter-related systems, understanding past behavior, predicting future behavior, directing, changing And controlling behavior.

UNIT IV
Process Management:
Definition of process management. Major process decisions-process choice, vertical integration, resource flexibility, customer involvement, capital intensity, relationships between decisions, service operation relationships between decisions, service operation relationships, economics of scale and gaining focus. Designing process-process rearranging and process improvement.

10 Hours

UNIT V

Management of Technology:

08 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Case Study evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2 1 2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
AUTOMOTIVE ENGINEERING-I

Sub Code : 14MEE570
Credits : 04
Hours/Week : 4+0+0
CIE Marks :50
Total Hours : 48
SEE Marks :50
Exam Hours :03
Course Type : Program Elective

Course Outcomes:
1. Students can enroll the importance of the components in an engine with its ignition and fuel supply system.
2. Students will have the knowledge about different parts involved in increasing the performance of the engine.
3. Enable the students to understand the concepts involved gear box, clutch mechanism, power trains, steering in driving an automotive.
4. Students can understand the criticality in function and mounting of shock absorbers, steering and wheels on to the chassis.
5. Students will study the different parts of automobile including tyres and pressure to be maintained as a hassle free vehicle.

UNIT I

Engines Components and Fuel Supply systems


Ignition Systems: Battery Ignition systems, magneto Ignition system, Transistor assist contacts, Electronic Ignition, Automatic Ignition advance systems.

Superchargers and Turbochargers: Naturally aspirated engines, Forced Induction, Types pf superchargers, Roots supercharger, Spiral (Scroll) supercharger, Turbocharger construction and operation, Intercooler, Turbocharger lag.

10 Hours

UNIT II

Auxiliary systems of automotive engines

Cooling system: Necessity, variation of gas temperature, Areas oh heat flow, heat transfer, piston and cylinder temperature, Heat rejected to coolant, quantity of water required, cooling system, air cooling, water cooling, thermodynamics of forced circulation, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators – types, cooling fan – power requirement, antifreeze solution, types of coolant

Lubrication system: Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, Oil cooling. Heat transfer coefficients, liquid and air cooled engines, coolants, additives and lubricity improvers, concept of adiabatic engines, oil filters, pumps, and crankcase ventilation – types.

10 Hours

UNIT III

Power Trains and steering systems


Steering System: center point steering, correct steering angle, steering mechanisms, cornering force, self-righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting, Numerical problems.

10 Hours
UNIT IV

Automotive Brakes and Suspension System

Brakes: Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock Braking systems, purpose and operation of antilock braking system, ABS Hydraulic Unit, Rear-wheel antilock.

Suspension system: basic considerations, Types of suspension springs, construction, operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting, Numerical problems.

10 Hours

UNIT V

Automotive Chassis and Wheels, Tyres

Frames: Types of frames – Two, Three, four wheelers & HV, general form & dimensions, materials, frame stresses, frame sections, cross members, proportions of channel sections, constructional details, loading points, sub frames, passenger car frames, X member type frame, Box section type frame, testing of frames, bending and torsion test, effect of brake application of frame stresses, truck frames, defects, Numerical problems.

Wheels and Tyres: Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting.

08 Hours

Course Assessment Method:

CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Case Study/Miniproject evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book
3. Automotive Engineering, Powertrain by Chassis System and Vehicle Body, Edited by David A. Crolla, Edited by David A. Crolla

Reference Book
Course Outcomes:
Students should be able to
1. Determine coefficient of friction, minor losses in flow through pipes and force developed by impact on jets on vanes.
2. Calibrate the flow measuring devices to measure the discharge coefficient and other flow parameters.
3. Conduct the experiments on hydraulic turbines to obtain different performance characteristics.
4. Determine and demonstrate performance parameters of pumps and compressors.
5. Write effective report and document.

UNIT I
1. Determination of Coefficient of Friction of flow in a pipe.
2. Determination of Minor Losses in Flow through pipes.
3. Determination of Force developed by impact on jets on Vanes.
4. Calibration of Flow measuring devices
   a. Orifice Plate
   b. Venturimeter
   c. Rotameter
   d. Nozzle

UNIT II
1. Performance testing of Turbines.
   a. Pelton wheel
   b. Francis turbine
2. Performance testing of pumps.
   a. Single stage & multi stage centrifugal pumps
   b. Double acting Reciprocating pump.
3. Performance test on a two stage Reciprocating Air compressor.

Pre-requisites:
Basic knowledge of Fluid Mechanics needed.

Course Assessment Method:
Record : 30 marks
Test : 15 marks
Study project/Viva :05 marks
SEE - Final Exam: 50 Marks

Scheme of Examination: Student will be asked to conduct one experiment from each unit.
MACHINE SHOP

Sub Code : 14MEL58
Credits : 1.5
Hours/Week : 0+0+3
CIE Marks : 50
Total Hours : 39
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:
Student will be able to
1. Identify the different machine tools.
2. Demonstrate the operations of lathe, shaping and milling machines.
3. Determine the various process parameters for machining operations.
4. Formulate the process chart for the job.
5. Estimate the machining rate of the job.

UNIT I
Plain Turning, Taper turning, step turning, Thread cutting, facing, knurling, Eccentric turning using lathe.
(Minimum 3 models involving all the above processes)

UNIT II
1. Cutting of gear teeth using milling machine.
2. Cutting of V-Groove, Dovetail, Rectangular groove using shaping machine.

Pre-requisites:
Basic knowledge of Manufacturing Technology needed.

Course Assessment Method:
Record : 30 marks
Test : 15 marks
Study project/Viva : 05 marks
SEE - Final Exam: 50 Marks

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DESIGN OF MACHINE ELEMENTS II

Sub Code : 14ME61
Credits : 04
Hours/Week : 4+1+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Core

Course Outcomes:

Students will be able to

1. Identify the design considerations for machine elements such as gears, bearings, brakes, clutches and springs.
2. Evaluate static and dynamic strengths of clutch, brakes, springs and gears for different
3. Design the machine elements for its functionality at design and off-design conditions
4. Apply specific methodology in synthesis and analysis of components
5. Select appropriate materials and optimize design parameters for the machine elements.

UNIT I

Spur Gears:
Terminology, Forces analysis, Beam strength of spur gear tooth. Lewis Equation and form factor, Design for strength, Dynamic Load and wear load

Helical Gears:
Terminology, Forces analysis, formative/virtual number of teeth, Beam strength of helical gear tooth. Lewis Equation and form factor, Design for strength, Dynamic Load and wear load.

10 Hours

UNIT II

Worm Gears:
Terminology, Forces analysis, efficiency of worm and worm gear, worm gear strength, Thermal capacity of worm gear sets.

Bevel Gears:
Terminology, Forces analysis, formative/virtual number of teeth, Beam strength of straight tooth Bevel gear, Design for strength, Dynamic Load and wear load.

10 Hours

UNIT III

Brakes:
Types, Thermal considerations in Brakes, Design of Block shoe (Single & Double), Band Brakes (Simple & differential): Self Locking of brakes

Springs:

10 Hours

UNIT IV

Lubrication:
Lubricants and their properties, Modes of Lubrication (Hydrodynamic & Hydrostatic).

Sliding Contact bearings:

Rolling contact bearings:
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

10 Hours

UNITV

Curved Beams:
Differences between Straight & curved beam, Derivation of bending Stress equation for a curved beam subjected to pure bending. Stresses in curved Beams subjected to Direct and Bending loading of Standard cross sections (Circular, Rectangular, Trapezium, Triangle, I & T Sections) used in crane hook, punching presses & clamps, Closed rings & chain links.

Clutches:
Types, friction materials & properties, Torque transmitting capacity- Uniform pressure & wear theory. Design of Single plate, multi plate and cone clutch.

08 Hours

Pre-requisites:
The student should possess good knowledge of Mechanics of Materials.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Mini Project/Case study is evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book
1. Design of Machine Elements by V.B.Bhandari, 2nd Ed 2007, TataMcgrawhill

Design Data Handbook
3. PSG Design Data Hand Book by PSG College of Technology.

Reference Book

| Course Outcomes | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

67
MECHANICAL VIBRATIONS

Sub Code : 14ME62
Credits : 04

Hours/Week : 4+1+0
CIE Marks : 50

Total Hours : 48
SEE Marks : 50

Exam Hours : 03
Course Type : Program Core

Course Outcomes:

Students will be able to

1. Formulate the mathematical models for undamped and damped mechanical vibrations systems.
2. Understand the role of damping, stiffness and inertia in mechanical systems.
3. Predict the frequency response for mechanical vibration systems under different loading conditions.
4. Analyze rotating systems to compute critical speed of shaft and studies different frequencies using measuring instruments.
5. Evaluate the natural frequencies of Two DOF Systems and Multi DOF Systems.

UNIT I

Fundamentals of Vibrations:
Concept of Vibration, Definitions, Vector method of representing Harmonic Motions, Addition of the two Simple Harmonic Motion of the same frequency, Beats Phenomenon, Fourier Series and Harmonic Analysis.

Undamped Free Vibrations of Single DOF systems:
Derivation of Differential equation for spring mass system, Solution of Differential equation, Equivalent Stiffness of spring combinations, Energy Method, Raleigh method, Torsional Vibration. Problems on Single DOF to find the frequency of the system such as simple pendulum, compound pendulum, spring controlled simple pendulum, Beams, A cylinder oscillating on another cylindrical surface, a half cylinder oscillating on a flat surface, vibrating liquid column in U tube, effect of mass of the spring on natural frequency, cylinder floating in a liquid, frequency for small oscillations of the fluid between the two tanks, spring mass pulley system.
10 Hours

UNIT II

Damped Free Vibrations of Single DOF systems:
Different types of Damping, Dry Friction, Solid damping, Interfacial Viscous Dampers. Free vibrations with Viscous damping for spring mass damper system, solutions for different amount of damping in the system: Over damped, Critically Damped, Under Damped. Logarithmic Decrement.
8 Hours

UNIT III

Forced Vibrations of Single DOF systems:
10 Hours

UNIT IV

Critical Speeds of Shafts:
Critical speed of a light shaft having a single disc, with and without damping.
Two Degrees of Freedom systems:
Principal modes of vibration for a two DOF spring mass system, two masses fixed on a tightly stretched string, double pendulum, two rotor system, combined pendulum and spring mass system. Combined rectilinear and angular modes. Systems with damping. Coordinate coupling. Torsionally equivalent shaft.
10 Hours

UNIT V

Multi-degree-of-Freedom Systems
Introduction, Influence Coefficients, Newton’s method, Maxwell’s reciprocity theorem, Dunkerley’s Formula, Holzer’s Method, Orthogonality of principal modes, Stodola method.
10 Hours

Pre-requisites:
Knowledge of Engg Mechanics, MOM and Maths I, II, III and IV is required.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments – to begiven on dynamic analysis as directed toward vibration problems. - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book
OPERATIONS RESEARCH

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
<th>Hours/Week</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Course Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>14MEH63</td>
<td>04</td>
<td>4+1+0</td>
<td>50</td>
<td>50</td>
<td>Program Core</td>
</tr>
</tbody>
</table>

Course Outcomes:
Students will be able to
1. Able to understand and reproduce the concept and scope of operations research in managerial problems to use the scarce resources (capitals, materials, staffing, and machines) more effectively
2. Apply the knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry.
3. Identify best possible method to find out optimized solution
4. Evaluate the decision variables for mathematical formulations using various methods
5. "Extend the skills in the use of Operations Research approaches in formulating and solving real time problems like transportation, assignment, game theory, Queue theory and Project analysis.

UNIT I
Introduction:
Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem formulation and solution by graphical method.
09 Hours

UNIT II
The simplex method
10 Hours

UNIT III
Transportation Problem:
Assignment Problem:
Mathematical Formulation, Hungarian method, Minimal, Maximal & unbalanced assignment problem, traveling salesman (Routing) problem.
10 Hours

UNIT IV
Sequencing:
Terminology & notations, Johnson’s algorithm, processing of : n-jobs to 2 machines, n jobs 3 machines, n jobs m machines without passing sequence. 2 jobs n machines with passing. Graphical solution.
Game Theory:
Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.
10 Hours

UNIT V
PERT-CPM Techniques:
variance under probabilistic models, prediction of date of completion, crashing of simple networks-
Optimum duration & Minimum duration cost.

**Queuing Theory:**
Queuing system and their characteristics. The M/M/1 queuing system, steady state performance and
analysis of M/M/1 & M/M/C queuing model.

09 Hours

**Course Assessment Method:**
*CIE* - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
*SEE* - Final Exam: 50 Marks

**Text Book**

**Reference Book**

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Programme Outcomes:

1. 2
2. 1
3. 3
4. 2
5. 1
SIMULATION LAB

Sub Code : 14MEL64
Credits : 2

Hours/Week : 1+0+2
CIE Marks : 50

Total Hours : 39
SEE Marks : 50

Exam Hours : 03
Course Type: Program Core

Course Outcomes:
1. Knowledge: Given an English language problem description &/or a schematic representation of the problem, define the problem precisely, identify the input/output requirements, examine the simplicity/complexity of the problem and develop a generic initial solution using MATLAB/SIMULINK software & finally to interpret & justify the correctness of the result.
2. Application: Given problem definition involving mechanical engineering or mechatronic system (Multi-discipline), apply various analytical modeling techniques to obtain the differential equation describing the system and to solve the same using MATLAB/SIMULINK environment.
3. Analysis: Examine the given problem, break down the given system into sub systems &analyze boundary conditions & the various process/system parameters associated with it.
4. Synthesis: Design a SIMULINK Model of the system by connecting all the sub systems together to obtain a unified system response solution for various values of the given input parameters and constraints.
5. Create: Develop a system describing the real world application problems in MATLAB/SIMULINK and solve them individually or in a group with effective project management skills (Communication, Documentation).

UNIT I

Fundamentals of MATLAB
Introduction to MATLAB, Graphic User Interface (GUI), Basic programming involving arithmetic operations, workspace variables, strings, calling functions, matrix & array operations, linear algebra, basic plotting functions, control flow. 10 Hours

UNIT II

Modeling, Simulation and Analysis
1. Dynamics & Vibrations of Mechanical Systems using MATLAB
   a) Spring Mass Damper System (Forced & Unforced System Response)-1 DOF & Multi DOF.
   b) Simple & Double Pendulum
   c) Inverted Pendulum on Cart
   d) Three bar linkage
2. System Response Simulation using SIMULINK
   a) Spring Mass Damper
   b) Electro-Mechanical System
   c) Quarter Car Model
   d) Simple Electrical System
3. Overview of various SIMULINK tools with Case Studies SimScape, SimMechanics, SimDriveline, SimHydraulics.
   20 Hours

UNIT III
Course Project - Max 2 Students per group
Students have to take up a case study or a mini project on real world application driven problem &
Solve them using MATLAB/SIMULINK. Each Group is required to give a brief report & presentation
on their project at the end of completion of their project.

09 Hours

Course Assessment (CIE+SEE)
CIE:
- Engineering Journal/Record: 10 Marks
- Mid Sem Exam (MSE)- 20 Marks
- Course Project: 10 Marks
- Viva/Voce: 10 marks

SEE:
- Final Exam: 50 Marks

Scheme of Examination:
- Students would be given a minor problem from Unit I & a major problem from Unit II.

Text Book & References
1. "MATLAB Primer" by MathWorksInc (Open Source available over Internet)

Course Pre-Requisites:
1. Computer Concepts & ‘C’ Programming
2. Mechatronics, Mechanical Vibrations & Control Engineering

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
TOOL DESIGN

Sub Code : 14MEE651
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03

Credits : 04
CIE Marks : 50
SEE Marks : 50

Course Type: Program Elective

Course Outcomes:
Students will be able to
1. An ability to define modern tools like Jigs & Fixtures Press tools, die casting dies and Injection moulding tools.
2. An ability to select the proper tool to increase the rate of production.
3. An ability to apply the knowledge in the shop-floor.
4. An ability to reduce the wastage of raw materials.
5. An ability to choose the proper die casting dies for almost defect free castings.

UNIT I

Introduction to tool design: Tooling requirement of a tool designer, General tool designing procedure.

Design of Single Point Cutting Tool: Design of single point lathe tool, Design of shank dimension using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry. Solid type tool, brazed tip tool, long indexable insert, through indexable insert types and chip breakers.

Design of Multi Point cutting Tool: Drill bit design of elements like back taper, Web thickness, land width, Margin, flute length, Cross section and selection of tool geometry.

Design of milling cutter: Design elements like Number of teeth and Height circular pitch, Body thickness, Chamfer width, fillet radius and Selection of tool geometry. Design of Flat and Circular form tools.

10 Hours

UNIT II


Design of Fixtures: Fixture design, Turning fixtures, Milling fixtures, Grinding and Broaching fixtures, Indexing fixtures, Design of fixtures for simple components.

10 Hours

UNIT III


10 Hours

UNIT IV

Bending & Drawing: Bending dies: Introduction, Bend allowances, Spring back, Edge bending die design., Drawing dies: Single action, Double action and triple action dies, Factors affecting drawing, Drawing die design.

09 Hours

UNIT V

Die casting Dies: Terminology: Core, Cavity, Sprue, Slug, Fixed and movable core, Finger cams, Draft, Ejector pins, Ejector plates, Gate, Goose nozzle, Over-flow, Platen, Plunger, Runner, Vent, Water-line, etc.

Types of Dies: Single cavity, Multicavity dies, Combination dies, Advantages and disadvantages of types of dies. Die casting alloys, Defects in die casting, Finishing trimming and inspection of die casting components, safety, modern trends in die casting dies.
**Injection Moulding:** Injection moulding machine and its elements, general configuration of a mould, 2 plate & 3 plate mould. Introduction to Gate, Runner, parting surface ejection system, Core & cooling system, Introduction to compression, Transfer Blow moulding, Extrusion, forming and Calendaring.

