UNIVERSITY OF KERALA

B. TECH DEGREE COURSE
2008 SCHEME

MECHANICAL STREAM
AUTOMOBILE ENGINEERING

I to VIII SEMESTER
REGULATION, SCHEME AND SYLLABUS

APPROVED BY
BOARD OF STUDIES IN ENGINEERING AND
FACULTY OF ENGINEERING AND TECHNOLOGY
1. Conditions for Admission

Candidates for admission to the B.Tech degree course shall be required to have passed the Higher Secondary Examination, Kerala or 12th Standard V.H.S.E., C.B.S.E., I.S.C. or any examination accepted by the university as equivalent thereto obtaining not less than 50% in Mathematics and 50% in Mathematics, Physics and Chemistry/ Bio- technology/ Computer Science/ Biology put together, or a diploma in Engineering awarded by the Board of Technical Education, Kerala or an examination recognized as equivalent thereto after undergoing an institutional course of at least three years securing a minimum of 50 % marks in the final diploma examination subject to the usual concessions allowed for backward classes and other communities as specified from time to time.

2. Duration of the course

i) The course for the B.Tech Degree shall extend over a period of four academic years comprising of eight semesters. The first and second semester shall be combined and each semester from third semester onwards shall cover the groups of subjects as given in the curriculum and scheme of examination

ii) Each semester shall ordinarily comprise of not less than 400 working periods each of 60 minutes duration

iii) A candidate who could not complete the programme and pass all examinations within Ten (10) years since his first admission to the B.Tech programme will not be allowed to continue and he has to quit the Programme. However he can be readmitted to the first year of the programme if he/she satisfies the eligibility norms applicable to the regular candidates prevailing at the time of readmission.

3. Eligibility for the Degree

Candidates for admission to the degree of bachelor of technology shall be required to have undergone the prescribed course of study in an institution maintained by or affiliated to the University of Kerala for a period of not less than four academic years and to have passed all the examinations specified in the scheme of study.

4. Subjects of Study

The subjects of study shall be in accordance with the scheme and syllabi prescribed.

5. Evaluation

Candidates in each semester will be evaluated both by continuous assessment and end semester University examination. The individual maximum marks allotted for continuous assessment and University examination for each subject is as prescribed by the scheme of study.

5.1 Continuous Assessment (C.A)

The marks awarded for the continuous assessment will be on the basis of the day-to-day work, periodic tests (minimum two in a semester) and assignments (minimum of three – one each from each module). The faculty member concerned will do the continuous assessment for each semester. The C.A. marks for the individual subjects shall be computed by giving weight age to the following parameters.
### 5.2. End Semester University Examinations

i) There will be University examinations at the end of the first academic year and at the end of every semester from third semester onwards in subjects as prescribed under the respective scheme of examinations. Semester classes shall be completed at least 10 working days before the commencement of the University examination.

ii) The examination will be held twice in a year – April/May session (for even semester) and October/November session (for odd semester). The combined 1st and 2nd semester is reckoned as equivalent to an even semester for the purpose of conduct of examination and the University examination will be held during April/May. However VII and VIII Semester examination will be conducted in both the sessions. This schedule will not be changed.

iii) A student will be permitted to appear for the university examination only if he/she satisfies the following requirements:

   a. He/she must secure not less than 75% attendance in the total number of working periods during the first year and in each semester thereafter and shall be physically present for a minimum of 60% of the total working periods. In addition, he/she also shall be physically present in at least 50% of total working periods for each subject.

   b. He must earn a progress certificate from the head of the institution of having satisfactorily completed the course of study in the semester as prescribed by these regulations.

   c. It shall be open to the Vice-Chancellor to grant condonation of shortage of attendance on the recommendation of the head of the institution in accordance with the following norms.

   d. The attendance shall not be less than 60% of the total working periods.

   e. He/she shall be physically present for a minimum of 50% of the total working periods.

   f. The shortage shall not be condoned more than twice during the entire course.

   g. The condonation shall be granted subject to the rules and procedures prescribed by the university from time to time.

   h. The condonation for combined 1st and 2nd semesters will be reckoned as a single condonation for attendance purposes.

iv) A student who is not permitted to appear for the University examinations for a particular semester due to the shortage of attendance and not permitted by the authorities for condonation of shortage of attendance shall repeat the semester when it is offered again. This provision is allowed only once for a semester.

v) The university will conduct examinations for all subjects (Theory, Drawing & Practical).

vi) The scheme of valuation will be decided by the chief examiner for theory / drawing subjects.

vii) For practical examinations, the examiners together will decide the marks to be awarded. The student shall produce the certified record of the work done in the laboratory during the examination. The evaluation of the candidate should be as per the guidelines given in the syllabus for the practical subject.
6. Letter Grades

For each subject in a semester, based on the total marks obtained by the student in the University examination and Continuous assessment put together a letter grade (S, A+, A, B+, B, C+, C, D, E and F) will be awarded. **All letter grades except ‘F’ will be awarded if the marks for the University examination is 40 % or above and the total mark (C.A marks + University Exam mark) is 50 % or above.** No absolute mark will be indicated in the grade card. Letter grade corresponding to total marks (C.A marks + University Exam mark) and the corresponding grade point in a ten-point scale is described below.

<table>
<thead>
<tr>
<th>% of Total marks (C.A marks + University Exam mark)</th>
<th>Letter Grade</th>
<th>Grade Point (G.P)</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>90 % and above</td>
<td>S</td>
<td>10</td>
<td>Excellent</td>
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<tr>
<td>85 % and above but less than 90%</td>
<td>A+</td>
<td>9</td>
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<tr>
<td>80 % and above but less than 85%</td>
<td>A</td>
<td>8.5</td>
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<tr>
<td>75 % and above but less than 80%</td>
<td>B+</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>70 % and above but less than 75%</td>
<td>B</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>65 % and above but less than 70%</td>
<td>C+</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>60 % and above but less than 65%</td>
<td>C</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>55 % and above but less than 60%</td>
<td>D</td>
<td>6</td>
<td></td>
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<tr>
<td>50 % and above but less than 55%</td>
<td>E</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>Below 50% (C.A + U.E) or below 40 % for U.E only</td>
<td>F</td>
<td>0</td>
<td>Failed</td>
</tr>
</tbody>
</table>

7. Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

Grade point average is the semester wise average points obtained by each student in a 10-point scale. GPA for a particular semester is calculated as per the calculation shown below.

$$ \text{GPA} = \frac{\sum \text{Credit} \times \text{GP obtained for the subject}}{\sum \text{credit for subject}} $$

Cumulative Grade point Average (CGPA) is the average grade points obtained by the students till the end of any particular semester. CGPA is calculated in a 10-point scale as shown below.

$$ \text{CGPA} = \frac{\sum \text{Credits for semester} \times \text{GPA obtained for the semester}}{\sum \text{credits for the semester}} $$

GPA and CGPA shall be rounded to two decimal points. The Grade card issued to the students shall contain subject number and subject name, credits for the subject, letter grades obtained, GPA for the semester and CGPA up to that particular semester. In addition to the grade cards for each semester all successful candidate shall also be issued a consolidated statement grades. On specific request from a candidate and after remitting the prescribed fees the University shall issue detailed mark to the individual candidate.

8. Minimum for a pass

a) A candidate shall be declared to have passed a semester examination in full in the first appearance if he/she secures not less than 5.5 GPA with a minimum of ‘E’ grade for all individual subject in that semester.

b) A candidate shall be declared to have passed in an individual subject of a semester examination if he/she secures grade ‘E’ or above.

c) A candidate who does not secure a full pass in a semester examination as per clause (a) above will have to pass in all the subjects of the semester examination as per clause (b) above before he is declared to have passed in that semester examination in full.

9. Improvement of Grades
i) A candidate shall be allowed to re-appear for a maximum of two subjects of a semester examination in order to improve the marks and hence the grades already obtained subject to the following conditions
   a) The candidate shall be permitted to improve the examination only along with next available chance.
   b) The candidate shall not be allowed to appear for an improvement examination for the subjects of the VII & VIII semesters
   c) The grades obtained by the candidate for each subject in the improvement chance he has appeared for or the already existing grades – whichever is better will be reckoned as the grades secured.
   d) First & Second semester will be counted as a single chance and they can improve a maximum of three subjects

ii) A candidate shall be allowed to repeat the course work in one or more semesters in order to better the C.A. marks already obtained, subject to the following conditions
   a) He/she shall repeat the course work in a particular semester only once and that too at the earliest opportunity offered to him/her.
   b) He/she shall not combine this course work with his/her regular course work
   c) He/she shall not be allowed to repeat the course work of any semester if he has already passed that semester examination in full
   d) The C.A marks obtained by the repetition of the course work will be considered for all purposes

iii) A candidate shall be allowed to withdraw from the whole examination of a semester in accordance with the rules for cancellation of examination of the University of Kerala.

10. Classification of Successful candidates

i) A candidate who qualifies for the degree passing all the subjects of the eight semesters within five academic years (ten consecutive semesters after the commencement of his/her course of study) and secures not less than 8 CGPA up to and including eighth semester (overall CGPA) shall be declared to have passed the B.Tech degree examination in FIRST CLASS WITH DISTINCTION

ii) A candidate who qualifies for the degree passing all the subjects of the eight semesters within five academic years (ten consecutive semesters after the commencement of his/her course of study) and secures less than 8 CGPA but not less than 6.5 CGPA up to and including eighth semester shall be declared to have passed the B.Tech degree examination in FIRST CLASS.

iii) All other successful candidates shall be declared to have passed the B.Tech Degree examination in SECOND CLASS

iv) Successful candidates who complete the examination in four academic years (Eight consecutive semesters after the commencement of the course of study) shall be ranked branch-wise on the basis of the CGPA in all eight semesters put together. In the case of a tie in the CGPA the total marks of the students who have got same CGPA shall be considered for finalizing the rank. Students who pass the examination in supplementary examination are also covered under this clause

11. Educational Tour

a) The students may undertake one educational tour preferably after fourth semester of the course and submit a tour report
b) The tour may be conducted during the vacation / holidays taking not more than 5 working days, combined with the vacation / holidays if required. Total number of Tour days shall not exceed 15 days.

c) The tour period shall be considered as part of the working periods of a semester

12. Revision of Regulations

The university may from time to time revise, amend or change the regulations, curriculum, scheme of examinations and syllabi. These changes unless specified otherwise, will have effect from the beginning of the academic year / semester following the notification of the University
## SCHEME AND SYLLABUS
### MECHANICAL STREAM
### AUTOMOBILE ENGINEERING

**Combined I and II Semesters, 2008 scheme**
*(Common for all branches)*

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Weekly load, hours</th>
<th>Max sessional marks</th>
<th>Exam Dur Hrs</th>
<th>Exam max marks</th>
<th>Credits</th>
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<td>L</td>
<td>T</td>
<td>D/P</td>
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<td>Hrs</td>
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The subject 08.109 will be handled by the Department of Electronics and Communication Engineering.

### Semester III

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Weekly load, hours</th>
<th>Max sessional marks</th>
<th>Exam Dur Hrs</th>
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<th>Credits</th>
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<td>T</td>
<td>D/P</td>
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<tr>
<td>08.301</td>
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<td>08.302</td>
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<td>08.304</td>
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<td>2</td>
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<td>08.308</td>
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### Semester IV

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<tr>
<th>Course No</th>
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<th>Weekly load, hours</th>
<th>Max sessio nal marks</th>
<th>Exam Dur. Hrs</th>
<th>Exam max marks</th>
<th>Credits</th>
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<tbody>
<tr>
<td>08.401</td>
<td>Engineering Mathematics – III (CMPUNERFHB)</td>
<td>L:3 T:1 D/P: -</td>
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<td>08.402</td>
<td>Computer programming and numerical methods (MNPU)</td>
<td>L:3 T:1 D/P: -</td>
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<td>08.403</td>
<td>Auto power plant (U)</td>
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<td>100</td>
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<td>08.404</td>
<td>Manufacturing Technology(U)</td>
<td>L:3 T:1 D/P: -</td>
<td>50</td>
<td>3</td>
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<tr>
<td>08.405</td>
<td>Thermal Engineering (MU)</td>
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<td>08.406</td>
<td>Automobile Engineering Drawing (U)</td>
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<td>08.407</td>
<td>Auto Chassis Lab (U)</td>
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<td>08.408</td>
<td>Machine shop I (U)</td>
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### Semester V

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<th>Course No</th>
<th>Name of subject</th>
<th>Weekly load, hours</th>
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<th>Exam Dur. Hrs</th>
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<td>08.501</td>
<td>Engineering Mathematics IV,(CMPU)</td>
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<td>08.502</td>
<td>Electrical Technology,(MPU)</td>
<td>L:3 T:1 D/P: -</td>
<td>50</td>
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<td>08.503</td>
<td>Automotive Transmission (U)</td>
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<tr>
<td>08.504</td>
<td>Auto Electrical &amp; Electronics (U)</td>
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<td>50</td>
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<td>08.505</td>
<td>Machine Design (U)</td>
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<tr>
<td>08.506</td>
<td>Elective - I</td>
<td>L:3 T:1 D/P: ..</td>
<td>50</td>
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<tr>
<td>08.507</td>
<td>Heat Engines Lab (U)</td>
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<td>08.508</td>
<td>Electrical &amp; Electronics Lab (MPU)</td>
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### Semester VI

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<th>Name of subject</th>
<th>Weekly load, hours</th>
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<th>Exam Dur. Hrs</th>
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<td>Vehicle Maintenance (U)</td>
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<td>Engine &amp; Drive line Design (U)</td>
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<td>08.603</td>
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<td>08.604</td>
<td>Heat and Mass Transfer (MU)</td>
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<td>08.605</td>
<td>Machanics of Machinery (U)</td>
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<td><strong>TOTAL</strong></td>
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### Semester VII

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Weekly load, hours</th>
<th>Max sessional marks</th>
<th>Exam Dur Hrs</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>08.701</td>
<td>Principles of Management &amp; Decision Modelling (MPU)</td>
<td>2 1 ..</td>
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<td>08.702</td>
<td>Mechatronics (MPU)</td>
<td>3 1 ..</td>
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<td>08.703</td>
<td>Vehicle Dynamics (U)</td>
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<tr>
<td>08.704</td>
<td>Production Process for Automotive Components (U)</td>
<td>4 0 ..</td>
<td>50</td>
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<tr>
<td>08.705</td>
<td>Modern Automotive Technology (U)</td>
<td>4 0 ..</td>
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<td>08.706</td>
<td>Elective- III</td>
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<tr>
<td>08.707</td>
<td>Vehicle Reconditioning Lab (U)</td>
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<tr>
<td>08.708</td>
<td>Mechatronics Lab (U)</td>
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<td>Project &amp; Seminar (MPU)</td>
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### Semester VIII

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Weekly load, hours</th>
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<td>08.801</td>
<td>Energy Management (MPU)</td>
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<td>08.802</td>
<td>Industrial Engineering (MPU)</td>
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<td>08.803</td>
<td>Theory of Advanced I.C. Engines (U)</td>
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<td>08.808</td>
<td>Project &amp; Viva Voce (MPU)</td>
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<td>150</td>
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</table>
ELECTIVE SECTION

LIST OF ELECTIVES

(Electives are common to Mechanical, Production and Automobile Engineering branches unless otherwise specified in the title)

**08. 506 Elective I**

1. Communicative English and technical writing
2. Human aspects of management
3. Disaster Management
4. Glimpses of world thought
5. Professional ethics and human values
6. Environmental Science
7. Advanced Welding technology
8. Foundry Technology
9. Environmental Pollution Control
10. Advanced Fluid Mechanics
11. Composite Materials Technology
12. Internet Technologies
13. Non Destructive Testing
14. Powder Metallurgy
15. Vehicle Transport & Fleet Management
16. Automotive Airconditioning
17. Two And Three Wheeled Vehicles