**09 Hours**

**Pre-requisites:**
The student must have undergone a course on Mechanics of Materials, Finite Element Methods and Mechanical Vibrations.

**Course Assessment Method:**
**MSE – 50 Marks**
1. Three Mid Semester Examination (MSE) tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - to familiarize students with the use of Compound interest tables as directed towards interest calculations, Present and future worth comparisons. - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

**SEE – 50 Marks**
3. Two questions to be set from each unit, carrying 20 mark each.
4. Students have to answer 5 questions selecting one full question from each unit

**Text Book**

**Reference Book**
2. Typical example and problems in metal Cutting theory and cutting tool design by N. Nefdov, K. Osipov, Mir Pub. Edn. 1987
5. Fundamentals of tools design, ASTME prentice hall India. 2000.

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
THEORY OF PLASTICITY AND METAL FORMING PROCESSES

Course Code : 14MEE652
Credits : 04
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
CIE Marks : 50
SEE Marks : 50
Course Type : Program Elective

Course Outcomes:

Students will be able to

1. Analyze the stress-strain behavior of various types of materials subjected to combinations in elasto-plastic region and their mechanisms.
2. Interpret suitable plastic yield criteria, check for yielding and plot yield locus for 2d and 3d stress space.
3. Analyze plastic flow problems using slip-line nets upon choosing ideal slip-line field constructing methods by considering sign conventions and apply suitable hencky’s theorem for the analysis.
4. "Compute for incipient, elasto-plastic, fully-plastic yielding and residual stresses for beams and bars subjected to bending and torsion respectively for both ideal and non-linear stress-strain behavior of materials.
5. Analyze the effect of process parameters during metal forming processes and interpret the flow stress, redundant work and method of analysis of metal forming processes, in both elasto-plastic and plastic region.

UNIT I

Plastic Deformation of Metals: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or luder’s cubes.

Stress Strain Relations: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St. Venant’s theory of plastic flow, the concept of plastic potential, the maximum work hypothesis, mechanical work for deforming a plastic substance.

08 Hours

UNIT II

Yield Criteria: Introduction, yield or plasticity conditions, Von-Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), energy required to change the shape with basic principle problems.

Slip Line Field Theory: Introduction, basic equations for incompressible two dimensional flows, continuity equations, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line nets.

10 Hours

UNIT III

Bending of Beams: Analysis for stresses, nonlinear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems.

Torsion of Bars: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems.

12 Hours

UNIT IV

Metal Forming Process: Introduction, Cold working, warm working, hot working, flow stress, Coefficient of friction, work of deformation, methods of analysis of metal forming.

Drawing & Extrusion Process: Introduction, zero-friction case, wire drawing and extruding considering friction, defects in extrusion, extrusion equipment.

10 Hours

UNIT V

Forging: Introduction, forging operations, forging processes, design of forging dies, drop forging die design, upset forging die design, forgeability, strip forging, upsetting under axial symmetry, closed die forging with overlapping dies, closed die press forging with axial symmetry and overlapping dies, forces in impression die forging.

08 Hours
Pre-requisites: The student should have studied Material Science, Mechanics of Materials, and Advanced Manufacturing Technology, Theory of Elasticity.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Two assignments / one course project- evaluated through rubrics for 10 marks. For assignments average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Books:

Reference Books:
2. Theory of Plasticity by L.S.Srinath, TMH.

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
REFRIGERATION AND AIR CONDITIONING

Sub Code : 14MEE653
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Describe the fundamental principles of refrigeration and air-conditioning systems through various refrigeration cycles.
2. Illustrate the functions of various components of refrigeration and air-conditioning systems with suitable refrigerants.
3. Compute the performance parameters of vapor compression refrigeration system using analytical and graphical approach.
4. Apply the concept of refrigeration in the use of air-conditioning systems through psychometric relations and charts.
5. Evaluate the various components of air-conditioning systems for optimum performance.

UNIT I
Brief Review of Various Methods of Refrigeration:
Refrigerants:
Survey of Refrigerants, Comparative study of Ethane and Methane derivatives, selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures.
10 Hours

UNIT II
Multi Pressure Vapour Compression Systems:
Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.
10 Hours

UNIT III
Vapour Absorption System:
Psychometry of Air Conditioning Process-Review:
Summer Air conditioning, Apparatus Dew point, winter air conditioning
10 Hours

UNIT IV
Design Conditions:
Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.
Load Calculations and Applied Psychometrics:
Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor,
cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.

10 Hours

UNIT V

Transmission and Distribution of Air:
Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design.

Controls in Refrigeration and Air Conditioning Equipments:
High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, by pass control-Damper motor. VAV controls. 08 Hours

Pre-requisites:
The student should have in-depth knowledge of subjects such as basic thermodynamics and applied thermodynamics.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book
OPERATIONS MANAGEMENT

Sub Code : 14MEE654
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Gain an understanding and appreciation of principles and applications relevant to planning, design and operation of manufacturing/ service firms.
2. Develop necessary skills to effectively analyze and synthesize many inter-relationship in production systems.
3. Gain ability to recognize the situations in production systems environment that suggests use of quantitative methods to assist in decision making.
4. Understand aggregate planning and master scheduling techniques.
5. Choose a frame work of inventory control and enterprise resource planning through MRP-II.

UNIT I
Operations Management Concepts and Decision Making:
11 Hours

UNIT II
System Design & Capacity Planning, Forecasting:
Design capacity, System capacity, and Determination of Equipment requirement. Facility Location and Facility Layout Location Planning for Goods and Services, foreign locations and facility layout. Forecasting Objectives and Uses, Forecasting Variables, Opinion and Judgmental methods, Time Series methods, Exponential smoothing, Regression and Correlation methods, Application and Control of Forecasts.
10 Hours

UNIT III
Aggregate Planning and Master Scheduling:
Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods.
08 Hours

UNIT IV
Supply chain, Inventory Control, Material and Capacity Requirements:
Planning Components and model of supply chain, inventory control, inventory cost, order quantities and inventory classification. MRP and CRP, MRP: Underlying Concepts, System Parameters, MRP Logic, System refinements, Capacity Management, CRP activities. Concept of continuous improvement of process.
09 Hours

UNIT V
Scheduling and Controlling Production Activities:
Introduction, PAC objectives and data requirements, Scheduling strategy and guidelines, Scheduling Methodology, Priority Control, Capacity Control.
Single Machine Scheduling:
Concept, Measures of Performance, SPT Rule, Weighted SPT Rule, EDD Rule, Minimizing the number of tardy jobs.
Flow Shop Scheduling:
Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS Heuristic.

Job Shop Scheduling:
Types of schedules, Heuristic Procedure, Scheduling 2 Jobs on 'm' machines.

10 Hours

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10  11  12</td>
<td>1  2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ALTERNATIVE FUELS

Sub Code : 14MEE655
Credits : 04

Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course outcomes
Students will be able to
1. Describe the properties of solid, liquid and gaseous forms of alternate fuels and their effective utilisation.
2. Interpret the concepts of emerging technologies of alternative fuels and drive trains.
3. Illustrate the production, handling, merits, demerits and environmental effects of alternate fuels.
4. Compute the exhaust emissions of various alternative fuels and compare with fossil fuel.
5. Analyse the benefits of alternative fuels to manage global fossil fuel crisis.

UNIT I
Overview of an Alternative fuels: Introduction, Classification of alternative fuels, Technological up gradation and inspection required for alternative fuel vehicles, need for alternative fuels, impelling causes for alternative fuels, implementation barriers.

10 Hours

UNIT II
Bio Fuel: Introduction, properties, production, applications, advantages, disadvantages, Health and Environmental effects and storage of Ethanol, Methanol and Butanol and Numerical problem

09 Hours

UNIT III
CNG, LNG and LPG
CNG: Storage, production, advantages and disadvantages
LNG: Storage, properties, production, advantages and disadvantages, LNG to CNG conversion system
LPG: Storage, properties, production, advantages and disadvantages safety system for LPG.

10 Hours

UNIT IV

09 Hours

UNIT V
Duel Fuel technology: Operations, Conversion of a CI engine to Duel fuel engine.

10 Hours

Course Assessment Method:
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text book

Reference book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
TOTAL QUALITY MANAGEMENT

Sub Code : 14MEE656
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Understand the philosophy and core value to TQM and to determine the voice of customers and its impact on quality.
2. Apply and evaluate best practices for attainment of total quality.
3. Understand the methodologies to enhance the management process such as bench marking, business process reengineering.
4. Choose the framework to evaluate the performance excellence of organization, human resource and to determine the set of performance indicators.
5. Identify the areas for quality improvement through QFD and FMEA.

UNIT I
Overview of TQM:
Leadership, Customer Satisfaction and Employee Involvement:
12 Hours

UNIT II
Human Resource Practices:
Scope of Human Resources Management, leading practices, designing high performance work systems-work and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal.
08 Hours

UNIT III
Tools and Techniques in TQM:
7 basic tools of quality control, Kaizen, Re-engineering, 6 sigma, Benchmarking, Definition, Process of benchmarking, 5S, Poke yoke, 3M, Pareto diagram, Process flow diagram.
08 Hours

UNIT IV
Building and Sustaining Total Quality Organizations:
Making the commitment to TQ, Organizational culture and Total Quality, Change management, sustaining the quality organization, quality assurance, concepts and objectives of quality assurance.
Quality Management Systems:
Quality management systems through ISO standards.
10 Hours

UNIT V
Quality Function Deployment and Failure Modes Effects Analysis:
Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, FMEA, Design FMEA and process FMEA
10 Hours

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Seminar will be conducted for a group of 5 students-evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book
2. Total Quality Management: Dale H. Besterfield, Publisher - Pearson Education India, Edition 03/e Paperback (Special Indian Edition).

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 2 2 3 3 2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2 2 1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1 2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1 2 2 3</td>
<td>2 2</td>
</tr>
</tbody>
</table>
STATISTICAL QUALITY CONTROL

Sub Code : 14MEE657
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students would be able to
1. Understand the quality improvement and control technique.
2. Formulate the different problems and analysis quality control technique.
3. Analyze the problems by the help of controls chart.
4. Analyze the problems by the help of controls chart of conformities and nonconformities.
5. Evaluate the graphical method of sampling problems to confirm whether the problems are in statistical control.

UNIT I
Introduction:
The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement).

UNIT II
Modeling Process Quality:
Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

Methods and Philosophy of Statistical Process Control:
Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

UNIT III
Control Charts for Variables:
Control Charts for X-Bar and R charts, Type I and Type II errors.

Process Capability:
The foundation of process capability, Natural Tolerance limits, Cp – process capability index, Cpk, pp – process performance index, summary of process measures.

UNIT IV
Control Charts For Attributes:
Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit.

UNIT V
Lot-By-Lot Acceptance Sampling For Attributes:
The accepting sampling problem, single sampling plan for attributes, Double, Multiple, and sequential sampling, AOQL, LTPD, OC curves

Cumulative-Sum (CUSUM) & Exponentially Weighted Moving Average (EWMA) Control Charts:
CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of a EWMA control chart.

Pre-requisites:
The student should have studied Maths I and Maths-II.
Course Assessment Method:
CIE –50 Marks  
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.  
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.  
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks  
1. Two questions to be set from each unit, carrying 20 mark each.  
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book  

Reference Book  

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes 1</th>
<th>Program Outcomes 2</th>
<th>Program Outcomes 3</th>
<th>Program Outcomes 4</th>
<th>Program Outcomes 5</th>
<th>Program Outcomes 6</th>
<th>Program Outcomes 7</th>
<th>Program Outcomes 8</th>
<th>Program Outcomes 9</th>
<th>Program Outcomes 10</th>
<th>Program Outcomes 11</th>
<th>Program Outcomes 12</th>
<th>PSO 1</th>
<th>PSO 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RENEWABLE ENERGY RESOURCES

Sub Code : 14MEE658
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type : Program Elective

Course Outcomes:
1. Identify the main energy sources and explain the same with the special reference to the Indian context.
2. Classify the various solar measuring devices, thermal radiation devices, solar concentrators and describe their working principles.
3. Interpret the desirable features and conversion technologies of solar, wind, biomass, tidal and geothermal energy resources.
4. Identify and solve the problems of energy crises using wind and solar energy.
5. Analyze various applications such as solar energy storage system, solar water heating, space heating, space cooling, solar thermal electric conversion.

UNIT I
Energy Sources and their Availability:
Introduction, commercial or conventional energy sources, Non-conventional energy sources, new energy techniques.

Solar Radiation and its Measurement:

09 Hours

UNIT II
Solar Energy collectors:
Introduction, physical principles of the conversion of solar radiation into heat, flat plate collectors, thermal analysis of flat plate collector and useful heat gained by the fluid, concentrating collector: focusing type, advantages and disadvantages of concentrating collectors over flat plate type collectors.

08 Hours

UNIT III
Applications of Solar Energy System:
Solar energy storage system, solar water heating, space heating, space cooling, solar thermal electric conversion, solar photovoltaics, solar distillation, pumping, furnace, cooking, green house, solar production of hydrogen.

09 Hours

UNIT IV
Wind Energy:
Introduction, Basic principles: nature of the wind, power in the wind, forces on the blade, wind energy conversion, wind data and energy estimation, basic components of wind energy conversion system (WECS), classification of WECS, advantages and disadvantages of WECS, Type of wind machines, energy storage, applications.

Energy from Biomass:
Introduction, biomass conversion technologies, photosynthesis, biogas generation, factors affecting biodigestion, classification of biogas plants, advantages and disadvantages of floating drum plant advantages, advantages and disadvantages of fixed dome type plant, constructional details of some main digesters, bio gas from plant wastes, materials used for bio gas generation, utilization of bio gas.

11 Hours

UNIT V
Geothermal Energy:
Introduction, geothermal sources, hot dry rock resources, magma resources, comparison of flashed steam and total flow concept, interconnection of geothermal fossil systems, applications, material selection for geothermal power plants.
Tidal Power:
Introduction, basic principle of tidal power, components of tidal power plants, operation methods, estimation of energy and power in simple single basin tidal system, storage, advantages and limitations.

11 Hours

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
AUTOMOTIVE ENGINEERING-II

**Sub Code:** 14MEE659  **Credits:** 04
**Hours/Week:** 4+0+0  **CIE Marks:** 50
**Total Hours:** 48  **SEE Marks:** 50
**Exam Hours:** 03  **Course Type:** Program Elective

**Course Outcomes:**
1. Students can understand the functions and importance of electrical and electronics based systems in a vehicle.
2. Students will have the knowledge in developing an automotive structure based on the type of the vehicle considering the vehicle safety.
3. Enable the students to understand the ethical standards of emission in consideration with environmental safety during the exhaust of an automobile.
4. Students can understand the importance of vehicle stability at high speed cruise and digitalization of engine control.
5. Students will study the different types of automobiles and importance of the parts based on the type of the vehicle.

**UNIT I**

**Automotive electrical and electronic systems**

**Battery:** Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency.

**Starter Motor & Drives:** Battery motor starting system, condition at starting, behavior of starter during starting series motor and its characteristics.

**Automotive Electronic systems:** Modern automotive Instrumentation, Input and output signal Conversion, Sampling, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, LED, LCD, CRT etc.

10 Hours

**UNIT II**

**Automotive Structural design and Material**

Terminology and overview of vehicle structure types, Strength, Stiffness, vibration behavior, Selection of vehicle type and concept, manufacturer’s approach to current design, Panel dent resistance and stiffness testing, fatigue, Integration of materials into designs, Engineering requirements for plastic and composite components, Cost analysis.

10 Hours

**UNIT III**

**Vehicle Control System**

**Vehicle motion control system:** Introduction, Typical cruise control system, Cruise control electronics, Antilock braking system, Electronic suspension system, Electronic steering control.

**Digital engine control systems:** Introduction, Digital engine control, Digital engine control features, Control modes for fuel control, Exhaust Gas Recirculation control, Variable valve timing control, electronic ignition control, integrated engine control system.

09 Hours

**UNIT IV**

**Vehicle safety, Air Pollution and Control**

**Vehicle safety:** Crash testing, Structural safety and airbags, Side impacts, Smart air bags, Seat belts, Seating, The pedal controls, Tyres, suspension and steering, Suspension control, Automatic braking and traction control, Ergonomic considerations and safety.

**Emission Control Systems:** Automotive emission controls, controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the
combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator system, Catalytic converter, Emission standards-Euro I, II, III and IV norms, Bharat Stage II, III norms.

**09 Hours**

**UNIT V**

**Alternative Vehicles:**

**Electric Vehicles:** Introduction, Battery Types, Lead-Acid Batteries, Nickel-Cadmium (NiCd) Batteries, Nickel-Metal Hydride (NiMH) Batteries, Lithium Ion (Li-Ion)/Lithium Polymer Batteries. Types of Electric Vehicles.

**Hybrid Electric Vehicles:** Introduction, Hybrid-drive prospects, Hybrid technology case Studies, Hybrid passenger and goods Vehicles, Dual Hybrid Systems.

**Earth Moving, equipment’s and Maintenance:** Different types of earth moving equipment’s and their applications (Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments). Basic types of transmissions, constructional and its working principles. Types of maintenance schedules purpose and advantages, organization set ups, documentation. Safety methods for earth moving equipment’s.