<table>
<thead>
<tr>
<th>08.606 Elective II</th>
<th>08.706 Elective III</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. New Energy systems</td>
<td>2. Advanced Thermodynamics</td>
</tr>
<tr>
<td>3. Object Oriented Programming</td>
<td>3. Industrial Heat Transfer</td>
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<tr>
<td>5. Mechanical working Methods</td>
<td>5. Fracture Mechanics</td>
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<tr>
<td>7. System Modeling &amp; Simulation</td>
<td>7. Entrepreneurship Development</td>
</tr>
<tr>
<td>8. Instrumentation and control</td>
<td>8. Industrial Hydraulics</td>
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<tr>
<td>10. Agro Machinery</td>
<td>10. Metal Forming</td>
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<tr>
<td>12. Precision Engineering</td>
<td>12. Non-conventional Machining</td>
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<tr>
<td>13 Advanced Manufacturing Processes</td>
<td>Techniques</td>
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<tr>
<td>14 Material Characterisation</td>
<td>13. Turbo Machines</td>
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<tr>
<td>15 Micromachining Methods</td>
<td>14 Experimental Methods in</td>
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<td>16 Tool Engineering (MU)</td>
<td>Engineering</td>
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<tr>
<td>18 Vehicle Performance And Testing</td>
<td>16. Failure Analysis</td>
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<tr>
<td>19 Automotive Fuels &amp; Alternate Fuels</td>
<td>17. Theory of Machining (MU)</td>
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<td>18 Bio Materials</td>
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<td>19 Concurrent Engineering</td>
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<td>20 Industrial Automation</td>
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<td>21 Alternate Energy Sources</td>
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<td>22 Automotive Pollution and</td>
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<td></td>
<td>Control</td>
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<td>23 Creativity, Innovation and New</td>
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<td>08. 805 Elective IV</td>
<td>08. 806 Elective V</td>
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<tr>
<td>1. Experimental Stress Analysis Techniques</td>
<td>1. Propulsion Engineering</td>
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<td>2. Aerospace Engineering</td>
<td>2. Industrial Refrigeration</td>
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<td>3. Facilities Planning</td>
<td>3. Industrial Quality Control</td>
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<tr>
<td>5. Non linear Dynamics and Chaos</td>
<td>5. Creativity &amp; Product Development</td>
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<tr>
<td>7. Multiphase flow</td>
<td>7. Random vibrations</td>
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<tr>
<td>8. Controls in Machine tools</td>
<td>8. Advanced Kinematics of Machines</td>
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<tr>
<td>10. Tribology</td>
<td>10. Flexible Manufacturing Methods</td>
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<tr>
<td>11. Value Engineering</td>
<td>11. Computational Fluid Dynamics</td>
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<tr>
<td>12. Software Engineering</td>
<td>12. Technology Forecasting</td>
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<tr>
<td>14. Bio Medical Engineering</td>
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<tr>
<td>16. Continuum Mechanics</td>
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<tr>
<td>17. Product and brand management</td>
<td>15. Project Management</td>
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<tr>
<td>20. Automotive Technology (P)</td>
<td>18. Logistics and Supply Chain Management</td>
</tr>
<tr>
<td>22. Industrial Safety Engineering</td>
<td>20. Surface Engineering</td>
</tr>
<tr>
<td>25. Embedded System In Automobiles</td>
<td>23. Automotive Aerodynamics</td>
</tr>
</tbody>
</table>
MODULE- 1

Applications of differentiation:-- Definition of Hyperbolic functions and their derivatives- Successive differentiation- Leibnitz’ Theorem(without proof)- Curvature- Radius of curvature- centre of curvature- Evolute ( Cartesian ,polar and parametric forms)
Partial differentiation and applications:-- Partial derivatives- Euler’s theorem on homogeneous functions- Total derivatives- Jacobians- Errors and approximations- Taylor’s series (one and two variables) - Maxima and minima of functions of two variables - Lagrange’s method- Leibnitz rule on differentiation under integral sign.
Vector differentiation and applications:-- Scalar and vector functions- differentiation of vector functions-Velocity and acceleration- Scalar and vector fields- Operator \( \nabla \)- Gradient- Physical interpretation of gradient- Directional derivative- Divergence- Curl- Identities involving \( \nabla \) (no proof) - Irrotational and solenoidal fields – Scalar potential.

MODULE-II

Laplace transforms:-- Transforms of elementary functions - shifting property- Inverse transforms- Transforms of derivatives and integrals- Transform functions multiplied by \( t \) and divided by \( t \) - Convolution theorem(without proof)-Transforms of unit step function, unit impulse function and periodic functions-second shifting theorem- Solution of ordinary differential equations with constant coefficients using Laplace transforms.
Differential Equations and Applications:-- Linear differential equations with constant coefficients- Method of variation of parameters - Cauchy and Legendre equations – Simultaneous linear equations with constant coefficients- Application to orthogonal trajectories (cartesian form only).

MODULE-III


REFERENCES
2. Peter O’ Neil; Advanced Engineering Mathematics, Thomson
5. Michel D Greenberg; Advanced Engineering Mathematics, Pearson International
MODULE-I


Electromagnetic Theory: Del operator – grad, div, curl and their physical significance. Concept of displacement current. Deduction of Maxwell’s equations. Prediction of electromagnetic waves. Transverse nature of electromagnetic waves. \( E \) and \( H \) are at right angles. Poynting’s theorem (qualitative only)


MODULE- II


MODULE – III


REFERENCE:
1. Sears & Zemansky; *University Physics. XI Edn.*; Pearson
2. Frank & Leno; *Introduction to Optics. III Edn.*; Pearson
3. J.C. Upadhyaya; *Mechanics.* Ram Prasad & Sons
4. David J Griffiths; *Introduction to Electrodynamics. III Edn.*; Pearson
7. John R Taylor, Chris D Zafiratos & Michael A Dubson; *Modern Physics for Scientists and Engineers. II Edn.* Prentice Hall of India
8. Eugene Hecht; *Optics.* IV Edn, Pearson
9. Robert Resnick; *Introduction to Special Relativity.* John Willey and Sons
10. Richard L Libboff; *Introduction to Quantum Mechanics. IV Edn.* Pearson
11. Donald A Mcquarrie; *Statistical Mechanics.* Vivo Books
12. Mark Ratner & Daniel Ratner; *Nanotechnology.*

**LIST OF DEMONSTRATION EXPERIMENTS**

2. Air Wedge – Diameter of a thin wire
5. Laser – Diffraction at a narrow slit.
6. Laser – Diffraction at a straight wire or circular aperture.
11. Computer stimulation – study of E & H. (Gauss’ law & Ampere’s law)

**Pattern of Question Paper**

University examination is for a maximum of **100 marks**, in **3 hour** duration. The syllabus is spread in 3 modules. The question paper will consist of two parts (A and B).

**Part A** contains short answer questions for **40 marks**. This part contains 10 questions without any choice, each of **4 marks** (uniformly taken from all modules).

**Part B** contains long answer questions for **60 marks**. From each module, this part contains 3 questions out of which 2 are to be answered, each of **10 marks**. Long answer questions from all the 3 modules will form 60 marks.
MODULE-1


Corrosion and its control - Theories of corrosion (chemical corrosion and electrochemical corrosion)- Galvanic series- Types of corrosion (Concentration cell corrosion, Stress corrosion, Galvanic corrosion) - Factors affecting corrosion (nature of metal and nature of environment) and different methods of corrosion control (corrosion inhibitors, cathodic protection). (5hrs)

Protective coatings - Metallic coatings- Chemical conversion coatings- paint (4hrs)


MODULE-2

Water treatment - Types of hardness- Degree of hardness- Related problems- Estimation of hardness- by EDTA method- Sludge and scales in boilers- Priming and foaming- Boiler corrosion-Water softening methods, Lime-soda process, Ion exchange methods-Internal treatments (colloidal, carbonate, phosphate and calgon conditioning)- Domestic water treatment- Methods of disinfection of water-Desalination process (Reverse osmosis, electro dialysis- Distillation). (12hrs)

Environmental damages and prevention - Air pollution- CFCs and ozone depletion-Alternative refrigerent-Green house effect-Water pollution- BOD and COD- Waste water treatment- Aerobic - Anaerobic and USAB processes. (3hrs)

Thermal methods of analysis- Basic principles involved in Thermo gravimetry, Differential thermal analysis and applications. (2hrs)

Spectroscopy - Molecular energy levels-Types of molecular spectra- Electronic spectra (Classification of electronic transitions- Beer Lamberts law- Vibrational spectra (mechanism of interaction and application), Rotational spectra (Determination of bond length and application). NMR spectra (Basic principle, chemical shift, spin-spin splitting) (6hrs)

Chromatography - General principles- High performance liquid chromatography- Gas chromatography. (2hrs)