**10 Hours**

**Course Assessment Method:**

Test: 30 marks  
Seminar/Assignment: 10 marks  
Surprise: 10 marks  
SEE - Final Exam: 50 Marks

**Text Books:**

3. *Automotive Engineering, Powertrain, Chassis System and Vehicle Body* Edited by David A. Crolla, Edited by David A. Crolla

**Reference Books:**

INDUSTRIAL ROBOTICS

Sub Code : 14MEE660  
Credits : 04

Hours/Week : 4+0+0  
CIE Marks : 50

Total Hours : 48  
SEE Marks : 50

Exam Hours : 03  
Course Type : Program Elective

Course Outcomes:
1. Will have the knowledge of fundamentals of robotics, graphics, and configurations of serial manipulators, workspace, frames, 3D transformations and Robot programming.
2. Describe the concepts of Euler’s angles, Differential velocities, D-H Representation, Forward and Inverse kinematics, fuzzy logic and robot vision.
3. Application of Calculus & Linear algebra, for kinematics, dynamics & trajectory planning respectively.
5. Development of generic algorithms to perform various robot tasks and obtain the robot program using AML and VAL.

UNIT I
Introduction and Mathematical Representation of Robots:
10 Hours

UNIT II
Kinematics of serial manipulators:
Velocity and Statics of Manipulators:
Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulator, Statics of serial manipulators.
10 Hours

UNIT III
Dynamics of Manipulators:
Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian, Newton- Euler formulation.
Trajectory Planning:
Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning
10 Hours

UNIT IV
Robot Programming:
Introduction, Manual teaching, lead through teaching, programming languages, AML and VAL simple example, programming with graphics, storing and operating, Task programs.
Fuzzy logic control:
Introduction, fuzzy control, fuzzy sets, fuzzification, fuzzy interference rule base, defuzzification, center of gravity method, mandani’s inference method, applications.

08 Hours

UNIT V

Robot Vision:

10 Hours

Pre-requisites:
Knowledge of Theory of Machines-I is essential.

Course Assessment Method:

CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
SMART MATERIALS

Sub Code : 14MEO661
Hours/Week : 4+0+0
Total Hours : 38
Exam Hours : 03

Credits : 03
CIE Marks : 50
SEE Marks : 50
Course Type : Open Elective

Course Outcomes:

Students will be able to
1. Describe the characteristics of materials such as Metals, Polymers and Ceramics.
2. Indicate the Electro, Magneto Rheological fluids and Chromic materials for various mechanical systems.
3. Exploit Electrostrictive and Magnetostrictive materials in the design of different actuators.
4. Distinguish the properties of shape memory alloys with other class of materials and propose its suitability for a range of applications.
5. Implement the smart materials in the development of smart composites.

UNIT I

Introduction:

Sensing and actuation:
Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation. Types of sensors and their applications. Compatibility with conventional and advanced materials.

07 Hours

UNIT II

Shape Memory Alloys:
History of shape memory alloys. Classification of shape memory alloys. NITINOLS – melting, casting and forming of NITINOLS, shape memory and pseudoplasticity. Mechanical and bio-medical applications of NITINOL. Vibration control through shape memory alloys.

08 Hours

UNIT III

Piezoelectric Materials:

08 Hours

UNIT IV

Electro rheological (ER) and magneto rheological (MR) fluids:
Mechanisms and properties, fluid composition and behavior. Applications to clutches, vibration dampers and others. Chromic materials – thermochromic, photochromic, piezochromic materials and their applications.

07 Hours

UNIT V

Composite Materials:

08 Hours

Pre-requisites:
The student should have basic knowledge of Materials Science & Metallurgy.
Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SOLAR ENERGY

Sub Code : 14MEO662
Credits : 03
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type : Open Elective

Course Outcomes:
Students will be able to
1. Identify the main energy sources and explain the same with the special reference to the Indian context.
2. Classify the various solar measuring devices, thermal radiation devices, solar concentrators and describe their working principles and performance parameters.
3. Interpret the various system components and technologies for thermal energy collection, conversion and utilization.
4. Determine the different sun earth angles and the solar radiation flux on a given location for optimum performance of the solar systems.
5. Analyze the effect of various parameters on the performance of photo-voltaic systems, liquid flat plate collectors and concentrators.

UNIT I
Introduction:
Energy source, renewable energy sources, renewable energy potential and achievements in India, Sustainable energy: The engine of sustainable development Solar energy: General characteristics of solar energy; the Sun, solar spectrum, spectral solar impedance.

Solar Radiation at the Earth Surface:

UNIT II
Solar radiation geometry:
Flux on a plane surface, Sun earth angles-latitude, declination, hour angle, zenith, solar altitude angle, surface azimuth angle, solar azimuth angle. Local apparent time, solar time, apparent motion of sun, day length, some numerical examples. Solar radiation on an inclined surface-Beam, diffuse, reflected radiation on a tilted surface, expression for flux on a tilted surface, monthly average daily radiation on slopped surface, numerical examples.

Solar Thermal Radiation Devices:
Liquid flat plate collectors, solar air heaters, concentrating collectors like cylindrical, parabolic, evacuated tubular collectors. Storage devices: Sensible heat storage, latent heat storage. Application of solar energy: water heating, space heating, space cooling, active and passive cooling, systems, power generation various methods, Refrigeration, Distillation, solar ponds, theory, working principle, operational problems (Sketches, principle of working).

UNIT III
Solar Photovoltaic System:
Introduction, Description, principles of working of solar cell:-Doping, Fermi level, p-n junction, photovoltaic effect. Photovoltaic Material:-Single crystal solar cell, Poly crystal solar cell, thin film solar cell, I-V characteristic and limits to cell efficiency, Cell temperature, Current status and Future potential of P.V.
Performance Analysis of Liquid Flat Plate Collectors:
General description, collector geometry, selective surface (qualitative discussion), basic energy – balance equation, stagnation temperature, transmissivity of the cover system, transmissivity-absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss-coefficient, problems (all correlations to be provided).

08 Hours

UNIT IV

Temperature Distribution :
Between the collector tubes, collector heat removal factor, collector efficiency factor and collector flow factor mean plate temperature, instantaneous efficiency (all expression to be provided). Effect of various parameters on the collector performance: Collector orientation, selective surface, fluid inlet temperature, number covers, dust.

Solar Concentrators:
Introduction, characteristic parameters:-Aperture area, Acceptance angle, absorber area, geometric concentration ratio. Local concentration ration or brightness concentration ratio, Intercept factor, optical efficiency, thermal efficiency. Concentration ratio.

08 Hours

UNIT V

Concentrators, Types, Classification, Tracking:

08 Hours

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
INDUSTRIAL ENGINEERING & MANAGEMENT

Sub Code : 14MEO663  
Credits : 03
Hours/Week : 4+0+0  
CIE Marks : 50
Total Hours : 38  
SEE Marks : 50
Exam Hours : 03  
Course Type : Open Elective

Course Outcomes:

Students will be able to
1. Recognize the motivational behavior of employees in an organization.
2. Identify various methods of improving overall productivity in an organization.
3. Improve the processes to help the industries to compete in global market.
4. Apply techniques of decision making, customer involvement, work-study, incentive schemes and process improvement.
5. Relate role of technology in management.

UNIT I

Introduction:

Historical perspective, contribution of Taylor, Henry Fayol, Gilbert, Charles Babbage, HL Gantt and others to the evolution of management science in the Indian context. Ownership of Industries Proprietorship, partnership, joint stock companies, public and private undertakings, co-operative organizations.

Management Functions:
Planning: corporate objectives, policies, strategies need for planning, responsibilities and types of plans, modern type of planning, selection of alternatives and process of decision making, case studies.
Organization: Basic requirement, types, structures and merits, Departmentation, vertical and horizontal growth, span of control, authority and responsibility, centralization and decentralization, formal and informal organizations, case studies.

08 Hours

UNIT II

Staffing:
Appraisal of needs, executive development schemes, performance appraisal and managerial mobility.
Directing: Types of instructions and characteristics of good order, communication flow of instructions motivation and leadership. Controlling: process of control, requirements of effective controlling, controlling techniques.

Work study, Incentives, Health and Safety:
Method study and time study, Foundations of work study, Job evaluation systems, Multi skilling, Incentive schemes, Training and Development, Safety Regulations and safe practices.

08 Hours

UNIT III

Management and Behavioral Approach:
Contribution of Elton Mayo and skinner and others to behavior sciences. Skills of a manager at various levels in an organization and inter-related systems, understanding past behavior, predicting future behavior, directing, changing And controlling behavior.

Motivation and Behavior:
Maslow’s hierarchy of needs, pretence of needs and satisfaction of needs, goal oriented behavior, integration of organizational goals and needs of employee. Hawthorn’s studies and its findings theory X and theory Y, immaturity theory, motivation hygiene theory.

08 Hours

UNIT IV
Process Management:
Definition of process management. Major process decisions-process choice, vertical integration, resource flexibility, customer involvement, capital intensity, relationships between decisions, service operation relationships between decisions, service operation relationships, economics of scale and gaining focus. Designing process-process rearranging and process improvement.

08 Hours

UNIT V

Management of Technology:

06 Hours

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Case Study evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit.

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NON DESTRUCTIVE TESTING

Sub Code : 14MEO664
Credits : 03
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type: Program Open Elective

Course Outcomes:
*Students will be able to*

1. Describe the basic concepts and principles of NDT methods.
2. Analyze characteristics of NDT techniques.
3. Interpret the characteristic of NDT technique in inspection methods.
4. Implement the method of viewing and inspecting the defects of various technique in NDT.
5. Apply NDT techniques in different industrial applications.

UNIT I

**Liquid penetrant Inspection:**
Introduction, principles of penetrant inspection, Characteristics of a penetrant, Water washable system, Post emulsification system, solvent removable system, surface preparation and cleaning, penetrant application, development, advantages and disadvantages, range of applications.

**Magnetic Particle Inspection:**
Introduction, magnetization, methods, continuous and residual methods, sensitivities, demagnetization, Magnetic particles, applications, advantages and disadvantages

08 Hours

UNIT II

**Electrical Test Methods (Eddy Current Testing):**
Introduction, principle, conductivity of a material, Magnetic properties, coil impedance, lift off factor and edge effects, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, display methods, application of eddy current techniques.

08 Hours

UNIT III

**Ultrasonic Testing:**
Introduction, Nature of sound, wave velocity and length. Generation of ultrasound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Inspection techniques identification of defects, immersion testing, surface conditioning, application of ultrasonic testing.

08 Hours

UNIT IV

**Radiography:**
Introduction, uses, limitation. Principle, radiation sources, production od X rays, ray spectra, radiation sources, shadow formation Exposure factor, Viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

08 Hours

UNIT V

**Other NDT techniques:**
Optical inspection probes, Neutron radiography, laser induces ultrasonic, acoustic emission inspection, Thermography, surface texture analysis, Multi phase flow analysis.

06 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
**Text Book**

**Reference Book**
2. **Non-Destructive Testing** by P. Halmshaw.

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
Course Outcomes:
1. Students can understand the functions and importance of automotive subsystems and their performance.
2. Students will have the knowledge of fuel supply and critical components of an engine.
3. Students will be exposed to the platform of electrical and electronics based systems and its automation.
4. Students can understand the importance of vehicle stability, safety and improvisation of the components for new introduction in any automotive sectors.
5. Students will be given clear idea of the challenges of an engineer at different levels of manufacturing an automotive parts and also follow the standards of developing and manufacturing.

UNIT I
Automotive subsystems and its function
Fuel supply system: carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors.
Engine cooling system: methods of cooling, thermostat valves, different lubrication arrangements, Engine Lubrication system: types of lubrications, different lubrication arrangements,
Suspension system: Requirements, air suspension system, independent and dependent suspension system,
Clutch and Gear box: General arrangement of clutch, Principle of friction clutches, Torque transmitted, Constructional details, Necessity for gear ratios in transmission, synchromesh gear boxes, 3,4 and 5 speed gear boxes.
Drive to wheels: Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle.Power trains, brakes, exhaust and introduction to super charges and turbo charges.
10 Hours

UNIT II
Engine Components and Fuel Supply systems
Ignition Systems: Battery Ignition systems, magneto Ignition system, Transistor assist contacts. Electronic Ignition, Automatic Ignition advance systems.
07 Hours

UNIT III
Electrical and electronic systems
Battery: Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency.
Starter Motor & Drives: Battery motor starting system, condition at starting, behavior of starter during starting series motor and its characteristics.
Automotive Electronic systems: Modern automotive Instrumentation, Input and output signal Conversion, Sampling, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, LED, LCD, CRT etc.
07 Hours

UNIT IV
Vehicle safety and Vehicle motion control
Vehicle Safety: Crash testing, Protection of occupants, Testing for occupant safety, Protection of pedestrians from serious injury, Active safety, Structural safety and air bags, Smart air bags, Seat belts, Improvement of active safety, Ergonomic considerations and safety, Seating.
Vehicle Motion Control: Introduction, Typical cruise control system, Cruise control electronics, Antilock braking system, Electronic suspension system, Automatic braking and traction control, Electronic steering control, Suspension control.

07 Hours

UNIT V

The manufacturing challenges in automotive
Introduction, Lean product development and lean production, Design to manufacture as a single process and IPPD (Integrated Product and Process Development), Manufacturing analysis, tools and methods: Design for manufacture and assembly, Quality function deployment, Design for dimensional control, Value engineering/analysis, Failure modes and effects analysis, Quality engineering, Materials processing and technology: Hydroforming, Adhesive bonding and Rapid prototyping.

07 Hours

Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
3. Automotive Engineering, Power train, Chassis System and Vehicle Body by David A. Crolla, Edited by David A. Crolla

Reference Book
1. An Introduction to Modern Vehicle Design by Julian Happian-Smith, Oxford Auckland Boston Johannesburg Melbourne New Delhi,
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

PROJECT MANAGEMENT

Sub Code: 14MEO666  Credits: 03
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 38  SEE Marks: 50
Exam Hours: 03  Course Type: Open Elective

Course Outcomes:

Students will be able to
1. Identify the specific management needs in the execution of projects at tactical and strategic level
2. Estimate the Project proposals for scope, time and cost to conclude its feasibility.
3. Synthesis the strategies to evolve suitable approach to accomplish the project with effective usage of the resources.
4. Illustrate team-building and leadership skills in planning and implementation of the project
5. Apply the effective management techniques in the project execution to fulfill.

UNIT I

Concepts of Project Management:
Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management.
08 Hours

UNIT II

Project Planning and Estimating:
Feasibility report, phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, evaluation of the project profitability.
07 Hours

UNIT III

Organizing And Staffing:
The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution and controls.
08 Hours

UNIT IV

Project Scheduling, Co-Ordination And Control:
Project implementation scheduling, different scheduling techniques bar (GANTT) charts, Bar charts for combined activities. Project evaluation and review techniques, PERT planning,Project direction communication in a project, Role of MIS in project control, performance control, schedule control, cost control cases.
08 Hours

UNIT V

Performance Measures in Project Management and Project inventory management:
Performance indicators, Performance improvement for the CM & DM companies for better project management. Nature of project inventory, supply and transportation of materials.
07 Hours

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book
2. **Project Execution Plan** by Chaudhry S., plan for project Execution Interaction, 2001

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MECHATRONICS

Sub Code : 14MEO667
Credits : 03

Hours/Week : 4+0+0
CIE Marks : 50

Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:

Students will be able to

1. Define & outline the development of Mechatronic systems, concept of concurrent & sequential engineering, Sensors, Actuators and Signal conditioners.
2. Illustrate & summarize the working principle of Microprocessor & Microcontrollers Based Mechatronics Systems.
3. Interpret the fundamentals of signal processing for electrical systems.
4. Analyze the importance of data conversions, processing and storage in the microprocessor.
5. Compile an assembly language program to perform various arithmetic operations using 8085A microprocessor.

UNIT I

Introduction of Mechatronics:

Introduction of Mechatronic systems, Evolution on Mechatronics, Measurement system, control systems, microprocessor based controllers, Mechatronics system design approach Automatic washing machine, automatic camera and Engine management system, Mechatronics approach and their associated problems. Examples and discussion on typical systems.

08 Hours

UNIT II

Transducers & Sensors:

Introduction of Transducers, Classifications, Potentiometer, Capacitive Sensor, Eddy current proximity sensor, Hall effect sensor, Temperature sensor, light sensors, selection of sensors, inputting data by switches, Strain gauge & Wheat Stone Bridge.

06 Hours

UNIT III

Electrical actuation systems:

Electrical systems, Mechanical switches, solid-state switches, solenoids, DC & AC motors, Stepper motors and their merits and demerits.

Signal Conditioning:

Introduction to signal conditioning. The operational amplifier, Protection, Filtering, Wheatstone bridge, and Digital Signals Multiplexers, Data acquisition, Introduction to Digital system processing Pulse-modulation.

08 Hours

UNIT IV

Introduction to Microprocessors:

Organization of Microprocessors (Preliminary concepts), basic concepts of programming of microprocessors. Review of concepts – Boolean algebra, Logic Gates and Gate Networks, Binary &Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation.

Logic function, Data word representation:

Basic elements of control systems 8085A processor architecture terminology such as CPU, memory and address, ALU, assembler data registers, Fetch cycle, write cycle, state, bus, interrupts. Micro Controllers. Difference between microprocessor and micro controllers. Requirements for control and their implementation in microcontrollers. Classification of micro controllers.
08 Hours

UNIT V

Organization & Programming of Microprocessors:
Introduction to organization of INTEL 8085-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming.

Central Processing Unit of Microprocessors:
Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085.

08 Hours

Pre-requisites:
Prior knowledge of Basic Electronics is required.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book:

Reference Book:

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3 2 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 2 1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3 2</td>
<td></td>
</tr>
</tbody>
</table>
FINITE ELEMENT METHODS

Sub Code : 14MEO668
Credits : 03
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Exam Hours : 03
Course Type : Open Elective

Course Outcomes:

Students will be able to
1. Recognize the importance of FEM and its application in solid mechanics.
2. Interpret the various methods in assembling the stiffness equations.
3. Classify the coordinate systems and will be able to indicate the shape functions for different family of elements.
4. Calculate the stress, strain and reaction forces and infer the temperature effects on structural and thermal problems.
5. Assess the mechanical system with appropriate considerations for public health and safety.