MODULE-3

Polymers- Classifications- Mechanism of polymarisation (Addition, free radical, cationic, anionic and coordination polymarisation)- Thermoplastics and thermostetting plastics- Compounding of plastics-Moulding techniques of plastics (Compression, Injection, Transfer and Extrusion moulding)-Preparation, properties and uses of PVC, PVA, PMMA, Nylon, PET, Bakelite, Urea formaldehyde resin- Silicon polymers- Biodegradable plastics. Elastomers-structure of natural rubber- vulcanisation- synthetic rubbers (Buna-S, Butyl rubber and Neoprene) (12hrs)

Organo electronic compounds -Super conducting and conducting organic materials like Polyaniline, polyacetylene and [polypyrrol and its applications. (2hrs)

Fuels - Calorific value- HCV and LCV-Experimental determination of calorific value- Theoretical calculation of calorific value by Dulong's formula - Bio fuels -Bio hydrogen and Bio diesel (5hrs)

Lubricants - Introduction-Mechanism of lubrication- solid and liquid lubricant Properties of lubricants-Viscosity index- flash and fire point- cloud and pour point- aniline value. (4hrs)

Cement - Manufacture of Portland cement- Theory of setting and hardening of cement (2hrs)
LAB-EXPERIMENTS (DEMONSTRATION ONLY)

1. Estimation of total hardness in water using EDTA.
2. Estimation of chloride ions in domestic water.
3. Estimation of dissolved oxygen.
4. Estimation of COD in sewage water.
5. Estimation of available chlorine in bleaching powder.
8. Determination of flash and fire point of a lubricating oil by Pensky Marten’s apparatus.
12. Determinations of PH using glass electrode and quinhydrone electrode.

REFERENCES

1. H.A. Willard, L.L. Merrit and J.A. Dean; *Instrumental methods of analysis*
2. A.K. De; *Environmental Chemistry*
3. K.J. Klauhunde; *Nanoscale materials in chemistry*
4. B.R. Gowariker; *Polymer science*
5. B.W. Gonser; *Modern materials*
6. V. Raghavan; *Material Science and engineering. A first course*
7. L.H. Van Vlack; *Elements of Material science and Engineering*
8. J.W. Goodby; *Chemistry of liquid crystals*
9. S. Glasstone; *A text book of physical chemistry*
10. P.C. Jain; *Engineering Chemistry*
11. Juhaina Ahad; *Engineering Chemistry*
12. Shashi Chawla; *A text book of Engineering Chemistry*
13. R. Gopalan, D. Venkappayya & S. Nagarajan; *Engineering Chemistry*
14. J.C. Kuriakose and J. Rajaram; *Chemistry of Engineering and Technology Vol. I & II*
15. R.N Goyal and Harmendra Goeal; *Engineering Chemistry, Ane Students Edition, Thiruvananthapuram*
INTRODUCTION: Introduction to technical drawing and its language. Lines, lettering, dimensioning, scaling of figures, symbols and drawing instruments. (1 sheet practice)

MODULE I

PLAIN CURVES: Conic sections by eccentricity method. Construction of ellipse: (i) Arc of circles method (ii) Rectangle method (iii) Concentric circles method. Construction of parabola (i) Rectangle method (ii) Tangent method. Construction of hyperbola (i) Arc of circles method (ii) given ordinate, abscissa and the transverse axis (iii) given the asymptotes and a point on the curve. Construction of Tangent and Normal at any point on these curves

MISCELLANEOUS CURVES: Construction of Cycloid, Epicycloid and Hypocycloid, Involute of a circle. Archimedian spiral, Logarithmic spiral and Helix. Construction of Tangent and Normal at any point on these curves

PROJECTION OF POINTS AND LINES: Types of projections, Principles of Orthographic projection. Projections of points and lines. Determination of true length, inclination with planes of projection and traces of lines.

MODULE II

PROJECTION OF SOLIDS: Projection of simple solids such as prisms, pyramids, cone, cylinder, tetrahedron, octahedron, sphere and their auxiliary projections.

SECTIONS OF SOLIDS: Types of cutting planes, section of simple solids cut by parallel, perpendicular and inclined cutting planes. Their projections and true shape of cut sections.

DEVELOPMENT OF SURFACES: Development of surfaces of (i) simple solids like prisms, pyramids, cylinder and cone (ii) Cut regular solids.

MODULE III

ISOMETRIC PROJECTION: Isometric scale, Isometric view and projections of simple solids like prisms, pyramids, cylinder, cone sphere, frustum of solids and also their combinations.

INTERSECTION OF SURFACES: Intersection of surfaces of two solids as given below.

(i) Cylinder and cylinder
(ii) Prism and prism.
(iii) Cone and Cylinder
(Only cases where the axes are perpendicular to each other and intersecting with or without offset.)


CAD: Introduction to CAD systems, Benefits of CAD, Various Soft wares for CAD, Demonstration of any one CAD software.

General Note:
(i) First angle projection to be followed

(ii) Question paper shall contain 3 questions from each module, except from CAD. Students are required to answer any two questions from each module.

(iii) Distribution of marks

<table>
<thead>
<tr>
<th>Module</th>
<th>Marks</th>
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<tr>
<td>Module II</td>
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<tr>
<td>Module III</td>
<td>2 x 17 = 34</td>
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</table>

100

REFERENCES
1. Luzadder and Duff; Fundamentals of Engineering Drawing
2. N. D. Bhatt; Engineering Drawing
3. K. Venugopal; Engineering Drawing and Graphics
4. P.S. Gill; Engineering Graphics
5. P.I. Varghese; Engineering Graphics
6. K.R. Gopalakrishnan; Engineering Drawing
7. Thamaraseli; Engineering Drawing
8. K.C. John; Engineering Graphics
9. K.N. Anil Kumar; Engineering Graphics
IDEALIZATIONS OF MECHANICS - ELEMENTS OF VECTOR ALGEBRA

**Statics**

- Composition and resolution of coplanar concurrent force systems
- Resultant and equilibrant of coplanar concurrent force systems
- Various analytical methods
- Lami's theorem, method of resolution
- Conditions of equilibrium
- Resultant and equilibrant of coplanar non-concurrent force systems
- Conditions of equilibrium
- Equilibrium of rigid bodies-free body diagrams (simple problems)

- Types of supports - types of beams - types of loading
- Support reactions of simply supported and overhanging beams under different types of loading
- Forces in space, equations of equilibrium, Vector approach
- Friction-Laws of friction-angle of friction
- Cone of friction
- Ladder friction
- Wedge friction

**Dynamics**

- Kinematics
  - Combined motion of translation and rotation
  - Instantaneous centre
  - Motion of link, motion of connecting rod and piston, wheel rolling without slipping
- Relative velocity - basic concepts
- Analysis of different types of problems

- Kinetics
  - Newton's laws of translatory motion
  - D'Alembert's principle
  - Motion of lift
  - Motion of connected bodies

**MODULE III (20 HRS)**

- Work, Power and Energy
- Work-Energy principle
- Impulse, Momentum
- Collision of elastic bodies
- Law of conservation of momentum
- Direct and oblique impact between elastic bodies and impact with fixed plane
- Angular momentum
- Angular impulse
- Kinetics of rigid bodies under combined translatory and rotational motion
- Work-energy principle for rigid bodies
- Centrifugal and centripetal forces
- Motion of vehicles on curved paths in horizontal and vertical planes
- Super elevation
- Stability of vehicles moving in curved paths (qualitative ideas only)
- Simple harmonic motion - vibration of mechanical systems
- Basic elements of a vibrating system
- Spring mass model
- Undamped free vibrations
- Angular free vibration
- Simple pendulum

**REFERENCES:**


**Note**

*Question For University Examination*: Part A – 8 compulsory questions covering entire syllabus, 5 marks each. (5 x 8 = 40) Part B – Three questions of 10 marks from each module, out of which two should be answered (10 x 2 x 3 = 60).
MODULE I

Surveying: Object and Principles of Surveying.
Linear Measurements: Direct measurements - Tape & chain only - Ranging out survey lines - Taking measurements of sloping ground - Errors - Tape correction (problems).
Levelling: Levelling instruments - Level (Dumpy Level, Tilting Level) - Levelling Staff. Measurements in levelling - Temporary adjustments of a level, holding the staff, reading the staff - Principles of leveling - recording measurements in the field book - reduction of level - height of collimation method only (simple examples). Contour maps (Brief description only). Computation of areas - Mid ordinate rule, average ordinate rule, Trapezoidal rule, Simpson's rule (examples) - Introduction to Distomat, Total Station & GPS (Brief description only)

MODULE II

Building construction: Selection of site for buildings - types of buildings - Components of buildings.
Foundation: Different types - Spread footing, Isolated footing, Combined footing, Mat foundation, Pile foundation (description only).
Safe Bearing Capacity of Soil: Importance of determination of the Safe Bearing Capacity of Soil (brief description only).