UNIT I

Overview of Finite Element Method: Basic Concept, Historical background, General and Engineering applications of the FEM, Finite Element Method vs Classical Method, FEM vs FDM, Force Vs Displacement method in FEM


Discontinuity: Geometry, Load, Boundary, Material, Types of Symmetry, Aspect Ratio, Banded Matrix.

Interpolation Models: Introduction, Polynomial form of interpolation function, Simplex, Complex, and Multiplex elements, Interpolation polynomial in terms of nodal DOF, Selection of the order of the interpolation polynomial, Convergence requirements, coordinate systems.

07 Hours

UNIT II


Basic Equations in Elasticity (No questions will be asked for MSE or SEE): Introduction. Stresses in a Typical Element, Equations of Equilibrium, Strains, Strain Displacement Equations, Linear Constitutive Law.


Techniques of saving memory: Use of symmetry and banded nature, Partitioning of matrix (Frontal solution), Skyline storage.

Coordinate Systems: Local, Global, Area.

08 Hours

UNIT III

Shape Functions: Derivation of Shape Functions Using Polynomials, Finding Shape Functions Using Lagrange Polynomials, Shape Functions for Serendipity Family Elements, Hermite Polynomials as Shape Functions.


08 Hours

UNIT IV

Plane Trusses: Transformation matrix, Element stiffness matrix, stress calculations. Problems

UNIT V

1D-Steady state Heat Transfer: Straight uniform fin analysis, convection loss from end surface of fin. Problems on composite wall and thin fins.

Isoparametric formulation: Basic theorems of Isoparametric concept, Uniqueness of mapping, isoparametric sub and super parametric elements, 2D-CST: Area coordinates Isoparametric representation, Jacobian matrix, Strain-displacement matrix, Element stiffness, force term. Problems.

07 Hours

Pre-requisites:
The student should have studied Eng. Mechanics and Matrices.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Case Study / Seminar / Mat lab programing / C programming for 10 marks.

SEE –50 Marks
3. Two questions to be set from each unit, carrying 20 mark each.
4. Students have to answer 5 questions selecting one full question from each unit

Text Book:
2. Finite Element Analysis by Bhavikatti, S S New age International, 3rd Edition 2015,

Reference Book:
NANO TECHNOLOGY

Sub Code: 14MEO669  Credits: 03
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 38  SEE Marks: 50
Exam Hours: 03  Course Type: Open Elective

Course Outcomes:

Students will be able to
1. Analyze and classify Nano materials based on their structures.
2. Compare and contrast between different methods of synthesizing the Nano materials.
3. Prepare and characterize Nano materials for specified applications.
4. Identify the difference between bulk and nano materials properties.
5. Relate the application of mechanical engineering with nanotechnology

UNIT I
Overview of Materials:
Introduction to materials; classification of materials: metallic, polymeric and ceramic materials; modification of properties of conventional materials by different methods: top-down and bottom-up approaches.
08 Hours

UNIT II
Nano materials and Nanostructures.
Difference between micro and nano materials; Structure and defects in crystalline nano materials; Hybrid nano materials; Synthesis of Nano materials; Nano materials in Nature.
Nanostructures:
Dimensionality of nanomaterials: 3D, 2D, 1D and 0D structures - bulk nano structures (nanocomposites and alloys), thin films, Nanotubes (carbon and others) and nanorods, Fullerenes, Nanowires, Quantum Dots. Cell's response to Surfaces and interfaces in nanostructures. Ceramic interfaces, Superhydrophobic surfaces, Grain boundaries in Nano crystalline materials, Defects associated with interfaces.
08 Hours

UNIT III
Synthesis of nano materials and nanostructures:
Chemical methods: Sol gel method, solution combustion method, chemical vapor deposition.
Physical methods: Evaporation - thermal and e-beam; Sputtering (DC, RF, Magnetron, Ion-assisted); MBE; ALD; Lithography.
08 Hours

UNIT IV
Properties and Characterization of nanomaterials
Properties of nanomaterials: Deformation behaviour of nanomaterials. Fracture and creep. Electrical, Magnetic and Optical properties
Characterization: Overview of characterization of nanostructures and nanomaterials.
SEM, TEM, STM, AFM, XRD, FTIR, UV spectroscopy, XPS, Resistivity Nano metrology.
06 Hours

UNIT V
Applications
Bio-Nanotechnology; Nano-electronics; Nano-photronics; Micro and Nano Fluidics; Polymer and Nano-composites; Thin Film Technology; Spintronics; Nanotechnology for Energy Systems; MEMS; data storage and retrieval.
08 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study /Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
INNOVATIVE PRODUCT DESIGN AND DEVELOPMENT

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>14MEO670</th>
<th>Credits</th>
<th>03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours/Week</td>
<td>3+0+0</td>
<td>CIE Marks</td>
<td>50</td>
</tr>
<tr>
<td>Total Hours</td>
<td>38</td>
<td>SEE Marks</td>
<td>50</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>03</td>
<td>Course Type</td>
<td>Open Elective</td>
</tr>
</tbody>
</table>

Course Outcomes:
1. Students will be able to apply the concepts of product design in the development of products to meet the societal needs.
2. Students will understand the importance of morphology in the design of a product with identification of need in functional aspect.
3. Enable the students to apply high ethical standards in terms of team work to be a good design engineer.
4. Students will understand and design the importance of man machine interface with design of display and control.
5. The students would have a good understanding of using special techniques such as SQC, work study etc. in improving the quality of any product before it is sent for manufacturing.

UNIT I
Introduction to Product Design:
Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology, Challenges in product development. Design definitions, the role and nature of design, old and new design methods, Design by evolution.
Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.
08 Hours

UNIT II
Morphology of Design:
Identification of customer needs analysis of need, Product specifications, Concept generation concept selection and concept testing. Conceptual type of design by divergent, transformation and convergent phases of product design.
08 Hours

UNIT III
Transformations:
07 Hours

UNIT IV
Reliability:
07 Hours

UNIT V
Product Appraisal:
Information and literature search, patents and Intellectual Property, standards and codes, environment and safety considerations, existing techniques such as work-study, SQC etc to improve method and quality of product, Product Economics, Innovation versus Invention, technological forecasting and Managing Project.
08 Hours
Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Books:

Reference Books:

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TOTAL QUALITY MANAGEMENT

Sub Code : 14MEO671
Credits : 03

Hours/Week : 3+0+0
CIE Marks : 50

Total Hours : 38
SEE Marks : 50

Exam Hours : 03
Course Type : Open Elective

Course Outcomes:

Students will be able to

1. Understand the philosophy and core value to TQM and to determine the voice of customers and its impact on quality.
2. Apply and evaluate best practices for attainment of total quality.
3. Understand the methodologies to enhance the management process such as benchmarking, business process reengineering.
4. Choose the framework to evaluate the performance excellence of organization, human resource and to determine the set of performance indicators.
5. Identify the areas for quality improvement through QFD and FMEA.

UNIT I

Overview of TQM:

Leadership, Customer Satisfaction and Employee Involvement:

08 Hours

UNIT II

Human Resource Practices:
Scope of Human Resources Management, leading practices, designing high performance work systems-work and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal.

08 Hours

UNIT III

Tools and Techniques in TQM:
7 basic tools of quality control, Kaizen, Re-engineering, 6 sigma, Benchmarking, Definition, Process of benchmarking, 5S, Poke yoke, 3M, Pareto diagram, Process flow diagram.

06 Hours

UNIT IV

Building and Sustaining Total Quality Organizations:
Making the commitment to TQ, Organizational culture and Total Quality, Change management, sustaining the quality organization, quality assurance, concepts and objectives of quality assurance.

Quality Management Systems:
Quality management systems through ISO standards.

08 Hours

UNIT V

Quality Function Deployment and Failure Modes Effects Analysis:
Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, FMEA, Design FMEA and process FMEA.

08 Hours

Course Assessment Method:
CIE – 50 Marks

1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Seminar will be conducted for a group of 5 students- evaluated through rubrics for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks

1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

2. Total Quality Management by Dale H. Besterfield, Publisher - Pearson Education India, Edition 03/e Paperback (Special Indian Edition).

Reference Book


<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

DESIGN LAB

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>14MEL67</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours/Week</th>
<th>CIE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+0+3</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Hours</th>
<th>SEE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exam Hours</th>
<th>Course Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Program Core</td>
</tr>
</tbody>
</table>

Course Outcomes:

**Students will be able to**

1. Conduct experiment and compare with analytical solution for single DOF vibrating systems and balancing of masses.
2. Determine the stress concentration and fringe constants in photo elasticity and principle stresses in strain rosettes.
3. Compute pressure distribution curve of a journal bearing.
4. Conduct experiment on governor and shaft considering speed as a critical parameter and demonstration of gyroscope.

UNIT I

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping Coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photo elastic material using.a) Circular disc subjected to diametral compression, Pure bending specimen (four point bending )
5. Determination of stress concentration using Photo elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

UNIT II

1. Determination of equilibrium speed, sensitiveness, power and effort of porter / proell Governor.
3. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
4. Determination of stresses in Curved beam using strain gauge.
5. Experiments on Gyroscope (Demonstration only).

Pre-requisites:
The student should have in-depth knowledge of TOM-I, TOM-II and Mechanical Vibrations.

**Course Assessment Method:**

- Record: 30 marks
- Test: 15 marks
- Study project/Viva:05 marks
- SEE - Final Exam: 50 Marks

**Scheme of Examination:**

Student will be asked to conduct one experiment from each unit.

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
FINITE ELEMENT ANALYSISLAB

Sub Code  :14MEL68  Credits  : 1.5
Hours/Week :0+0+3  CIE Marks  :50
Total Hours :39  SEE Marks  :50
Exam Hours  :03  Course Type: Program Core

Course Outcomes:
Students will be able to
1. Solve analytically for stresses, strains and deformation of bars and beams due to axial load, torsion and bending, acting individually or in combination and validate using software
2. Ability to create models for trusses, frames, plate structures and solve using software.
3. Do thermal analysis and heat flux in 2d with conduction and convection boundary conditions for homogenous and composite materials.
4. Solve modal and buckling analysis problems for given boundary conditions

UNIT I
Study of a FEA package and modeling, stress analysis of :
1. Bars of constant cross section area, tapered cross section area and stepped bar
2. Trusses – (Minimum 2 exercises)
3. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc. (Minimum 4 exercises)
5. Dynamic Analysis – to find the natural frequency of beams, bars (Minimum 2 exercises).

UNIT II
1. Composite laminate/ply lay-up analysis (minimum 1 exercise).
2. Thermal Analysis – 2D problem with conduction and convection boundary conditions (Minimum 2 exercises).
3. Fluid flow Analysis (Minimum 1 exercise : Y-duct)
4. Modal analysis of Spring Mass system.
5. Buckling Analysis of a given structure

Pre-requisites:
The student needs to possess knowledge of FEM theory, SOM theory, Vibration theory, Basics of thermal conduction and fluid flow.

Course Assessment Method:
Record  : 30 Marks
Test  : 15 Marks
Study project/Viva : 05 Marks
SEE - Final Exam  : 50 Marks

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3  3  2  3  2  2  2  2  2  2  2  2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3  3  2  3  2  2  2  2  2  2  2  2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3  3  2  3  2  2  2  2  2  2  2  2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3  3  2  3  1  2  2  2  2  2  2  2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3  3  3  3  3  3  3  3  3  3  3  3</td>
<td></td>
</tr>
</tbody>
</table>
CONTROL ENGINEERING

Course Outcomes:
Students should be able to
1. Identify & define the type of control system, controllers, various test signals, compensators, stability, concepts, Analogous systems and frequency response terminologies.
2. Develop mathematical models of mechanical, electrical, electro-mechanical and hydraulic control systems in order to obtain system response for given input test signals.
3. Analyze & integrate each sub system for a desired control system and obtain the relevant transfer functions
4. Predict the stability of a control system by developing R-H criterion, polar, bode and root locus plots.
5. Obtain the transfer functions by applying block diagrams reduction techniques and signal flow graphs for different applications of control system.

UNIT I

Introduction:
Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system. Types of controllers – Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers.

Mathematical Models:
Laplace Transforms, Transfer Function, Models of Mechanical Systems, Problems related to mathematical models.

UNIT II

Mathematical Models:
Models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems. Analogous Systems: Force-voltage analogy and force-current analogy.

UNIT III

Transient and Steady State Response Analysis:
Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response, Problems

Block Diagram Reduction Technique:
Transfer Functions definition, function, block representation of system elements, problems on reduction of block diagrams

UNIT IV

Signal Flow Graphs
Manson’s gain formula, Problems

Frequency Response Analysis:
Polar plots, Nyquist Stability Analysis, Relative stability concepts, phase and gain margin, System stability: Roth’s-Hurwitz Criterion.

UNIT V

Frequency Response Analysis using Bode Plots:

Control Action and System Compensation:
Series and feedback compensation, Physical devices for system compensation (Design Excluded).

Root Locus Plots:
Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.

10 Hours
Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Mini project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
2. Control Systems Principles and Design by M. Goal, TMH, 2000

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HYDRAULICS AND PNEUMATICS

Sub Code: 14ME72  
Credits: 04

Hours/Week: 4+1+0  
CIE Marks: 50

Total Hours: 48  
SEE marks: 50

Exam Hours: 03  
Course Type: Program
Core

Course Outcomes:
Students will be able to
1. Describe the working principle and performance parameters of various hydraulic and pneumatic components and systems.
2. Design hydraulic and pneumatic circuits for mechanical engineering applications.
3. Analyze performance evaluation of fluid power systems and propose improvements.
5. Students to select the appropriate hydraulic and pneumatic actuating system for the different integrated applications.

UNIT I
Introduction to Hydraulic Power:
Pascal’s law and problems on Pascal’s Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System.
The Source of Hydraulic Power:
07 Hours

UNIT II
Hydraulic Actuators and Motors:
Control Components in Hydraulic Systems:
Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.
07 Hours

UNIT III
Hydraulic Circuit Design and Analysis:
Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.
Maintenance of Hydraulic systems:
Hydraulic oils – Desirable properties, general type of fluids, sealing devices, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control.
08 Hours

UNIT IV
Introduction to Pneumatic control:
Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system.
Pneumatic Actuators:
Directional Control valves:
Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve.
Simple Pneumatic Control:
Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve.

120
Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the sue of logic gates. Pressure dependent controls types construction – practical applications. Time dependent controls – Principle, construction, practical applications.

08 Hours

UNIT V

Multi-cylinder applications:

Electro-Pneumatic control:
Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications.

08 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3 3</td>
<td></td>
</tr>
</tbody>
</table>
HEAT TRANSFER

Sub Code : 14ME73
Credits : 04

Hours/Week : 4+1+0
CIE Marks : 50

Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Understand, reproduce and explain the fundamental concepts of heat and mass transfer, mechanisms and governing laws for steady and unsteady cases.
2. Analyze the system and derive the expressions for rate of heat transfer and temperature distribution.
3. Apply the concept of heat transfer for the given problem and compute the unknown parameters.
4. Analyze and evaluate heat transfer rates for problems involving phase transformation like condensation, evaporation and boiling.
5. Recall the concept of heat transfer for simple profiles like rectangle, cylinder and sphere and apply to real time applications.

UNIT I
Introductory Concepts and Definitions:
Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal Conductivity; Convective Heat Transfer coefficient; Stefan Boltzmann constant; combined heat transfer mechanism; boundary conditions of 1st, 2nd and 3rd kind.
Conductive Heat Transfer I:
Derivation of general three dimensional Conduction equations in Cartesian coordinates, discussion on Conduction equations in Cylindrical and Spherical coordinate systems without derivation. Special cases of one dimensional conduction equations in Rectangular slabs and Cylindrical and Spherical shells. Definitions of Thermal Resistance, Conductance, Thermal Diffusivity, Thermal Conductivity, Overall Heat Transfer Coefficient; Thermal Contact Resistance, Critical Thickness of Insulation and its importance Steady state Conduction with Heat Generation in Slab, Cylinder and Sphere; Numerical problems.
10 Hours

UNIT II
Conductive Heat Transfer II:
Heat transfer in extended surfaces (Fins) - infinitely long fin, fin with insulated tip and fin with convective heat transfer at the tip, Fin Efficiency or Effectiveness. Numerical problems on Fin Heat Transfer. Transient Conduction:- Conduction in solids with negligible internal temperature gradient (Lumped System Analysis), Use of Transient Temperature and Heat Transfer Charts (Heisler’s Charts) for Transient Conduction in Slab, Long Cylinder and Sphere; Numerical Computation of Transient Conduction problems; Graphical Analysis(Schmidt Plot); Numerical Problems.
09 Hours

UNIT III
Convective Heat Transfer I:
Concepts of Hydrodynamic Boundary Layers for flow over a flat plate and flow in a duct without heat transfer– definitions of Critical Reynolds number, Hydrodynamic Entrance Lengths for duct flow, Friction Factor – analytical relationship for Laminar and empirical relationship for Turbulent flows; Concepts of Thermal Boundary Layer - its growth for Constant Wall Temperature and Constant Heat Flux conditions. Dimensional analysis for free convection - physical significance of Grashoff number; use of experimental correlations for Free convection from or to Vertical, Horizontal and Inclined Flat Plates, Vertical and Horizontal Cylinders.
10 Hours

UNIT IV
Convective Heat Transfer II:
Dimensional analysis for Forced Convection problems: Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various experimental correlations for hydro dynamically and thermally developed flows; use of empirical correlations for flow over a flat plate, over a cylinder and across a tube bundle. Numerical problems;
UNIT V

Radiation Heat Transfer:
Thermal Radiation; definitions of various terms; Stefan-Boltzman law, Kirchoff’s law, Planck’s law and Wein’s Displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of Radiation Shield; Intensity of Radiation and Solid Angle; Lambert’s law; Radiation Heat exchange between two finite surfaces - Configuration Factor or View factor; properties of and determination of View Factors; View Factor Algebra; Network Method for Radiation Heat Exchange in an Enclosure: Numerical Problems.