Super structure: Masonry - stone masonry, brick masonry - Types - desirable qualities of stone and brick.
Partition: Materials used for making partition - plywood, particle boards & glass.
Doors, windows & ventilators: Types - materials used for the construction of doors and windows - wood, steel & Aluminium.
Plastering: Mortar - properties - Preparation of Cement mortar.
Painting: Preparation of surfaces for painting - plastered, wood and steel surfaces - Types of paint - enamel, emulsion & distemper.
Flooring: Types - mosaic tiles, ceramic tiles, marble, granite and synthetic materials.
Roofing: Selection of type of roof - flat roof, sloping roof - Concrete roof, tiled roof. Selection of roof covering materials. GI Sheet, AC Sheet, PVC Sheet

MODULE III

Concrete: Ingredients - cement, aggregate, and water. Qualities of ingredients (brief description only).
Tests on Cement - consistency, initial and final setting times. Compressive strength - IS Specifications.
Aggregates - desirable qualities of fine and coarse aggregates.
Steel - common types used in construction - Mild Steel, HYSD Steel and their properties.
Reinforced Cement Concrete (RCC) - advantages of RCC over Plain Cement Concrete.
Elementary ideas on pre-cast and pre-stressed concrete constructions.
Building services - vertical transportation - stairs - types, escalators and elevators, ramps (brief description only). Plumbing services - brief description of water supply and sewage disposal arrangements for residential buildings.

REFERENCES:
8. Jha and Sinha, “Construction and Technology”
10. Santha Minu, “Basic Civil Engineering” Karunya Publications, Trivandrum

*Note:* The question paper will consists of two parts. Part I and part II.

Part I is Compulsory covering the entire syllabus, for 40 marks. It contains 8 questions of 5 marks each.

Part II is to cover 3 modules. There will be two questions (20 marks each) from each module out of which one from each module is to be answered. (20 X 3 = 60)
08.107 BASIC MECHANICAL ENGINEERING

L-T-P: 2-1-0 Credit: 6

MODULE I

Thermodynamics: Basic concepts and definitions of Zeroth law, First law, Second law of thermodynamics- concept of reversibility and entropy. p-v and T-s diagrams
Air cycles: Carnot, Otto and Diesel cycles-Air standard efficiency (simple problems)
IC Engines: Working and comparison of two stroke and four stroke petrol and diesel engines - general description of various systems using block diagrams – air system, fuel system, ignition system and governing system. A brief description of CRDI, MPFI, GDI and Hybrid Vehicles
Steam boilers: Classification – Cochran boiler, Babcock and Wilcox boiler, Benson boiler- fluidized bed combustion,

MODULE II

Principles and fields of application of - compressors - reciprocating and centrifugal, blower, pumps- reciprocating, centrifugal and jet pumps, steam and hydraulic turbines- impulse and reaction, gas turbine cycles- open and closed
Elementary ideas of hydro electric, thermal and nuclear power plants
Refrigeration & Air Conditioning: Refrigerants, CFC free refrigerants. Vapor compression refrigeration system, Comfort and Industrial air conditioning-typical window air conditioning unit (general description only).

MODULE III

Mechanical Power transmission systems: Belt, rope and gear drives-types, comparison and fields of application-velocity ratio-slip (simple problems) friction disc, single plate clutch, gear trains (no derivations).
Manufacturing processes: Elementary ideas of casting, forging, rolling, welding, soldering and brazing
Machining processes- turning, taper turning, thread cutting, shaping, drilling, grinding, milling (simple sketches and short notes).
Non conventional machining - Electro discharge machining (EDM) and Electro chemical machining (ECM)
Principle, application and advantages of C N C machine

REFERENCES

2. Gill, Smith and Zuirys, “Fundamentals of IC Engines”
3. Amstead, Ostwald and Begeman, “Manufacturing processes”
5. Roy and Choudhary, “Elements of Mechanical Engineering”
6. Haja Choudhary, “Workshop Technology”
7. R K Bensal, “Fluid mechanics and machines”

Note: Lectures are to be supplemented by demonstration in laboratories.

Note: The question paper will consist of two parts. Part I is to be compulsory for 40 marks. This may contain 10 questions of 4 marks each. Part II is to cover 3 modules. There can be 3 questions from each module (10 marks each) out of which 2 are to be answered.
MODULE – I

Alternating current fundamentals - generation of alternating currents – waveforms - frequency - period - average and rms values - form factor. Phasor representation of alternating quantities - rectangular polar and exponential forms.
Analysis of simple ac circuits – concept of impedance and admittance - phasor representation - j notation - power and power factor in ac circuits - active and reactive components. Solution of RL, RC and RLC series circuits.
Three phase systems - generation of three phase voltage - star and delta connection - relation between phase and line values of voltage and current - phasor representation - three wire and four wire systems.
Measurement of power in three phase circuits (two wattmeter method). Measurement of energy – working of 1-phase energy meter.

MODULE – II

Transformers - Principle of operation - EMF equation - constructional details of single phase and three phase transformers
Methods of bulk generation of electric power. Block schematic of layout of generating stations - hydroelectric, thermal and nuclear power plants. Renewable energy sources - solar, wind, tidal, wave and geothermal energy.
Bulk transmission of electric power - typical electrical power transmission scheme - need for high transmission voltage - substations - substation equipments. Primary and secondary transmission and distribution systems
Different methods of wiring for LT installations. Schematic layout of LT switchboards. Earthing of installations - necessity of earthing - plate and pipe earthing. Protective fuses, MCBs, ELCBs and switches.
Working of incandescent lamps, -fluorescent lamps, energy efficient lamps

MODULE – III

Diodes - PN junction diodes,. V-I characteristics, dynamic & static resistance, principle of working and V-I characteristics of Zener diode, principle of Photo diode, Solar cell, & LED. Rectifiers & power supplies - block diagram description of a dc power supply, circuit diagram & working of half-wave & full wave rectifier, final equations of Vrms, Vdc, ripple factor and peak inverse voltage in each case, principle of working of series inductor and shunt capacitor filters. Working of simple zener voltage regulator. Power devices – V – I characteristics and applications of SCR and Triac Working principle of UPS and SMPS. Transducers – Resistance strain guage, thermistor, LVDT

REFERENCES
5. TP Imthias Ahmed, B. Premlet, "Introduction to Electrical Engineering", Phaser Books, Kollam

**Note**: The question paper will consist of two parts. Part – A is to be compulsory for 40 marks (10 questions of 4 marks each). Part-B is to cover 3 modules for 60 marks. (50% choice- One out of two or two out of four from each module).
MODULE 1 (Qualitative Treatment)
(a) Bipolar junction transistors: NPN & PNP transistors, structure, typical doping, working of NPN transistor, concepts of common base, common emitter & common collector configurations, current gain of each, input & output characteristics of common emitter configuration, comparison of three configurations with reference to voltage & current gain, input & output resistances and applications. (6 hrs)
(b) Field effect Transistors: basic principles of JFET, MESFET and MOSFET, comparison with BJT. (3 hrs)
(c) Amplifiers & Oscillators: circuit diagram & working of common emitter amplifier, function of each component in the circuit, need of proper biasing, frequency response, voltage gain and 3dB bandwidth, concepts of class A, B, AB and Class C power amplifiers, circuit diagram & working of push pull amplifiers, concepts of feedback, working principles of oscillators, circuit diagram & working of RC phase shift oscillator (7 hrs)
(d) Integrated circuits: advantages of ICS, analog and digital ICS, functional block diagram of operational amplifier, ideal operational amplifier, use as inverting amplifier, non inverting amplifier, summing amplifier, integrator and comparator. (4 hrs)
(e) Digital ICs: logic gates, realization of logic functions, principle of combinational and sequential logic circuits, flip flop (JK), logic families: TTL and CMOS Logic (No internal diagram) (4 hrs)
(f) IC fabrication: purification of silicon, crystal growth, wafer preparation. unit process: oxidation, diffusion, ion implantation, epitaxy, deposition, photolithography. (4 hrs)