Heat Exchangers:

10 Hours

Pre-requisites:
The student should have studied ATD and BTD

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
ENTERPRENEURSHIP DEVELOPMENT AND IPR

Sub Code : 14MEH74
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03

Course Type: Program core

Course Outcomes:
*Students will be able to*

1. Recognize the importance of entrepreneurship and its role in economic development of the Country.
2. Identify various schemes of Central and State Governments and their agencies available to promote MSME and steps in setting up small enterprises, to know the sources of financing and analyzing financial statements.
3. Identify and select the projects by conducting feasibility studies with respect to marketing, technical, financial, economic and social.
4. Prepare project report for starting an enterprise in line with planning commission guidelines for appraising to various statutory authorities and financial institutions.
5. Appraise of IP rights like patents, industrial design, trademark, copyrights for effective protection and utilization of innovations.

UNIT I
Introduction-meaning and importance of entrepreneurship, entrepreneur, types, characteristics, entrepreneurial process, role of entrepreneurs in economic development, problems faced by entrepreneurs, scope in India, Start ups
Make in India Concept: Plans and policies, Sectors, Government Initiatives, Investment Opportunities, Ease of doing Business.
08 Hours

UNIT II
Micro, Small and medium enterprises, Definition of MSMEs as per MSME act, characteristics of small enterprises, need and advantages of small enterprises, Steps in setting up of small enterprises,
Institutional support to MSMEs-State supporting agencies-TECSOK, KIADB, KSSIDC, KSFC, National Schemes-MSME-DI, NSIC, SIDBI
10 Hours

UNIT III
Preparation of Project reports, control variables in project, project lifecycle, project report, need, project identification, project selection, components of project report, formulation of report, planning commission guidelines, project appraisal, feasibility study-market, financial, technical and economic, PERT and CPM, errors in report.
10 Hours

UNIT IV
Introduction to IP, What is Intellectual Property (IP)?, Historical background of IP, Economic value of IP, Motivation to IP development, IP system strategy, Emerging issues, IPR governance, Institutions for administering the IP system, IP rights and marketing regulations, IPR protection, protecting consumers and protecting competition, IP management framework, Drivers of IP management, IP value chain, IP management framework, IP strategies, Strategic considerations, managing trademarks.
10 Hours

UNIT V
Intellectual Property Rights-What are IPRs?, Types of IPRs, Indian IPR scenario, Legal use of IP, Global Vs Indian IPR landscape, TRIPS and its implications Patents-What is a patent, history of patent, Criteria for patent, types of patents, Indian patent act, patents for computer software, business models, incremental innovation, patent infringement Trademarks-role, as a marketing tool, trademark rights, types, use of trademarks, trademark act, trademark registration in India Copyrights-meaning, copyright protection in
India, enforcement measures, copyright act.

10 Hours

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
2. Entrepreneurship and Management by S Nagendra and Manjunath VS, Pearson Publications

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
<td>10 11 12</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3 3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 2 1</td>
<td>3 3 2 3 3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2 2 3 2 3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1 2 2 3 3</td>
</tr>
</tbody>
</table>
DESIGN DRAWING TECHNOLOGY

Sub Code: 14MEE751
Credits: 04
Hours/Week: 4+0+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Elective

Course Outcomes:

students will be able to

1. Identify the different factors to be considered during different manufacturing processes
2. Design Joints and couplings considering the different loading conditions
3. Design power screws, IC engine parts - Connecting rod, Crank shaft, Cylinder and piston considering the different loading conditions
4. Draw the different components Joints and couplings and assemble the same after the analytical design process.
5. Draw the different components of Power screws and IC engine parts and assemble the same after the analytical design process.

UNIT-I
08 Hours

UNIT-II
Cotter and knuckle Joints: Design and drawing of Socket and spigot cotter joints, sleeve and cotter joint, Gib and cotter joint, Knuckle joint, Turn Buckle.
10 Hours

UNIT-III
Couplings: Sleeve or Muff Coupling, Flange Coupling, Flexible coupling, Bushed pin Flexible coupling, Oldhams and Universal Coupling.
10 Hours

UNIT-IV
Power Screws: Design of components involving power screws, Design of C-Clamp, Screw jack, Toggle jack.
10 Hours

UNIT-V
Design of internal combustion parts: Design of connecting rod, Crank shaft, Design consideration and design of Cylinder and piston.
10 Hours

TEXT BOOKS

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
TRIBOLOGY

Sub Code: 14MEE752
Hours/Week: 4+0+0
Total Hours: 48
Exam Hours: 03
Credits: 04
CIE Marks: 50
SEE Marks: 50
Course Type: Program Elective

Course Outcomes: students will be able to
1. Realize and describe the Lubrication principle and mechanisms.
2. Compute load carrying capacity in light and heavy loaded journal bearings.
3. Analyze the friction force and power loss in hydrodynamic and hydrostatic lubrication.
4. Identify the appropriate material for bearings based on the application.
5. Recognize the different wear mechanism in tribological components.

UNIT I
Introduction to Tribology:
09 Hours

UNIT II
Hydrodynamic Lubrication:
Friction forces and power loss in lightly loaded bearing, Petroff’s law, Tower’s experiments, idealized full journal bearings.
Mechanism of Pressure Development in an Oil Film:
Reynold’s investigations, Reynold’s equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.
10 Hours

UNIT III
Slider / Pad Bearing with a Fixed and Pivoted Shoe:
Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.
10 Hours

UNIT IV
Hydrostatic Lubrication:
Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.
Bearing Materials:
Commonly used bearings materials, properties of typical bearing materials.
10 Hours

UNIT V
Wear:
09 Hours

Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book
1. **Lubrication of Bearings – Theoretical Principles and Design** by Redzimovskay E I., Oxford press company 2000
2. **Principles and Applications of Tribology** by Moore, Pergamaon press 1998

Reference Book
1. **Fundamentals of Tribology** by Basu S K., Sengupta A N., Ahuja B. B., PHI 2006
2. **Introduction to Tribology Bearings** by Mujumdar B. C., S. Chand company pvt. Ltd 2008

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

128
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

ELEMENTS OF AERONAUTICS

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>14MEE753</td>
<td>04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours/Week</th>
<th>CIE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+0+0</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Hours</th>
<th>SEE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exam Hours</th>
<th>Course Type:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Program Elective</td>
</tr>
</tbody>
</table>

Course Outcomes:

**Students will be able to**

1. Cite the developments in an aircraft and discover the recent trends in aerospace industry.
2. Recognize various systems such as Mechanical, Electrical, Pneumatics and hydraulic systems.
3. Recognize various sub systems such as ice protection, flight management system and avionics and their performance.
4. Interpret the basic principles of flight mechanics.
5. Relate the effects of operational parameters and its response in aircraft systems with respect to stability and control and aircraft maneuvers.

**UNIT I**

**Aircraft Industry Overview**

Evolution and History of flight, types of aerospace Industry, key players in aerospace Industry, Aerospace manufacturing, Mergers and acquisitions, Aerospace industry trends, advances in Engineering. Global and Indian Aircraft scenario.

03 Hours

**Introduction to Aircrafts**

Basic components of an Aircraft, structural members, Aircraft Axis system, Aircraft Motions, Control surfaces and high lift devices.

Types of Aircrafts- Lighter than Air/ Heavier than Air aircrafts Conventional Design configurations based on power plant location, Wing vertical location, intake location, tail unit arrangements, landing gear arrangements. Unconventional configurations- Biplane, variable sweep, canard layout, twin boom layouts, span loaders, blended body wing layout, STOL and STOVL Aircraft, stealth Aircraft. Advantages and disadvantages of these configurations.

07 Hours

**UNIT II & III**

**Introduction to Aircraft Systems**


20 Hours

**UNIT IV**

**Basic Principles of Flight**

Significance of speed of Sound, Air speed and ground speed, Properties of Atmosphere, Bernoulli’s Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching Moments, Types of Drag, Lift curve, Drag Curve, Lift/ Drag Ration Curve, Factors affecting lift and drag, Center of pressure and its effects. Aerofoil Nomenclature, Types of Aerofoil, Wing section- Aerodynamic Center, Aspect Ratio, Effects of lift, drag speed, air density on drag.

09 Hours

**UNIT V**

**Basics of Flight Mechanics**

Mach waves, Mach angles, sonic and Supersonic Flight and its effects

**Stability and Control**

Degree of stability- Lateral, Longitudinal and Directional stability and controls of Aircraft. Effects of flaps and Slats on Lift Coefficients, Control tabs, stalling, Landing, Gliding, Turning, Speed of Sound, Mach
Numbers, Shock Waves

**Aircraft Performance and Maneuvers**

Power Curves, Maximum and minimum speeds of horizontal flight, effects of changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on an Aeroplane during a turn, loads during a Turn, correct and incorrect angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability.

**09 Hours**

**Course Assessment Method:**

Test: 30 marks
Assignment: 10 marks
Study project/Surprise: 10 marks

**SEE - Final Exam: 50 Marks**

**Resources**

**Text Books**


**Reference**

2. *Introduction to Flight* by Dave Anderson
3. *Aircraft systems: Mechanical, Electrical and Avionics subsystems integration* by Iainmoir, Allen Seabridge

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2 3</td>
</tr>
<tr>
<td>3</td>
<td>3 3 2 3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3 2 3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

BIO MASS ENERGY SYSTEM

Sub Code : 14MEE754  
Credits : 04

Hours/Week : 4+0+0  
CIE Marks : 50

Total Hours : 48  
SEE Marks : 50

Exam Hours : 03  
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Understand the basic principles and methods for biomass energy conversion, utilization and sustainability
2. Interpret the desirable features of biomass energy sources and their advantages over traditional fuels such as coal and oil
3. Apply the basic principles of biomass technology for ethanol production from biowastes and biogas digester with factors influencing biogas yielding
4. Analyze the thermodynamic cycles in bio power generation
5. Employ the knowledge of biomass utilisation for environmental issues and overcome fuel crisis

UNIT I
Biomass Energy:

Biomass Conversion Methods:
Physical, Agrochemical, Thermo chemical, Biochemical (flowchart) & Explanation.
09 Hours

UNIT II
Physical & Agrochemical Conversion:
Briquetting, Pellatigation, Agrochemical, fuel Extraction, Thermo chemical Conversion: Direct combustion for heat, domestic cooking & heating.

Biomass Gasification:
Chemical reaction in gasification, Producer gas& the constituents, Types of gasifiers: Fixed bed gasifiers, Fluidized bed gasifiers.
10 Hours

UNIT III
Liquefaction & Bio Methanization:
10 Hours

UNIT IV
Biogas for power generation, Engine Power using Biogas. Ethanol as an Automobile Fuel Ethanol production & its use in engines.
10 Hours

UNIT V
Bio Power Plants:
Bio Power generation routes, Basic Thermodynamic cycles in Bio power generation, Brayton cycle, Sterling cycle, Rankine cycle, Cogeneration cycle, Biomass Based steam power plant. Calculations for sizing the Biogas plant.
10 Hours
Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
### SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

<table>
<thead>
<tr>
<th>GAS TURBINE AND JET PROPULSION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub Code:</strong> 14MEE755</td>
</tr>
<tr>
<td><strong>Credits</strong> : 04</td>
</tr>
<tr>
<td><strong>Hours/Week :</strong> 4 +0+0</td>
</tr>
<tr>
<td><strong>CIE Marks :</strong> 50</td>
</tr>
<tr>
<td><strong>Total Hours :</strong> 48</td>
</tr>
<tr>
<td><strong>SEE Marks :</strong> 50</td>
</tr>
<tr>
<td><strong>Exam Hours :</strong> 03</td>
</tr>
<tr>
<td><strong>Course Type:</strong> Program Elective</td>
</tr>
</tbody>
</table>

#### Course Outcomes:

_Students will be able to_

1. Identify and outline the clear concepts of Gas Dynamic processes with Conservation Laws and governing equations for Mass, Momentum and Energy for Compressible flows- compressibility, Shock Wave, Mach Number, Flow in a convergent-divergent nozzle with and without friction and heat transfer.

2. Explain and interpret the working of various elements of gas turbines and jet propulsions—centrifugal, axial compressors, axial flow gas turbines and combustion systems and jet propulsion.

3. Apply and calculate Degree of Reaction, Pressure Ratio, Thermal Efficiency, Specific Output, optimum pressure ratio, Thermal Efficiency, specific power output and Pressure drop in a Stage, Polytropic Efficiency, Losses in a Turbine stage of gas turbines and compressors at different operating conditions.

4. Analyze Jet Propulsion System, thrust and power computation for air-breathing system, employing principles of Ramjet, Pulsejet, Turbojet, Turboprop and Turbofan systems, non-air breathing system—Rocket Engines.

5. Assess the Physicochemical process of high speed combustion and flame, Thrust augmentation systems, Flame stabilization, Ignition and Droplet combustion, Design requirements of high speed combustion systems.

#### UNIT I

10 Hours

#### UNIT II

**Gas Turbines:** Relative merits over conventional IC Engines, Introduction to Brayton and Atkinson cycle for Gas turbines, Pressure Ratio, Thermal Efficiency, Specific Output, optimum pressure ratio, Enhancement of Thermal Efficiency and/or specific power output using inter cooling, heat exchangers, reheat burners.  
08 Hours

#### UNIT III

**Centrifugal Compressor:** Inducer, Impeller, Vaneless Diffuser, Vaned Diffuser, Volute Casing, Velocity & Pressure variation in a stage, Pressure Rise for Radial Tipped Vanes, Degree of Reaction, Prewhirl and Surging.

**Axial Flow Compressor:** Stage consisting of a Rotor and Stator, Pressure Rise in a Stage, Polytropic Efficiency, Losses in a compressor stage, Stall & Surging, Performance Curves.

**Axial Flow Turbine:** Rotor and a Stator, Pressure drop in a Stage, Polytropic Efficiency, Losses in a Turbine stage, Chocking, Performance Curves.  
10 Hours

#### UNIT IV

**Jet Propulsion:** Thrust and Propulsion systems for flying vehicles—Turboprop, Turbojet, Turbofan, Ram Jet, Pulse Jet, SCRAM Jets with supersonic combustion. Definition & derivation of Pressure Thrust, Momentum Thrust, Propulsive Power, Propulsive Efficiency, Thermal and Overall Efficiency.

**Thrust Augmentation:**
Water Injection, Liquid Injection, Afterburning, Bleed Air system

**Rocket Propulsion**: Turbojets Vs Rockets, Rocket Thrust, Specific Impulse, Total Impulse, Thermal Efficiency, Rocket Equation and applications

**10 Hours**

**UNIT V**

**Combustion Systems**:

**10 Hours**

**Pre-requisites**: The student should have studied Fluid Machineries.

**Course Assessment Method**:
Test: 30 marks
Case study/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

**Text Book**

**Reference Book**

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
SMART MATERIALS

Sub Code : 14MEE756
Credits : 04

Hours/Week : 4+0+0
CIE Marks : 50

Total Hours : 48
SEE Marks : 50

Exam Hours : 03
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Describe the characteristics of materials such as Metals, Polymers and Ceramics.
2. "Indicate the Electro, Magneto Rheological fluids and chemic materials for various mechanical systems.
3. Exploit Electro strictive and Magneto strictive materials in the design of different actuators.
4. "Distinguish the properties of shape memory alloys with other class of materials and propose its suitability for a range of applications.
5. Implement the smart materials in the development of smart composites.

UNIT I
Introduction:
Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics

Sensing and Actuation:
Principals of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility writer conventional and advanced materials, signal processing, principals and characterization.

10 Hours

UNIT II
Piezoelectric Materials:

10 Hours

UNIT III
Shape Memory Alloys:
History of shape memory alloys. Classification of shape memory alloys. NITINOLS – melting, casting and forming of NITINOLS, shape memory and pseudoplasticity. Mechanical and bio-medical applications of NITINOL. Vibration control through shape memory alloys.

10 Hours

UNIT IV
Electro rheological (ER) and magneto rheological (MR) fluids:

10 Hours

UNIT V
Biomimetics:
Learning from nature. Smart structures. Devising self-repairing structures. smart composites in transport. Bio-mimetics

08 Hours

Pre-requisites:
The student should have basic knowledge of Materials Science & Metallurgy.

Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PROJECT MANAGEMENT

Sub Code : 14MEE757
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type : Program Elective

Course Outcomes:
Students will be able to
1. Identify the specific management needs in the execution of projects at tactical and strategic level
2. Estimate the Project proposals for scope, time and cost to conclude its feasibility.
3. Synthesis the strategies to evolve suitable approach to accomplish the project with effective usage of the resources.
4. Illustrate team-building and leadership skills in planning and implementation of the project.
5. Apply the effective management techniques in the project execution to fulfill.