MODULE 2 (Qualitative Treatment)
(a) Measurements: principle and block diagram of analog and digital multimeter, working principle of CRT, block diagram of CRO, measurements using CRO, principle of digital storage oscilloscope, principle and block diagram of function generator. (5 hrs)
(c) Color television: TV Standards, interlaced scanning, block diagram of PAL TV transmitter & receiver, basic principles of cableTV, CCTV system, basic principles of HDTV, basic principles of LCD & Plasma displays. (5 hrs)
(d) Radar and navigation: principle of radar and radar equation, block schematics of pulsed radar, factors affecting range, applications of radar in measurements and navigation. (4 hrs)
(e) Satellite communication: microwave frequency bands, concept of geo-stationary satellite, frequency bands used, satellite transponder, block diagram of earth station transmitter & receiver, advantages of satellite communication, principle of Global Positioning System(GPS). (3 hrs)
(f) Optical communication: block diagram of the optical communication system, principle of light transmission through fiber, concepts of Single Mode and Multi Mode optical fiber, working principle of source (semiconductor Laser) & detector (PIN, APD), advantages of optical communication. (5 hrs)
MODULE 3 (Qualitative Treatment)

(a) Computer Architecture: functional units: basic concept of ALU-data path and control, memory hierarchy, caches, main memory, virtual memory, operating systems, microprocessors - functional block diagram of 8085 (9 hrs)

(b) Data communication: overview, analog and digital data transmission, transmission media, digitization of wave forms, PCM, digital modulation techniques-ASK, PSK, FSK, basic concepts of error detection, parity checking. (6hrs)

(c) Mobile communication: basic principles of cellular communications, concepts of cells, frequency reuse, principle and block diagram of GSM, principle of CDMA, WLL & GPRS technologies. (4hrs)

(d) Internet Technology: concepts of networking: client-server computing, IP addresses, domain names, network interface unit - modem, switching technologies-circuit switching and packet switching, LAN, MAN, WAN & World wide web, network topologies, communication protocols-TCP/IP, Introduction to web languages-HTML, XML, internetworking concepts, network devices-basics principles of router, bridge, switch, network security-Firewall. (7 hrs)

REFERENCES
6. David A. Bell, *Electronic Instrumentation and Measurements*, PHI [Module 2(a)]

This subject shall be handled by faculty of Dept.of Electronics and Communication in the Colleges.

Question Paper

The question paper shall consist of two parts. Part I is to cover the entire syllabus, and carries 40 marks. This shall contain 10 compulsory questions of 4 marks each. Part II is to cover 3 modules, and carries 60 marks. There shall be 3 questions from each module (10 marks each) out of which 2 are to be answered.
C: Sheet Metal Work: Study of tools. Selection of different gauge GI sheets for jobs. Practice on riveted joints. Preparing tube joints, frustums, trays and containers.
D. Plumbing: Study of tools. Details of plumbing work in domestic and industrial applications. Study of pipe joints, cutting, threading and laying of pipes with different fittings using PVC pipes. Use of special tools in plumbing work.
E: Foundry: Study of tools. Preparation of sand, moulding practice and demonstration of casting.
G: Smithy: Study of tools. Demonstration on forging of square prism, hexagonal bolt, T bolt and Eye bolt.

NOTE: For the university examination the student shall be examined in sections A, B, C, D and E only.
SEMESTER III

08. 301 ENGINEERING MATHEMATICS II (CMPUNERFHBA)

L-T-P/D: 3-1-0 Credits 4

Module I

Module II
Fourier series: Fourier series of periodic functions of period $2\pi$ and $2l$. Dirichlet's condition for convergence. Odd and even functions. Half range expansions.
Fourier Transforms: Fourier integral theorem (no proof)-Fourier transforms- Fourier sine and cosine transforms, inverse Fourier transforms, properties.

Module III
Application of PDE: Derivation of one dimensional Wave and Heat equations. solution by seperation of variables. Boundary value problems in one dimensional Wave and Heat equations.

References

Examination Duration: 3 hours
Note: The question paper shall consists of two parts. Part A (40 marks) Ten compulsory questions of 4 marks each. Part B (60 marks) Student must answer one out of two from each module. Each question carries 20 marks.
PART I

ECONOMICS (2 periods per week)

MODULE – I


Meaning of Demand and Supply – Types of demand – Determinants of Demand – Demand forecasting

Production function – Law of Variable proportion – Returns to scale - Least cost combination of inputs – Cost concepts – Cost output relationship

Module II

Inflation – causes of inflation – measures to control inflation – Demand – Pull inflation – cost push inflation – effects of Inflation – effects of inflations comparison between inflation and deflation


PART II

Module III

ACCOUNTANCY (1 Period per week)


Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems) - Introduction to Accounting packages (Description only)

References:

1. K.K Dewett, Modern Economic theory
3. Mohinder Kumar Sharma _ Business Environment in India
5. Rudder Dutt and K.P.M Sundaran – Indian Economy
8. Double Entry book Keeping – Batliboi
9. A Systematic approach to Accounting: Dr K.G. Chandrasekharan Nair
University question
Note: Part I and Part II to be answered in separate answer books.

Part – I Economics
   Part A – 30 Marks (short answers) covering entire syllabus (3x10=30)
   Part B – 40 marks (50% choice one out of two or two out of four from each module)

Part – II Accountancy
   Three questions covering entire syllabus out of which two questions has to be answered (2x15=30)
Module – I
Properties of fluid - Density, Specific weight, viscosity, surface tension, bulk modulus, compressibility, velocity, rate of shear strain, Newton's law of viscosity, Newtonian and non-Newtonian fluids, real and ideal fluids, incompressible and compressible fluids. Atmospheric pressure, Gauge pressure and Absolute pressure. Pressure at a point in a fluid, Pascal's Law. Measurement of pressure - Piezo meter, manometers, pressure gauges.
Energies in flowing fluid, head - pressure, dynamic, static and total head, Continuity equation, Eulers equation, Bernoulli’s equation, Practical applications: Flow rate measurements- Venturi and Orifice meters, Notches and Weirs (description only for notches and weirs). Velocity measurements- Pitot tube and Pitot – static tube.
Flow through pipes: Reynolds experiment, Reynolds number, Laminar and Turbulent flow, Hagen- Poiseuille equation, Turbulent flow through pipes, head loss due to friction, friction factor, Mody’s chart, Darcy-weisbach equation, Chezy’s formula - Losses at entry, exit, sudden expansion and sudden contractions, Compound pipes, branching of pipes, siphon effect, water hammer Transmission of power through pipes (simple problems)

Module – II
Impact of jets: Stationary and moving vanes – Flat and curved vanes – Series of vanes - work done and efficiency.
Hydraulic Turbines : Impulse and Reaction Turbines – Pelton Wheel – Constructional features - Velocity triangles – Euler's equation – Speed ratio, jet ratio & work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, workdone and efficiencies – Axial flow turbine (Kaplan ) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , similarity and model testing-selection of water turbines for power plants. Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power

Module – III
Positive displacement pumps- reciprocating pump – air vessels and their purposes – separation and cavitation - slp negative slip and work required and efficiency- indicator diagram- effect of acceleration and friction on indicator diagram – multi cylinder pumps.
Rotary motion of liquids – free, forced and spiral vortex flows- rotodynamic pumps- centrifugal pump impeller, casings –manometric head- work, efficiency and losses, priming, specific speed. Performance characteristics-multistage pumps-selection of pumps-pumping devices-hydraulic ram jet pumps, gear pumps, vane pump and lobe pump.
Dimensional analysis : Rayleigh method, Buckingham π theorem – Dimensionless numbers - Similarity Laws – Shape numbers – Impeller shapes based on shape numbers

References :
2. Robert W. Fox, Introduction to fluid dynamics, John Wiley and sons
3. K. Subrahmanya, Theory and applications of fluid mechanics, (TMH)
5. Jagadish Lal, Fluid mechanics and Hydraulic machines
6. R K Bansal, Hydraulic Machines
7. R.K.Rajput, Hydraulic Machines
8. D S Kumar, Hydraulics & Hydraulic Machines
10. N. S Govinda Rao, Fluid flow mechanics

Note
The question paper shall contain two parts. PART- A & PART – B

**Part – A** shall contain 10 compulsory short answer type questions of 4 marks each, covering the entire syllabus \( 10 \times 4 = 40 \)

**Part – B** shall contain 2 questions from each module. Each question carries 20 marks. Student has to answer three full questions selecting one from each module \( 3 \times 20 = 60 \).
Module I
Concept of stress – normal stress and shear stress, concept of strain, normal strain and shear strain, constitutive relation, Hooke’s law, modulus of elasticity, modulus of rigidity, deformation of axially loaded bars, members with varying cross section, principle of superposition, composite bars, thermal stress.
Saint-Venant’s Principle and stress concentration, lateral strain, Poisson’s ratio, volumetric strain, bulk modulus of elasticity, relationship between elastic constants.
Concept of stress and strain tensor, generalised Hooke’s law, definition of plane stress, plane strain and examples. Stress transformation (2D only) principal stress and Mohr’s circle, Strain energy due to axial loads- gradually and suddenly applied impact loads.