UNIT I
Concepts of Project Management:
Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, tools and techniques for project management.
10 Hours

UNIT II
Project Planning and Estimating:
Feasibility report phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation, and evaluation of the project profitability.
09 Hours

UNIT III
Organizing And Staffing:
The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution and controls.
10 Hours

UNIT IV
Project Scheduling, Co-Ordination And Control:
Project implementation scheduling, different scheduling techniques bar (GANTT) charts, Bar charts for combined activities. Project evaluation and review techniques, PERT planning. Project direction communication in a project, Role of MIS in project control, performance control, schedule control, cost control cases. Risk identification, Risk mitigation plan, Risk contingency plan, Root cause analysis, Corrective analysis and Preventive analysis.
10 Hours

UNIT V
Performance Measures in Project Management and Project inventory management:
Performance indicators, Performance improvement for the CM & DM companies for better project management. Nature of project inventory, supply and transportation of materials.
09 Hours

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
2. **Project Execution Plan** by Chaudhry S., plan for project Execution Interaction. 2001

**Reference Book**


<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

NON DESTRUCTIVE TESTING

**Sub Code:** 14MEE758  
**Credits:** 04

**Hours/Week:** 4+0+0  
**CIE Marks:** 50

**Total Hours:** 48  
**SEE Marks:** 50

**Exam Hours:** 03  
**Course Type:** Program Elective

**Course Outcomes:**

Students would be able to

1. Describe the basic concepts and principles of NDT methods.
2. Analyze characteristics of NDT techniques.
3. Interpret the characteristic of NDT technique in inspection methods.
4. Implement the method of viewing and inspecting the defects of various technique in NDT.
5. Apply NDT techniques in different industrial applications.

**UNIT I**

Liquid penetrant Inspection:
Introduction, principles of penetrant inspection, Characteristics of a penetrant, Water washable system, Post emulsification system, solvent removable system, surface preparation and cleaning, penetrant application, development, advantages and disadvantages, range of applications.

Magnetic Particle Inspection:
Introduction, magnetization, methods, continuous and residual methods, sensitivities, demagnetization, Magnetic particles, applications, advantages and disadvantages.

10 Hours

**UNIT II**

Electrical Test Methods (Eddy Current Testing):
Introduction, principle, conductivity of a material, Magnetic properties, coil impedance, lift off factor and edge effects, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, display methods, application of eddy current techniques.

10 Hours

**UNIT III**

Ultrasonic Testing:
Introduction, Nature of sound, wave velocity and length. Generation of ultrasound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Inspection techniques identification of defects, immersion testing, surface conditioning, application of ultrasonic testing.

10 Hours

**UNIT IV**

Radiography:
Introduction, uses, limitation. Principle, radiation sources, production od X rays, ray spectra, radiation sources, shadow formation Exposure factor, Viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

10 Hours

**UNIT V**

Other NDT techniques:
Optical inspection probes, Neutron radiography, laser induces ultrasonic, acoustic emission inspection, Thermography, surface texture analysis, Multi phase flow analysis.

08 Hours

**Course Assessment Method:**

Test: 30 marks  
Assignment: 10 marks  
Surprise: 10 marks  
SEE - Final Exam: 50 Marks
Text Book

Reference Book
1. Practical Non-Destructive Testing by Baldev Raj, Jayakumar, Thavasimuthu, Wood Head Publishing Ltd. 2nd edition
2. Non-Destructive Testing by P. Halmshaw

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
COMPUTATIONAL FLUID DYNAMICS

Sub Code: 14MEE759
Hours/Week: 4 +0+0
Total Hours: 48
Exam Hours: 03

Credits: 04
CIE Marks: 50
SEE Marks: 50
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Recall the knowledge and mathematical description of Fluid Mechanics and recognize how to discretize the conservation equations for mass, momenta and energy and define the truncation, round-off and discretization errors
2. Recognize and use different Grid Generation procedures for discretization of space around complex configuration to be analyzed; distinguish between differential and algebraic procedures of grid generation
3. Analyze Finite Difference and Finite Volume schemes to solve non-linear fluid-flow problems using appropriate numerical discretization of the relevant mass, momenta and energy fluxes; emphasize on the concept and merit of Upwind Differencing of different accuracy levels to discretize convective fluxes for problems of engineering interest
4. Recognize and employ Turbulence Models of different levels of accuracy for computing different real life fluid flow and heat transfer problems
5. Compute flow situations of simple geometry using the current best practice for selection of numerical grid, turbulence model and flux discretization scheme, followed by validation against experimental data

UNIT I
Introduction to CFD:
Relative merits with respect to Experimental and Theoretical Fluid Dynamics, Concept of Transport process – Importance in design, major elements of a CFD Code, - Preprocessor, Flow Equation Solver and Postprocessor- Conservation Equations in coordinate-free form and Solution Errors.

05 Hours
Grid Generation:

05 Hours

UNIT II
Governing Equations for CFD:
Brief introduction to Vectors & Tensors, Mathematical behaviour of partial differential equations relevant to CFD, Conservation Equations for mass, momentum and energy in cartesian coordinates, Conservation equations in dimensionless form, Importance of different dimensionless numbers, Approximation of Navier Stokes to Euler and Potential Flow equation, Different ways of handling Continuity equation, Pressure Poisson Equation, Generic Form of Governing Equations for flow

09 Hours

UNIT III
Discretisation of Conservation Equations:

10 Hours

UNIT IV
Simulation of Turbulence:
Phenomenon of Turbulence, Reynolds Averaging, Reynolds Stress, Closure Problem, Linear Eddy
Viscosity Hypothesis, Mixing Length Model, Turbulence Energy ($k$), Turbulence Dissipation ($\varepsilon$), $k$-$\varepsilon$ model, $k$-$\omega$ model, Boundary Conditions.

10 Hours

UNIT V

Solution of Linear Equation System and Application Examples of CFD:
Direct solver – Gauss Elimination, LU Decomposition, Iterative Solver - Point Jacobi, Gauss Siedel, Thoma’s Algorithm for Tri-Diagonal matrix, Alternate Direction Implicit (ADI) method for 2D and 3D problems, Simple FORTRAN Programs, Formulation of 1D and 2D Fluid Flow and Heat Transfer problems with proper Boundary Conditions.

10 Hours

Pre-requisites:
The student should have studied Fluid Mechanics.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
INNOVATIVE PRODUCT DESIGN AND DEVELOPMENT

Sub Code : 14MEE760  
Credits : 04  
Hours/Week : 4+0+0  
CIE Marks : 50  
Total Hours : 48  
SEE Marks : 50  
Exam Hours : 03  
Course Type : Program Elective

Course Outcomes:
1. Students will be able to apply the concepts of product design in the development of products to meet the societal needs.
2. Students will understand the importance of morphology in the design of a product with identification of need in functional aspect.
3. Enable the students to apply high ethical standards in terms of team work to be a good design engineer.
4. Students will understand and design the importance of man machine interface with design of display and control.
5. The students would have a good understanding of using special techniques such as SQC, work study etc. in improving the quality of any product before it is sent for manufacturing.

UNIT I

Introduction to Product Design:
Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology, Challenges in product development. Design definitions, the role and nature of design, old and new design methods, Design by evolution.
Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.
10 Hours

UNIT II

Morphology of Design:
Identification of customer needs analysis of need, Product specifications, Concept generation concept selection and concept testing. Conceptual type of design by divergent, transformation and convergent phases of product design.
10 Hours

UNIT III

Transformations:
09 Hours

UNIT IV

Reliability:
09 Hours

UNIT V

Product Appraisal:
Information and literature search, patents and Intellectual Property, standards and codes, environment and safety considerations, existing techniques such as work-study, SQC etc to improve method and quality of product. Product Economics, Innovation versus Invention, technological forecasting and Managing Project.
10 Hours
Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Books:

Reference Books:

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>2 3 3 2</td>
<td>3 3 3</td>
</tr>
<tr>
<td>2</td>
<td>3 3</td>
<td>3 3 3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3 3 3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3 3 3</td>
</tr>
<tr>
<td>5</td>
<td>3 3 2</td>
<td>3 3 3</td>
</tr>
</tbody>
</table>
NON – TRADITIONAL MACHINING

Sub Code: 14MEO761
Credits: 03

Course Outcomes:
Students will be able to
1. Recognize a process suitable for a particular application and infer the same
2. Apply the knowledge to unconventional machining process in industry
3. Analyze the concept, mechanism of material removal and their influence on the machining process.
4. To indicate the merits, demerits and applications of various non-traditional machining processes
5. Ability to compare the various nontraditional machining process with respect to process parameters.

UNIT I
Mechanical Process:
Ultrasonic machining (SUM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Magnetostriction assembly, Tool cone (Concentrator), Exponential concentrator of circular cross section & rectangular cross section, Hallow cylindrical concentrator. Mechanics of cutting-
Theory of Miller & Shaw., Effect of parameter: Effect of amplitude and frequency and vibration, Effect of grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.
Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, standoff distance Applications, advantages & Disadvantages of AJM.
08 Hours

UNIT II
Electrochemical and Chemical metal Removal Process: Electrochemical machining (ECM):
Introduction , study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.
06 Hours

UNIT III
Chemical Machining (CHM):
Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: ;material removal rate accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.
08 Hours

UNITIV
Thermal Metal Removal Processes:
Electrical discharge machining (EDM) introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear , EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode, machining time. Flushing pressure flushing suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy surface finish, Heat affected Zone. Machine tool selection, Application EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.
08 Hours
UNIT V

Plasma Arc Machining (PAM):

Laser Beam Machining (LBM):
Introduction, equipment of LBM mechanism at metal removal, LBM parameters, Process characteristics, Applications, Advantages Limitations.

Electron Beam Machinery (EBM):
Principles, equipment, operations, applications, advantages and limitation of EBM.

08 Hours

Pre-requisites:
The student should have studied Manufacturing Technology and Advanced Manufacturing Technology.

Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments-evaluated through rubrics for 10 marks. Average of two will be considered. (or) Students have to give seminar on the selected topic and have to submit a report, which can be considered for 10 marks.(or)Students have to submit a mini project with report, which can be considered for 10 marks.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book
1. New Technology by BHATTACHARAYA 2000
2. Modern Machining Process by P .C Pandy & H.S. Shan

Reference Book
2. “Modern Machining Process” by ADITYA. 2002
4. “Modern Machining Processes”, by K . Mishra

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

| 1               | 2               | 5   |
| 6               | 7               | 8   |
| 9               | 10              | 11  |
| 12              | 1               | 2   |
ORGANISATIONAL BEHAVIOUR

Course Outcomes:
1. Students will be able to understand the need of individual behavior, group behavior and the ethics at work place.
2. Students will be able to learn the leadership theory, change theory, organization behavior theory to effectively implement the same in the work place.
3. Student will understand the importance of learning in an origination as an individual and as also as a team.
5. Students will be able to understand leadership qualities and need of communication to perform effectively in an organization.

UNIT I
Introduction:
Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems).

The Individual:
Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values

UNIT II
Learning:
Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement.

Perception:
Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

UNIT III
Motivation:
Maslow's Hierarchy of Needs, Me. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Me Cleland three needs theory, Victor vroom's expectancy theory of motivation.

The Groups:
Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

UNIT IV
Conflict & Stress management:
Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.

UNIT V
Principles of Communication:
Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10  11  12</td>
<td>1  2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Maintainance and Reliability Engineering

Sub Code: 14MEO763  
Credits: 03  
Hours/Week: 3+0+0  
CIE Marks: 50  
Total Hours: 38  
SEE Marks: 50  
Exam Hours: 03  
Course Type: Open Elective

Course Outcomes:
Students will be able to
1. Enable students to understand the principles, functions and practices adopted in industry for the successful management of maintenance activities,
2. Elucidate different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements
3. Illustrate some of the simple instruments used for condition monitoring in industry.
4. Create awareness about reliability and its need for industries.

UNIT I
Principles, Practices of Maintenance and Planning
Introduction: Fundamentals of maintenance engineering, Engineering importance in material and energy conservation, inventory control, productivity, safety, Pollution control, Basic principles of maintenance planning – Objectives and principles of planned maintenance activity- Importance and benefits of sound maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT factors of availability – Maintenance organization – Maintenance economics.
07 Hours

UNIT II
Maintenance Policies and Management
Types of maintenance strategies, Planned & Unplanned maintenance, Break down, Preventive & Predictive maintenance – Comparative Merits and limitations of each category, maintenance schedules, repair cycle, computer aided maintenance, maintenance scheduling, Spare parts management, inventory control, Tribology in maintenance- Principles and methods of lubrication- TPM.
08 Hours

UNIT III
Machine Health Monitoring
Condition based maintenance, Signature Analysis, Oil Analysis, Wear- debris analysis, Vibration, noise and thermal signature, online and off line techniques, Instrumentation and assignment use in MHM, Cost comparison with and without CM-On load testing And Off load testing- Methods and instruments for CM – Temperature sensitive tapes- Pistol thermometers.
Repair methods for material handling equipment- Equipment records- Job order systems- Use of computers in maintenance.
08 Hours

UNIT IV
Fundamentals of Reliability
Definition, mean fracture rate, mean time to failure, mean time between failure, hard rate, hazard models. Constant hazard, linearly increasing hazard, weibull model, system reliability, series, parallel and mixed configuration, simple problems.
08 Hours

UNIT V
Reliability Improvement
Reliability, availability and maintainability- Analysis, Introduction to RAM failure mechanism, failure data analysis, failure distribution, reliability of repairable and non-repairable system, Improvement in reliability, reliability testing, reliability in prediction, utilization factor, system reliability by Moute Carlo- Simulation technique, redundancy, element, unit and stand by redundancy, reliability allocation for a series system, system down time, reliability and maintainability trade-off, simple problems.
07 Hours

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
1. Maintenance Engineering Hand Book by Higgins.

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
MARKETING MANAGEMENT

Sub Code : 14MEO764  
Credits : 03  
Hours/Week : 3+0+0  
CIE Marks : 50  
Total Hours : 38  
SEE Marks : 50  
Exam Hours : 03  
Course Type: Open Elective

Course Outcomes:

Students will be able to
1. Knowledge of analytical skills in solving marketing related problems
2. Awareness of marketing management process
3. Construct and present effective oral and written forms of professional communication.
4. Apply knowledge of key marketing concepts in an integrated manner
5. Describe the global environment of business.

UNIT I

Introduction
08 Hours

UNIT II

Marketing Strategy:
Marketing strategy formulations – Key Drivers of Marketing Strategies - Strategies for Industrial Marketing – Consumer Marketing — Services marketing – Competitor analysis - Analysis of consumer and industrial markets – Strategic marketing Mix components.
08 Hours

UNIT III

Marketing Mix Decisions :
08 Hours

UNIT IV

Buyer Behaviour :
Understanding industrial and individual buyer behavior - Influencing factors – Buyer Behaviour Models – Online buyer behaviour - Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection.
08 Hours

UNIT V

Marketing Research & Trends in Marketing :
07 Hours

Pre-requisites:
Knowledge of Basic thermodynamics & fluid mechanics is essential.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

REFERENCES
7. **Marketing** – An Innovative approach to learning and teaching- Lamb, hair, Sharma, Mc Daniel— A south Asian perspective, Cengage Learning — 2012

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2 3 2 1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2 3</td>
<td>2 3 2 2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>3 3 2 3</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>3 3 2 3</td>
</tr>
</tbody>
</table>

152
STATISTICAL QUALITY CONTROL

Course Code : 14ME0765
Credits : 03
Hours/Week : 03
Total Hours : 38
Exam Hours : 3
CIE Marks : 50
SEE Marks : 50
Course Type : Open Elective

Course outcomes:
Students will be able to
1. Understand the quality improvement and control technique.
2. Formulate the different problems and analysis quality control technique.
3. Analyze the problems by the help of controls chart.
4. Analyze the problems by the help of controls chart of conformities and nonconformities.
5. Evaluate the graphical method of sampling problems to confirm whether the problems are in statistical control.

UNIT I
Introduction:
The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement).
08 Hours

UNIT II
Modeling Process Quality:
Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, finding the Z score, Central limit theorem.
Methods and Philosophy of Statistical Process Control:
Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)
06 Hours

UNIT III
Control Charts for Variables:
Control Charts for X-Bar and R charts, Type I and Type II errors.
Process Capability:
The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – Process performance index, summary of process measures
06 Hours

UNIT IV
Control Charts for Attributes:
Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit
10 Hours

UNIT V
Lot-By-Lot Acceptance Sampling For Attributes:
The accepting sampling problem, single sampling plan for attributes, Double, Multiple, and sequential sampling, AOQL, LTPD, OC curves
Cumulative-Sum (CUSUM) & Exponentially Weighted Moving Average (EWMA) Control Charts:
CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of an EWMA control chart
08 Hours

Pre-requisites:The student should have studied Maths I and Maths-II.
Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments- evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.
SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Books:

Reference Books:
1. **Statistical Process Control and Quality Improvement** by Gerald M. Smith, Pearson Prentice Hall.

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

RENEWABLE ENERGY RESOURCES

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>14MEO766</td>
<td>03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours/Week</th>
<th>CIE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3+0+0</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Hours</th>
<th>SEE Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exam Hours</th>
<th>Course Type:</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Open Elective</td>
</tr>
</tbody>
</table>

Course Outcomes:
Students will be able to
1. Identify the main energy sources and explain the same with the special reference to the Indian context.
2. Classify the various solar measuring devices, thermal radiation devices, solar concentrators and describe their working principles.
3. Interpret the desirable features and conversion technologies of solar, wind, biomass tidal and geothermal energy resources.
4. Identify and solve the problems of energy crises using wind and solar energy.
5. Analyse various applications such as solar energy storage system, solar water heating, space heating, space cooling, solar thermal electric conversion.

UNIT I
Energy Sources and their Availability:
Introduction, commercial or conventional energy sources, Non-conventional energy sources, new energy techniques.

Solar Radiation and its Measurement:

07 Hours

UNIT II
Solar Energy collectors:
Introduction, physical principles of the conversion of solar radiation into heat, flat plate collectors, thermal analysis of flat plate collector and useful heat gained by the fluid, concentrating collector: focusing type, advantages and disadvantages of concentrating collectors over flat plate type collectors.

08 Hours

UNIT III
Applications of Solar Energy System:
Solar energy storage system, solar water heating, space heating, space cooling, solar thermal electric conversion, solar photo voltaics, solar distillation, pumping, furnace, cooking, green house, solar production of hydrogen.