Module II
Shear force and bending moment diagrams– cantilever, simply supported and over hanging beams-concentrated and UD loads, Theory of simple bending-bending stress and shear stress distribution-rectangular, circular and I sections.
Slope and deflection of beams, load- deflection differential equation, computation of slope and deflection of simply supported and cantilever beams- Macaulay’s method.

Module III
Torsion of circular shafts-solid and hollow shafts-power transmitted by shafts.
Thin cylinders and shells subjected to internal and external pressures – thick cylinders and spherical shells- Lame’s equation – compound cylinders.
Direct and bending stress – short columns – core of section Crippling load-Eulers equation
Analysis of pin-jointed plane perfect frames by the method of joints.

References :
1. S.B.Junarkar, Mechanics of structures Vol I & II
2. Egor P Popov, Engineering Mechanics of solids PHI
3. Timoshenko, Strength of Materials

Note: University question paper consists of two parts
Part A – 40 Marks (8 compulsory questions of 5 marks each to cover the entire syllabus)
Part B – 60 marks ( 50% Choice, One out of Two from each module)
08. 305 AUTO CHASSIS (U)

L-T-D: 4-0-0

Credits: 4

MODULE - I
Introduction: Profile of Automobile Industry, Types of automobiles, general considerations relating to chassis layout and power plant Location, relative merits & demerits of different layouts, description of different types of chassis layout.
Frames: Types of Frames (conventional, integral construction and perimeter frame) materials, cross members and X members, frame sections, defects in frames, frame repairs, frame alignment.
Front axle and steering system: Front axle construction, stub axles, dead axle & live axle, front wheel assembly, steering geometry / wheel alignment - castor, camber, kingpin inclination, toe-in, toe-out, Condition for true rolling, effects of wheel misalignments, Ackerman & Davis steering gear, different types of steering gears and their construction, conventional layout of steering linkage. Power and power assisted steering, under steering and over steering effects, four wheel steering.

MODULE - II
Suspension: Objectives, types of springs, spring materials, leaf spring, coil spring, torsion bar, rubber & pneumatic suspension, Hydro-elastic suspension, shock absorbers, types of independent suspension.
Drive line: Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, propeller shaft, universal joints, types, differential action, constructional details, differential lock, limited slip differential, axle housing types & construction, double reduction axles.

MODULE - III
Brakes: Types, stopping times & distance, braking efficiency, brake drums and liners, theory of shoe brakes, self energizing brakes, determination of brake torque, disc brakes, classification of brakes, Hydraulic brakes, mechanical brakes, servo brakes, power assisted brakes, air brakes, fail safe brakes, exhaust brakes, retarders, layout & details of components.
Wheels and tyres: Types of wheel, construction of wired wheel, disc wheel, tyre type & construction, aspect ratio, specification of tyres, tyre rotation, static & rolling properties of pneumatic tyres.

References:
3. G.B.S. Narang - Automobile Engineering, Khanna publishers, Delhi
6. TR Banga and Nathu -Singh - Automobile engineering, Khanna publishers, Delhi
7. N.K Giri - Automotive mechanics, Khanna publishers, Delhi
Conversion of pictorial views into Orthographic views – Sectional views, types of sectional views, Conventions-Dimensioning techniques, BIS standards

Module-1

Free hand sketching: Screw thread forms and conventional representations, lock nuts, foundation bolts, forms of rivet heads, Riveted Joints – Lap (chain and zigzag with multiple rows), butt joints (chain and zigzag with multiple rows, single strap and double strap), different types of keys, Pipe joint-socket and spigot.

Module-2


References:
1. N.D. Bhatt, Machine Drawing
2. P.I.Varghese, Machine Drawing
3. P.S.Gill, Machine Drawing
4. Parkinson, Machine Drawing

Module I

Drawing: Principles of building drawing, preparation of drawing of buildings such as office building, residential building (RCC and tiled roof, single storied and two storied), factory building with steel trusses for small scale industries.

Module II

Estimating: Principles of estimation, quantity estimation and cost estimation of building such as residential building and factory buildings.
References:


University examination duration – 4 hours
Part A and Part B are to be answered in separate answer books

Part A (50 marks) The question paper shall contain 2 questions. The first question is from module-1 which carries 20 marks. It contains 3 sub divisions and any 2 has to be answered, (2x10=20 marks). The second question is from Module 2, Dimensioned drawing which is a compulsory question and carries 30 marks.

Part B (50 marks) The question paper shall contain 2 questions from each module and one has to be answered from each. Module I carries 30 marks and module II carries 20 marks.
08.307 CIVIL ENGINEERING LAB (MPU)

L-T-D: 0-0-2
Credits: 2

Experiments
1. Test on Mild Steel, High carbon steel and Cast Iron specimens
2. Shear test on MS Rod
3. Torsion test on MS Rod
4. Torsion test using Torsion Pendulum on MS, Aluminium and Brass wire
5. Izod and Charpy Impact tests
6. Hardness test (Brinell Hardness & Rockwell Hardness)
7. Spring test (Open and closed coiled )
8. Bending test on Wood
9. Determination of Moment of Inertia of Rotating Bodies
10. Chain Surveying and Levelling (4hrs only.)

Scheme of Examination:-
Exam. Duration: 3 hrs.
No examination for chain surveying and levelling, but viva shall be asked.

08.308 FLUID MECHANICS & MACHINES LAB (U)

L-T-D: 0-0-2
Credits: 2

Study of meters, gauges and valves - pressure gauge, vacuum gauge, manometers, flow measuring equipments-water meters-venturi meter-orifice meter-current meter, stop valve, gate valve and foot valve

Experiments
1. Determination of Coefficient of discharge and calibration of Notches, Orifice meter, Nozzle and Venturimeter.
2. Determination of Chezy’s constant and Darcy’s coefficient on pipe friction apparatus
3. Determination of Hydraulic coefficients of orifices
4. Determination of Metacentric Height and Radius of gyration of floating bodies.
5. Performance test on Rotodynamic and Positive displacement pumps
6. Performance test on Impulse and Reaction turbines
7. Speed variation test on Impulse turbine
8. Determination of best guide vane opening for Reaction turbine
9. Performance test on variable speed pump and plotting iso-efficiency curves
SEMESTER IV

08.401 ENGINEERING MATHEMATICS III (CMPUNERFHB)

L-T-P/D; 3-1-0 Credits 4

Module I
Complex Differentiation: Limits, continuity and differentiation of complex functions. Analytic functions—Cauchy Reimann equations in Cartesian form (proof of necessary part only) properties of analytic functions—harmonic functions. Milne Thomson method

Conformal mapping: The Transformations \( w = \frac{1}{z}, \ w = z^2, \ w = z + \frac{1}{z}, \ w = \sin z, \ w = \cos z \), Bilinear transformation

Module II

\[ 2\pi \int f (\sin \theta, \cos \theta) \, d\theta, \ \int_0^\infty f (x) \, dx \text{ with no poles of } f (z) \text{ on the real axis (proof of theorems not required)} \]

Module III

References:
7. S.S.Sastry, Introductory methods of numerical analysis.

University Examination
The question paper shall contain two parts. Part A and Part B. Part A shall contain 10 compulsory questions of 4 marks each covering the entire syllabus (10 x 4 = 40). Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60)
Module – I

Introduction to Computer programming concept - Algorithm and flow chart, Basics of procedure oriented and object oriented programming.
Introduction to C++: Structure of C++ program; Key words; Identifiers; Data types – integer, real, character, string, boolean, enumeration, array and pointer; Constant and Variables; Escape sequences; Operators – assignment, arithmetic, relational, logical, increment & decrement, conditional, size of, comma and bitwise operators; Statements – simple & compound, declaration statements, Control statements -if, if-else, switch, for loop, while, do-while, break and continue statements, Input and output streams, Arrays – one dimensional & two dimensional; Functions- inline functions, function over loading, Functions with default arguments, recursion, pointers. Simple programs using above features.