08 Hours

UNIT IV
Wind Energy:
Introduction, Basic principles: nature of the wind, power in the wind, forces on the blade, wind energy conversion, wind data and energy estimation, basic components of wind energy conversion system(WECS), classification of WECS, advantages and disadvantages of WECS, Type of wind machines, energy storage, applications.

Energy from Biomass:
Introduction, biomass conversion technologies, photosynthesis, biogas generation, factors affecting biodigestion, classification of biogas plants, advantages and disadvantages of floating drum plant advantages, advantages and disadvantages of fixed dome type plant, constructional details of some main digesters, bio gas from plant wastes, materials used for bio gas generation, utilization of bio gas.

08 Hours

UNIT V
Geothermal Energy:
Introduction , geothermal sources, hot dry rock resources, magma resources, comparison of flashed steam and total flow concept, interconnection of geothermal fossil systems, applications, material selection for geothermal power plants.
**Tidal Power:**
Introduction, basic principle of tidal power, components of tidal power plants, operation methods, estimation of energy and power in simple single basin tidal system, storage, advantages and limitations.

**07 Hours**

**Course Assessment Method:**
Test: 30 marks  
Assignment: 10 marks  
Surprise: 10 marks  
SEE - Final Exam: 50 Marks

**Text Book**
1. **Non-conventional Energy resources** by G D Rai, Khanna Publishers

**Reference Book**

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
ENGINEERING ECONOMICS

Sub Code : 14MEO767
Credits : 03
Hours/Week : 3+0+0
CIE Marks : 50
Total Hours : 38
SEE Marks : 50
Course Type : Open Elective

Course Outcomes:
Students will be able to
1. Demonstrate problem solving and decision making process based on economic concepts like law of returns, interest factors, cash flow diagrams etc.
2. Evaluate alternative proposals for investment based on economic methods.
3. Apply the methods to find rate of return, depreciation of capital items for decision making.
4. Utilize the process of estimating and costing for analyzing the economic feasibility.
5. Evaluate financial healthiness of a company by calculating and analyzing various financial ratios and asses the budgets for future activities.

UNIT I
Introduction:
07 Hours

UNIT II
Equivalent Annual Worth Comparisons: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, difference between tangible and intangible assets, Exercises Problems.
08 Hours

UNIT III
Rate of Return Calculations and Deprecation: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, and corporate income tax.
08 Hours

UNIT IV
Introduction, Scope of finance, Finance functions:
07 Hours

UNIT V
Financial and Profit Planning: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting.
08 Hours
Course Assessment Method:
CIE – 50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - to familiarize students with the use of Compound interest tables as directed towards interest calculations, Present and future worth comparisons. - evaluated through rubrics for 10 marks. Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE – 50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
INDUSTRIAL ROBOTICS

Sub Code : 14MEO768 Credits : 03
Hours/Week : 3+0+0 CIE Marks : 50
Total Hours : 38 SEE Marks : 50
Exam Hours : 03 Course Type : Open Elective

Course Outcomes:
Students will be able to
1. Will have the knowledge of fundamentals of robotics, graphics, and configurations of serial manipulators, workspace, frames, 3D transformations and Robot programming.
2. Describe the concepts of Euler’s angles, Differential velocities, D-H Representation, Forward and Inverse kinematics, fuzzy logic and robot vision.
3. Application of Calculus & Linear algebra, for kinematics, dynamics & trajectory planning respectively.
5. Development of generic algorithms to perform various robot tasks and obtain the robot program using AML and VAL.

UNIT I
Introduction and Mathematical Representation of Robots:
10 Hours

UNIT II
Kinematics of serial manipulators:
Direct kinematics of 2R manipulator, Inverse kinematics of manipulator.
Velocity and Statics of Manipulators:
Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulator, Statics of serial manipulators.
10 Hours

UNIT III
Dynamics of Manipulators:
Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian, Newton-Euler formulation.
Trajectory Planning:
Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning.
10 Hours

UNIT IV
Robot Programming:
Introduction, Manual teaching, lead through teaching, programming languages, AML and VAL simple example, programming with graphics, storing and operating, Task programs.
Fuzzy logic control:
Introduction, fuzzy control, fuzzy sets, fuzzification, fuzzy interference rule base, defuzzification, center of
gravity method, mamdani’s inference method, applications.

08 Hours

UNIT V

Robot Vision:

10 Hours

Pre-requisites:
Knowledge of Theory of Machines-I is essential.

Course Assessment Method:
CIE –50 Marks
1. Three internals tests (each 30 marks) are conducted, average of best two marks will be considered.
2. Minimum two assignments - Average of two will be considered.
3. Two written surprise quiz tests conducted and evaluated for 10 marks. Average of these two will be considered.

SEE –50 Marks
1. Two questions to be set from each unit, carrying 20 mark each.
2. Students have to answer 5 questions selecting one full question from each unit

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 2 2 2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2 1 2 2</td>
<td></td>
</tr>
</tbody>
</table>
CIM & AUTOMATION LAB

Sub Code : 14MEL77
Hours/Week : 0+0+3
Total Hours : 39
Exam Hours : 03
Credits : 1.5
CIE Marks : 50
SEE Marks : 50
Course Type: Program Core

Course Outcomes:
Students will be able to

1. Write CNC part programs to simulate Turning operations such as Step turning, Taper turning, Grooving and Thread cutting using Fanuc simulator.
2. Write CNC part programs to simulate Milling operations such as Profile milling, End milling, Pocketing (Rectangular and Circular) using Fanuc simulator.
3. Create basic Turning profiles using Edge cam
4. Create basic Milling profiles using Edge cam
5. Write Effective Report and Document

UNIT I
CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master – CAM, or any equivalent software.

UNIT II
(Only for Demo/Viva voce)
1. FMS (Flexible manufacturing System) : Programming of Automatic storage and Retrieval system (ASRS) and liner shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.
2. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects, 2 programs.
3. Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

Pre-requisites:
The student should have theoretical knowledge of CAD/CAM /CIM theory.

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3 2 2 3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>2</td>
<td>3 2 2 3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>3</td>
<td>3 2 2 3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>4</td>
<td>3 2 2 3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2 1 1</td>
</tr>
</tbody>
</table>
HEAT TRANSFER LAB

Sub Code: 14MEL78
Credits: 1.5
Hours/Week: 0+0+3
CIE Marks: 50
Total Hours: 39
SEE Marks: 50
Exam Hours: 03
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Determine the thermal conductivity, Overall Heat Transfer Coefficient and Effectiveness for heat transfer through conduction.
2. Select the appropriate dimensional and functional parameters to measure the heat transfer coefficient for free and forced convection and comparing with experimental values.
3. Demonstrate and determine emissivity and stefan boltzmann constant for a surface.
4. Apply the basic heat transfer mechanisms for to conduct performance test on Vapour compression refrigerator and heat exchangers on various phenomenon.
5. Write effective report and document.

UNIT I
1. Determination of Thermal Conductivity of a Metal Rod.
3. Determination of Effectiveness on a Metallic fin.

UNIT II
1. Determination of Stefan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour
4. Performance Test on a Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air – Conditioner

Pre-requisites:
The student should have theoretical knowledge of Heat and Mass transfer theory.

Course Assessment Method:
Record: 30 marks
Test: 15 marks
Study project/Viva: 05 marks
SEE - Final Exam: 50 Marks

Scheme of Examination:
Student will be asked to conduct one experiment from each unit.

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7 8  9  10 11 12</td>
<td>1  2</td>
</tr>
<tr>
<td>1</td>
<td>3  3  1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3  3  2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3  3  2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1  3  2</td>
</tr>
</tbody>
</table>
COMPOSITE MATERIALS

Sub Code : 14ME81
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type: Program Core

Course Outcomes:
Students will be able to
1. Identify the significance and suitability of composite materials for various engineering applications.
2. Analyze laminates using constitutive matrices.
3. Synthesize the various processing techniques in the development of PMC’S and MMC’S.
4. Improve the properties of composites through secondary and special fabrication techniques.
5. Determine the influence of size, shape and particle distribution in MMC’S.

UNIT I
Introduction To Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.
Fiber Reinforced Plastic Processing: Layup and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.
10 Hours

UNIT II
Characteristics of Fiber Reinforced Lamina:
Fundamentals, Elastic properties of a Lamina, Unidirectional Continous fibre zero degree and angle-ply lamina.
Introduction to properties of Laminate and failure theories.
09 Hours

UNIT III
Applications of PMCs: Automobile, Aircrafts, missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites. Introduction to modelling software analysis using ANSYS.
10 Hours

UNIT IV
Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC’s and its application.
Fabrication Process For MMC’S: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.
10 Hours

UNIT V
Study Properties of MMC’S: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.
09 Hours

Pre-requisites:
The student should have studied Material Science & Metallurgy theory.

Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
TEXT BOOKS:

REFERENCE BOOKS:
1. *Fiber Reinforced Composites* by P. K. Mallick, Marcel Dekker, Inc

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
SCHEME AND SYLLABUS FOR I TO VIII SEM BE MECHANICAL ENGG-2014 SCHEME

AIRCRAFT STRUCTURES

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>14MEE821</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours/Week</td>
<td>4+0+0</td>
<td>CIE Marks</td>
<td>50</td>
</tr>
<tr>
<td>Total Hours</td>
<td>48</td>
<td>SEE Marks</td>
<td>50</td>
</tr>
<tr>
<td>Exam Hours</td>
<td>03</td>
<td>Course Type: Program Elective</td>
<td></td>
</tr>
</tbody>
</table>

Course Outcomes:

Students will be able to

1. Build preliminary concepts of the aircraft design methodologies and its structural analysis.
2. Select materials for aircraft structure as per required mechanical properties.
3. Solve indeterminate structures strength analysis as in aircraft.
4. Formulate airworthiness requirement of aircraft certification.
5. Apply the necessary repairing techniques for various structural parts

UNIT I

Overview of the Aircraft Design Process
Phases of aircraft design, Aircraft Conceptual design process, Conceptual stage, Preliminary design, Detailed design, Design methodologies.

Introduction to Aircraft Structures
Types of structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectonal properties of structural members and their loads, types of structural joints, types of loads on structural joints.
09 Hours

UNIT II

Aircraft loads
Aerodynamic loads, Inertial loads, loads due to engine, actuator loads, Maneuver loads, V-N diagrams, Gustloads, Ground loads, Miscellaneous loads.(No problems)

Materials for Aircraft Structures
Metallic and non-metallic materials, Use of Aluminum alloy, Titanium, Stainless steel and Composite materials, Use of advanced materials.
09 Hours

UNIT III

Concept of Determinate and Indeterminate structure, compatibility, Clapeyron’s 3 moment equation and Moment distribution method for indeterminate beams.(No derivations, Simple problems).
10 Hours

UNIT IV

Columns : Inelastic buckling–effect of initial curvature–the South well plot–columns with eccentricity–beam columns.
10 Hours

UNIT V

Types of structural damage, Nonconformance, Rework, Allowable damage limit, Repairable damage limit, Overview of ADL analysis, Types of Repair, Repair considerations and best practices.
Airworthiness regulations, Regulatory bodies, Type certification, General requirements, Requirements related to Aircraft design, Performance and Flight requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions ,Emergency landing requirements.
10 Hours

Pre-requisites:
The student should have a good understanding of Mechanics of Materials, Engg Mechanics and Elements of Aeronautics.
Course Assessment Method:
Test: 30 marks
Study Project/Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Resources
Text Books

Reference
2. The Elements of Aircraft preliminary Design by Roger D Schaufele, aries Publications, 2000
5. An Introduction to Aircraft Certification: A guide to understanding Jaa, Easa and FAA by Filippo De Florio,Butterworth – Heinemann

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
EXPERIMENTAL STRESS ANALYSIS

Sub Code : 14MEE822
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Define various phenomenon and properties associated with light and photo elastic materials.
2. Elucidate different types strain gauges
3. Explain and illustrate the principles of measuring strain for photo elasticity and electrical strain gauges.
4. Apply the concept of photo elasticity, strain gauge circuit and rosette for the calculation of stress in the given component under different loading conditions
5. Examine different methods of calibration and compensation techniques

UNIT I
Nature of Light:
Nature of light, Harmonic wave, phase amplitude, polarization, passage of light through isotropic material, total internal reflection, normal incidence and oblique incidence, passage of light through crystalline medium. Absolute and relative phase difference, quarter wave plate and half wave plate. Production of plane polarized light.
08 Hours

UNIT II
Two Dimensional Photoelasticity:
10 Hours

UNIT III
Two Dimensional Photo Elastic Analysis:
Isoclinics and isochromatics fringe order at a point, methods of compensation, calibration methods, separation techniques.
Application of Photoelasticity:
Types of application, properties of an ideal photoelastic material, casting techniques, stress relieving, two dimensional applications.
10 Hours

UNIT IV
Strain Measurement:
Mechanical, optical, Pneumatics, Acoustic strain gauges. Electrical strain gauges – Induction, capacitance and electrical resistance strain gauges.
Electrical Resistance Strain Gauges:
10 Hours

UNIT V
Strain gauge Circuit and Rosette:
Wheat stone bridge, error due to input impedance of the measuring instrument, bridge balancing, temperature compensation. Strain gauge transducers, calibration of strain measuring system.
Two, Three and four element rosette problems.
10 Hours

Pre-requisites:
The student should have studied Mechanics of Materials.

Course Assessment Method:
Test: 30 marks

Credits :04
CIE Marks :50
SEE Marks :50
Study Project/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book
1. Experimental Stress Analysis by Sadhu Singh, Khanna Publishers

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10  11  12</td>
<td>1  2</td>
</tr>
<tr>
<td>1</td>
<td>2  1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1  1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2  2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3  3  1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2  2</td>
<td></td>
</tr>
</tbody>
</table>
FOUNDRY TECHNOLOGY

Sub Code : 14MEE823
Credits : 04

Hours/Week : 4+0+0
CIE Marks : 50

Total Hours : 48
SEE Marks : 50

Exam Hours : 03
Course Type: Program Elective

Course Outcomes:

Students will be able to

1. Identify different types of melting methods that are employed in different casting process.
2. Illustrate the design of defect-free castings considering proper gating and risering.
3. Analyze the structure of casting and its influence on mold characteristics.
4. Compare ferrous and non-ferrous castings that are used in special molding techniques.
5. Identify the need of modernization and mechanization of foundry molding process considering pollution control norms that is appropriate for public health and safety.

UNIT I

Foundry Metallurgy: Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid metals.

Casting Design: Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, safety factors, design for low pattern cost and model making as an aid in design.

09 Hours

UNIT II

Solidification Of Castings: Crystallization and development of cast structure - nucleation, growth and dendritic growth. Structure of castings – significance and practical control of cast structure, grain shape and orientation, grain size, refinement and modification of cast structure. Concept of progressive and directional solidification, solidification time and derivation of Chvorinov’s equation, influence on mold characteristics and cast metal.

10 Hours

UNIT III


10 Hours

UNIT IV

Special Molding Techniques: Principles, materials used, process details and application of no-bake sand systems, vacuum molding, flask less molding, and high pressure molding.

Cupola Melting: Developments in cupola melting – hot blast cupola, water cooled cupola, balanced blast cupola, coke less cupola, cupola charge calculations.

Ferrous Foundry: Melting procedures, casting characteristics, production, specification, and properties of some typical steels, grey cast iron, malleable iron, and spheroidal graphite cast iron castings.

Non-Ferrous Foundry: Melting procedures, casting characteristics, production, specification, and properties of some typical aluminum, copper, and magnesium based alloy castings.

10 Hours

UNIT V

Modernization And Mechanization Of Foundry: Need for modernization, and mechanization, molding and core making, melting, pouring, shake out equipment and fettling, dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands. Pollution control – norms, and agencies.

09 Hours

Pre-requisites:
The student should have studied Manufacturing Process
Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
1. *Principles of metal casting* by Heine Loper & Rosenthal TMH - 2005

Reference Book
2. *Foundry Technology* by P. N. Rao

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DESIGN FOR MANUFACTURING

Sub Code      :  14MEE824
Hours/Week    :  4+0+0
Total Hours   :  48
Exam Hours    :  03
Credits       :  04
CIE Marks     :  50
SEE Marks     :  50
Course Type   : Program Core

Course Outcomes:
Students will be able to
1. List & Define the process of design and basic guidelines of Design for Manufacture encompassing the selection of materials & manufacturing processes.
2. Identify & illustrate various GD&T symbols, explain the concepts of Tolerance, Datums, True Positional Theory, Selective Assembly and Quantitative material selection process.
3. Apply the design for manufacture guidelines for a given component to meet the technical & economical feasibility. Also compute the tolerances for gauges & selective assembly components.
4. Analyse the design and effect of tolerance on a given component &/or a pattern, examine the design flaws associated with it & identify its parting line, Datum features & sequence of Manufacturing processes.
5. Re-design the given component by rearranging the sequence of manufacturing processes or by redesigning the pattern to obviate the sand cores for a sustainable economic feasibility.

UNIT I
10 Hours

UNIT II
Selective Assembly: Interchangeable part manufacture and selective assembly, Deciding the number of groups-Model-1: Group tolerance of mating parts equal, Model total and group tolerances of shaft equal. Control of axial play-Introducing secondary machining operations. Laminated shims, examples.
10 Hours

UNIT III
09 Hours

UNIT IV
Component Design: Component design with machining considerations link design for turning components-milling, Drilling and other related processes including finish-machining operations.
Design of Gauges: Design of gauges for checking components in assemble with emphasis on various types of limit gauges for both hole and shaft.
10 Hours

UNIT V
09 Hours
Course Assessment Method:
Test: 30 marks
Seminar/Assignment: 10 marks
Surprise/Course project: 10 marks
SEE - Final Exam: 50 Marks

TEXT BOOKS:

REFERENCE BOOKS:

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9</td>
<td>10 11 12</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2 2 2</td>
</tr>
<tr>
<td>2</td>
<td>3 2</td>
<td>2 2 2</td>
</tr>
<tr>
<td>3</td>
<td>3 2 3</td>
<td>2 2 2</td>
</tr>
<tr>
<td>4</td>
<td>3 2 3</td>
<td>2 2 2</td>
</tr>
<tr>
<td>5</td>
<td>3 2 3</td>
<td>2 2 2</td>
</tr>
</tbody>
</table>
INTRODUCTION TO AERODYNAMICS

Sub Code : 14MEE825
Hours/Week : 4+0+0
Total Hours : 48
Exam Hours : 03

Credits : 04
CIE Marks : 50
SEE Marks : 50
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Define the geometrical details of an Aircraft wing; recognize the performance coefficients like Lift, Drag and Pitching Moment as function of operating parameters like the Wing geometry, Angle of Attack, Mach number, Reynolds number; distinguish between the deformation of a solid and a fluid element using unambiguous definitions of substantial derivatives of flow variables, Shear Strain Rate, Normal Strain Rate and Vorticity
2. Recognise the distinction between irrotational, inviscid and viscous flow, their relative importance and complexity in simulation of real-life turbulent flow past a full aircraft configuration; to apply basic flow singularities like Sources, Vortices, Doublets & Uniform flow and their multiple combinations to compute potential flow around different complex shaped configuration
3. Employ the Potential flow based Singularity, Panel and Vortex Lattice methods to analyse the flow field around simple aerodynamic configuration; appreciate the important role of Bernoulli’s Equation to calculate the relevant forces and moments on a 2D Aerofoil and a Circular Cylinder
4. Analyse the BiotSavert’s Law and Helmholtz Theorem for Vortices leading to Prandtl’s Lifting Line theory for computing Induced Drag and Downwash of Finite Wings
5. Ascertain the effect of fluid viscosity on flow past Flat Plates, Aerofoils or Finite Wings; differentiate between Laminar and Turbulent flow situations for attached and separated flow over wing surface; explain the formation of Wing Tip Vortices and Wake Vortices for aircrafts

UNIT I
1. Aerodynamics: Fundamental principles
Models of the fluid: control volumes and fluid elements, continuity and momentum equation, application of momentum equation: drag of a 2D body, Energy equation, angular velocity, vorticity, and strain, circulation, stream function, velocity potential, relationship between the stream function and velocity potential.
09 Hours

UNIT II
Fundamentals of Inviscid, incompressible flow
Bernoulli equation, Incompressible flow in a duct: the venturi and low speed wind tunnel, pitot tube: measurement of airspeed, pressure coefficient, condition of velocity for incompressible flow, governing equation for incompressible flow: laplace's equation, uniform flow, source flow, doublet flow, non lifting flow over a circular cylinder, vortex flow, lifting flow over a cylinder.
10 Hours

UNIT III
Incompressible flow over aerofoils
Introduction, aerofoil nomenclature and characteristics, vortex sheet, kutta condition, kelvin's theorem and the starting vortex, airfoil theory: symmetric and cambered, circulation theory of lift, lifting flow over arbitrary bodies.
09 Hours

UNIT IV
Incompressible flow over finite wings
Downwash and induced drag, vortex filament, biot savart law, helmboltz vortex theorem, prandtl's classical lifting theory-line theory, numerical nonlinear lifting-line method, lifting surface theory-vortex lattice method, lanchester and prandtl - development of finite wing theory.
10 Hours

UNIT V
Viscous flow
Introduction, qualitative aspects of viscous flow, viscosity and thermal conduction, navier stokes equation, Incompressible flow over flat plate-blasius solution, compressible flow over flat plate, results for turbulent boundry layers.
10 Hours

Pre-requisites:
The student should have a good understanding of Fluid Mechanics

Course Assessment Method:
Test: 30 marks
Study Project/Assignment: 10 marks
Case study/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Resources
Text Books

Reference
2. L.M. Milne-Thomson, Theoretical aerodynamics, Dover Publications

<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

174
MATERIALS SELECTION IN MECHANICAL DESIGN

Sub Code: 14MEE826
Sub Code: 14MEE826
Credits : 04
Hours/Week: 4 +0+0
Total Hours: 48
Exam Hours: 03
CIE Marks: 50
SEE Marks: 50
Course Type: Program Elective

Course Outcomes:
1. Students will able to understand the importance of materials in design, material selection and its strategies.
2. Students will come across different case studies and can apply the material selection strategies for other problems.
3. Students will able understand the processes and process selection with enumerated case studies and can apply the same concept for other problems.

UNIT I
Introduction: Introduction and synopsis, Materials in design, the evolution of engineering materials, Case study-the evolution of materials in Vacuum cleaners.
The design process: Introduction and synopsis, design process, types of design, design tools and materials data. Function, material, shape and process. Case Study-Devices to open cocked bottle.
10 Hours

UNIT II
Material selection - the basics: Introduction and synopsis, the selection strategy, Attribute limits and material indices, the selection procedure, Computer-aided selection, the structural index, Case Studies.
08 Hours

UNIT III
10 Hours

UNIT IV
Selection of Material and Shape: Introduction and synopsis, shape factors, microscopic or micro-structural shape factors, limits to shape efficiency, exploring and comparing structural sections, material indices that include shape, co-selecting material and shape. Case studies.
10 Hours

UNIT V
Materials and the environment: Introduction and synopsis, the material life cycle, material and energy consuming systems, the eco-attributes of materials, eco-selection, Case studies- Drink containers and crash barriers.
Materials and industrial design: Introduction and synopsis, the requirements pyramid, product character, using materials and processes to create product personality.
10 Hours

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Study project/Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book
<table>
<thead>
<tr>
<th>Course outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
ORGANISATIONAL BEHAVIOUR

Sub Code : 14MEE827
Credits : 04
Hours/Week : 4+0+0
CIE Marks : 50
Total Hours : 48
SEE Marks : 50
Exam Hours : 03
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Understand the need of individual behavior, group behavior and the ethics at work place.
2. To learn the leadership theory, change theory, organization behavior theory to effectively implement the same in the work place.
3. Understand the importance of learning in an origination as an individual and as also as a team.
5. Understand leadership qualities and need of communication to perform effectively in an organization.

UNIT I
Introduction:
Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems).

The Individual:
Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values

UNIT II
Learning:
Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement.

Perception:
Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

UNIT III
Motivation:
Maslow's Hierarchy of Needs, Me. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Me Cleland three needs theory, Victor vroom's expectancy theory of motivation.

The Groups:
Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

UNIT IV
Conflict & Stress management:
Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.

UNIT V
Principles of Communication:
Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication.

Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MICRO ELECTROMECHANICAL SYSTEMS (MEMS)

Sub Code: 14MEE828  Credits: 04
Hours/Week: 4+0+0  CIE Marks: 50
Total Hours: 48  SEE Marks: 50
Exam Hours: 03  Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Recognize smart materials, structures, sensors and actuation systems for various applications.
2. Analyze smart material processing and flip-chip module technology to develop and fabricate the micro systems.
3. Interpret the different smart sensors for analyzing the need of miniaturization towards recent technology in micro fabrication
4. Identify the need of electronic component circuits and its utilization in optimization of micro and smart systems.
5. Ascertain proper integration and packaging processes for MEMS devices.

UNIT I
Introduction to Micro and Smart Systems:
09 Hours

UNIT II
Micro and Smart Devices and Systems, Principles and Materials:
a) Definitions and salient features of sensors, actuators, and systems.
b) Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conductometric gas sensor, fiber-optic gyroscope and surface-acoustic-wave based wireless strain sensor.
c) Actuators: silicon micro-mirror arrays, piezo-electric based inkjet print-head, electrostatic comb-drive and micromotor, magnetic micro relay, shape-memory-alloy based actuator, electro-thermal actuator
d) Systems: micro gas turbine, portable clinical analyzer, active noise control in a helicopter cabin.
10 Hours

UNIT III
Micromanufacturing and Material Processing:
a) Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding, and metallization.
b) Silicon micromachining: surface, bulk, moulding, bonding based process flows.
c) Thick-film processing:
d) Smart material processing:
e) Processing of other materials: ceramics, polymers and metals
f) Emerging trends
10 Hours

UNIT IV
Micro Electronics, Circuits and Control:
10 Hours

UNIT V
Integration and Packaging of Micro electro mechanical Systems:
Integration of microelectronics and micro devices at wafer and chip levels. Microelectronic packaging: wire and ball bonding, flip-chip. Low-temperature-co fired-ceramic (LTCC) multi-chip-module technology.
Case Studies:
BEL pressure sensor, and active vibration control of a beam.

09 Hours

**Pre-requisites:** The student should have studied Basic Electrical & Electronics.

**Course Assessment Method:**
*CIE* - Test: 30 marks
Course Project / Assignment: 10 marks
Surprise: 10 marks
*SEE* - Final Exam: 50 Marks

**Text Book**
1. **MEMS & Microsystems: Design and Manufacture** by Tai-Ran Tsu, Tata Mc-Graw-Hill.
2. **MEMS** by Nitaigour Premch and Mahalik, TMH 2007

**Reference Book**

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2 3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2 3 3</td>
<td>2</td>
</tr>
</tbody>
</table>
Marketing Management

Sub Code: 14MEE829
Credits: 04
Hours/Week: 4+0+0
CIE Marks: 50
Total Hours: 48
SEE Marks: 50
Exam Hours: 03
Course Type: Program Elective

Course Outcomes:

Students will be able to
1. Knowledge of analytical skills in solving marketing related problems
2. Awareness of marketing management process
3. Construct and present effective oral and written forms of professional communication.
4. Apply knowledge of key marketing concepts in an integrated manner
5. Describe the global environment of business.

UNIT I

Introduction
10 Hours

UNIT II

Marketing Strategy:
Marketing strategy formulations – Key Drivers of Marketing Strategies - Strategies for Industrial Marketing – Consumer Marketing — Services marketing – Competitor analysis - Analysis of consumer and industrial markets – Strategic marketing Mix components.
10 Hours

UNIT III

Marketing Mix Decisions :
10 Hours

UNIT IV

Buyer Behaviour :
Understanding industrial and individual buyer behavior - Influencing factors – Buyer Behaviour Models – Online buyer behaviour - Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection.
09 Hours

UNIT V

Marketing Research & Trends in Marketing :
09 Hours

Pre-requisites:
Knowledge of Basic thermodynamics & fluid mechanics is essential.

Course Assessment Method:
Test: 30 marks
Case study/Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks
Text Book

REFERENCES
7 Marketing – An Innovative approach to learning and teaching- Lamb, hair, Sharma, Mc Daniel— A south Asian perspective, Cengage Learning — 2012

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
NANO TECHNOLOGY

Sub Code: 14MEE830  
Credits: 04
Hours/Week: 4+0+0  
CIE Marks: 50
Total Hours: 48  
SEE Marks: 50
Exam Hours: 03  
Course Type: Program Elective

Course Outcomes:
Students will be able to
1. Analyze and classify Nanomaterials based on their structures.
2. Compare and contrast between different methods of synthesizing the Nanomaterials.
3. Prepare and characterize Nanomaterials for a specified application.
4. Identify the difference between bulk and nano materials properties.
5. Relate the application of mechanical engineering with nanotechnology

UNIT I
Overview of Materials:
Introduction to materials; classification of materials: metallic, polymeric and ceramic materials; modification of properties of conventional materials by different methods: top-down and bottom-up approaches.
08 Hours

UNIT II
Nano materials
Difference between micro and nano materials; Structure and defects in crystalline nanomaterials; Ceramic interfaces, Hybrid nanomaterials; Synthesis of Nanomaterials; Nanomaterials in Nature.
Nanostructures:
Dimensionality of nanomaterials: 3D, 2D, 1D and 0D structures-bulk nano structures (nanocomposites and alloys), thin films, Nanotubes(carbon and others) and nanorods, Fullerenes, Nanowires, Quantum Dots, Cell’s response to Surfaces and interfaces in nanostructures., Superhydrophobic surfaces, Grain boundaries in Nano crystalline materials.
08 Hours

UNIT III
Synthesis of nanomaterials and nanostructures:
Chemical methods: Aerosol synthesis, Spray pyrolysis, electrochemical deposition, electro spinning, colloidal dispersion,Sol gel method, solution combustion method, chemical vapour deposition.
Physical methods: Evaporation - thermal and e-beam; Sputtering (DC, RF, Magnetron, Ion-assisted);MBE; ALD; Lithography.
08 Hours

UNIT IV
Properties and Characterization of nanomaterials
Properties of nanomaterials: Deformation behaviour of nanomaterials. Fracture and creep. Electrical,Magnetic and Optical properties
Characterization: Overview of characterization of nanostructures and nanomaterials.
SEM, TEM, STM, AFM, XRD, FTIR, UV spectroscopy, XPS, Nano metrology.
08 Hours

UNIT V
Applications
Bio-Nanotechnology; Nano-electronics; Nano-photonics; Micro and Nano Fluidics; Polymer and Nano-composites; Thin Film Technology; Spintronics; Nanotechnology for Energy Systems; MEMS;Data storage and retrieval.
08 Hours
Course Assessment Method:
Test: 30 marks
Assignment: 10 marks
Case study /Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book
2. Introduction to Nanotechnology, Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2</td>
</tr>
<tr>
<td>1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3 3</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4 3</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5 3</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Maintainance and Reliability Engineering

Sub Code: 14MEE831  
Credits: 04  
Hours/Week: 4+0+0  
CIE Marks: 50  
Total Hours: 48  
SEE Marks: 50  
Exam Hours: 03  
Course Type: Open Elective

Course Outcomes:
Students will be able to
1. Enable students to understand the principles, functions and practices adopted in industry for the successful management of maintenance activities,
2. Elucidate different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements
3. Illustrate some of the simple instruments used for condition monitoring in industry.
4. Create awareness about reliability and its need for industries.

UNIT I
Principles, Practices of Maintenance and Planning
Introduction: Fundamentals of maintenance engineering, Engineering importance in material and energy conservation, inventory control, productivity, safety, Pollution control, Basic principles of maintenance planning – Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT factors of availability – Maintenance organization – Maintenance economics.
09 Hours

UNIT II
Maintenance Policies and Management
Types of maintenance strategies, Planned & Unplanned maintenance, Break down, Preventive & Predictive maintenance – Comparative Merits and limitations of each category, maintenance schedules, repair cycle, computer aided maintenance, maintenance scheduling, Spare parts management, inventory control, Tribology in maintenance - Principles and methods of lubrication - TPM.
10 Hours

UNIT III
Machine Health Monitoring
Condition based maintenance, Signature Analysis, Oil Analysis, Wear-debris analysis, Vibration, noise and thermal signature, online and off line techniques, Instrumentation and assignment use in MHM, Cost comparison with and without CM-On load testing And Off load testing - Methods and instruments for CM – Temperature sensitive tapes - Pistol thermometers.
Repair methods for material handling equipment- Equipment records- Job order systems- Use of computers in maintenance.
10 Hours

UNIT IV
Fundamentals of Reliability
Definition, mean fracture rate, mean time to failure, mean time between failure, hard rate, hazard models. Constant hazard, linearly increasing hazard, weibull model, system reliability, series, parallel and mixed configuration, simple problems.
10 Hours

UNIT V
Reliability Improvement
Reliability, availability and maintainability- Analysis, Introduction to RAM failure mechanism, failure data analysis, failure distribution, reliability of repairable and non-repairable system, Improvement in reliability, reliability testing, reliability in prediction, utilization factor, system reliability by Monte Carlo- Simulation technique, redundancy, element, unit and stand by redundancy, reliability allocation for a series system, system down time, reliability and maintainability trade-off, simple problems.
09 Hours
Course Assessment Method:
CIE - Test: 30 marks
Assignment: 10 marks
Surprise: 10 marks
SEE - Final Exam: 50 Marks

Text Book

Reference Book

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 1 2</td>
<td></td>
</tr>
<tr>
<td>1 3 2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2 3 2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3 3 2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4 3</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5 3 1 1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
PROJECTWORK

Sub Code : 14MEP84       Credits : 14
Hours/Week : 0+0+30      CIE Marks : 50
Total Hours : 216        SEE Marks : 50
Exam Hours : 1.5Hr/Batch  Course Type: Program Core

Course outcomes:

1. Apply the knowledge of Science, Technology engineering and mathematics (STEM), which are acquired within the technical area, to a given problem.
2. Analyze the complex mechanical engineering problems independently or in a team within given constraints and able to apply appropriate engineering design and development techniques to handle larger problems within the technical area to obtain acceptable results.
3. Conduct thorough investigation of complex engineering problems to an advanced level with help of techniques, skills, and modern engineering tools necessary for engineering practice.
4. Design a system, component, or process to meet desired needs within a broad set of constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability; and also to understand the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Develop and exercise leadership, team work and effective communication, conflict management, decision-making skills and also to Recognize the need for life-long learning.
6. Apply project management tools, best practices and techniques to plan, manage, to close a project and also to Identify legal issues that impact financial and other risks affecting project.

The Project work shall be on a topic in the area of specialization specified by the guide and opted by the candidate. The project batch should contain 2 to 4 members only. The students shall seek the guidance of the internal guide on a continuous basis, and the guide shall give a certificate to the effect that the candidate has worked satisfactorily under his/her guidance on completion of the project work. On completion of the project work, students shall prepare a report according to the guidelines and submit it to the concerned authority.

The students are supposed to finalize the topic of the project work at the beginning of the 7th semester. 3 seminars have to be given,

1. Start of the 8th semester about the literature survey.
2. Progress of the project.
3. Final Presentation.

The seminars will be assessed by a project committee who will make suitable recommendations at each stage.

Course Assessment Method:
CIE – 50 Marks
SEE - Final Exam: 50 Marks

<table>
<thead>
<tr>
<th>Course outcome</th>
<th>Programme Outcomes</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>