Module –II

Introduction to Class and Object- definition, data members, member function, private & public member function, member access, friend declaration, class objects, predefined classes, initialization, constructor and destructor; Operator overloading, Inheritance- base class and derived class; Input/output stream libray - ifstream, ofstream, fstream, class files. Simple problems using the above features.

Module-III


References :
1. Ashok M. Kamthane, Object oriented Programming with ANSI & Turbo C++, Pearson Education.
3. Stanley B. Lippman and Josee Lajoie, C++ Primer, Pearson Education.

University Examination

The question paper shall contain two parts. Part A and Part B. Part A shall contain 10 compulsory questions of 4 marks each covering the entire syllabus (10 x 4 = 40).Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60)
MODULE I

Introduction: Types of power plant, Basic engine nomenclature, classification of IC engines (Classification by cylinder arrangement, Valve arrangement and Type of valves), Engine cycles, Comparison of SI and CI engines, working of 2-stroke and 4 stroke engines with relative merits and demerits, Numbering of cylinders, firing order.

Constructional details of engine components: Moving parts and stationary parts, engine block, Cylinder block and crank case-types, cylinder liners, types of cylinder head, gasket materials, piston types, piston rings, piston pins, connecting rod, crank shaft, flywheel, vibration damper, Main Bearings, camshaft, camshaft drives, Types of valve and valve seats, valve actuating mechanisms (mechanisms with side camshaft and overhead camshaft), inlet and exhaust manifold construction, hydraulic tappets.

MODULE II

Fuel supply system in petrol engines: Types of fuel feed systems, fuel tank, fuel pumps and fuel filters (types and construction), air filter types and construction, combustion and ignition limits in SI engines, carbeuretion, properties of air-petrol mixtures, mixture requirements for steady state operation, transient mixture requirements, simple carbeuretor, different circuits in carbeuretor, type of carbeuretors like Solex, SU, Carter etc, MPFI engines, GDI engines, Flex fuel engines.

Fuel supply system in diesel engines: Requirements of diesel injection system, Components of diesel injection system, Diesel filters, fuel feed pump, hand pump, heavy duty air filters, Diesel injection pump types - simple and multiple unit pump, C-AV Bosch pump, Modern distributor type pumps, CRDI, injection nozzles and types of injectors, governors (mechanical, pneumatic and hydraulic governors), cold starting devices.

MODULE III

Cooling system: Necessity of engine cooling and correct operating temperatures, types of cooling systems like Direct air cooling, Indirect or water cooling, Liquid cooling, Pressure sealed cooling, Evaporative cooling or steam cooling, components of water cooling system (thermostat, water pump, radiator, cooling fan etc), antifreeze solution, temperature gauges.

Lubrication system: Function of lubrication system, lubrication principles, classification of lubricants, types of lubricants, properties of lubricants, service ratings of oils, oil additives, specification of lubricants, crankcase ventilation, lubrication systems (Mist, Wet sump Dry sump lubrication systems), pre-lubrication systems, effect of engine conditions on lubricating oil, consumption of lubricating oil, Components of lubrication system (oil strainers, oil filters, oil pumps, oil coolers), Oil pressure warning system, oil pressure gauges, chassis lubrication.

References:

2. Kripal Singh- Automobile Engineering Volume I & II, Standard publications, NewDelhi
7. Crouse & Anglin – Automotive mechanics, TATA Mcgrawhill publishers
Note: Question Paper consists of two parts.

Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE-1

Lathe and its operations: Description of typical types of lathe, lathe parts, lathe accessories, taper turning - different methods of taper turning calculations, taper turning attachments. Capston and Turret Lathes: Description of types of turret lathes, tool holders etc.
Drilling: Types of drilling machines, operations performed, tool and work holding devices, description of pneumatic drilling machines, vertical boring machines, Jig borer, Jig grinders.

MODULE - 11

Shaping and Planing machines: Principle of crank shaper, hydraulic shaper, shaper tools etc. Planer: principle, description of planer, feed mechanism, etc

Milling machines: Description of typical types of milling machines, milling cutters, different operations, indexing etc.

Grinding wheels & grinding operations: Selection of wheels, speed, feed etc., wheel dressing, balancing, standard marking system
Types of grinding operations, grinding machinery etc,

MODULE III

Broaching: Broaching operation, principle, broaching cutters, types of broaching machines etc.
Finishing operations: Lapping, honing, super finishing, etc.
N. C. Machines: Concept and working of N.C. Machines

Reference:
1. Kalpakijan - Manufacture Technology -Addison & Wesley
4. R.K. Jain - Production Technology

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Steam engineering, T-S diagram, Mollier chart, Rankine cycle, Modified Rankine cycle, Binary vapor cycle
Boilers:- High pressure boilers:- Benson boiler, LaMont boiler, Loeffler boiler, Velox boiler, Schmidt Hartman boiler,
Steam nozzle:- effect of friction, super saturated flow. Steam turbine: classification, velocity diagrams, condition for maximum efficiency, multistage turbines, condition line, stage efficiency, reheat factor, degree of reaction, cycles with reheating and regenerative heating, governing of turbines,

Module II
Fuels and combustion, types of fuels, Properties of fuels. Calculation of air fuel ratio and equivalence ratio- volumetric and gravimetric analysis, Adiabatic flame temperature.
IC engines:- combustion in CI and SI engines, Normal combustion and flame front propagation, Abnormal combustion, factors affecting auto ignition, preignition, detonation, octane and cetane numbers, Anti knocking agents, combustion chambers for SI and CI engines, Alternate fuels for IC engines. Introduction to HCCI combustion.
Gas turbines:- classification, simple cycle, isentropic efficiency and mechanical efficiency, simple cycle with regeneration, intercooling and reheating, cycle efficiency and work output., types of combustion chambers,

Module III
Compressors- classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)
Rotary compressors- classification, centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, effect of impeller blade shape on performance, compressor characteristics, surging and choking, performance.
Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor

References :
3. Gill and Smith, Internal combustion engines.

University Examination
The question paper shall contain two parts. Part A and Part B. Part A shall contain 10 compulsory questions of 4 marks each covering the entire syllabus (10 x 4 = 40). Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60)
Drawing the simple layout of service stations showing the details of departments, equipments and specifications.

Drawing the general electrical wiring diagrams of various vehicles like Scooters Motor cycles and LMV. Drawing the wiring diagram of Ignition circuit, charging circuit, Starter circuit, Horn circuit, fuel gauge, oil pressure gauge and temperature gauge circuits.

Surface finish symbols Fits and tolerance to be indicated on working drawings as per BIS Specifications.

Assembly drawing of piston, connecting rod, fuel injector, master cylinder, wheel cylinder, flanged coupling, Diaphragm valve, Rotator gear pump, Clutches, Air valve, Differential assembly, S.U. Carburetor.

REFERENCES

5. ET Weston - Automobile Engineering Drawing
L-T-P/D: 0-0-3  Credits: 3

1. Study of hand tools, sketching and its uses, study of different types of chassis layouts, components.
2. Disassembling cylinder head, servicing of valves, adjusting tappet clearance, testing valve spring tension with spring tester.
3. Disassembling of engine, inspection of components, servicing of components, decarbonising procedure, measurement of dimension of different components of engine, compare with standard specifications, piston ring testing, assembling using special tools.
4. Valve timing & adjustments of fan belt tension.
5. Compression test of petrol and diesel engine.
6. Rectifying the troubles in ignition system, adjusting spark plug and CB Point gap, checking ignition timing.
7. Servicing of carburetor, carburetor adjustments, tuning of carburetors.
8. Servicing of A.C. Mechanical fuel pump and testing the pump.
9. Servicing of fuel injection pump, injector, testing of injector.
10. Servicing of clutch assembly, checking the spring tension of coil springs in spring tester.
11. Dismantling of gear box, inspecting Components, servicing, checking the gear ratios.
13. Servicing of steering gear box, checking for end play.
14. Servicing master and wheel cylinders in hydraulic brake system, bleeding of brakes.
15. Preparing immature models of body structures of cars, jeeps, van and heavy duty vehicles. (By adopting suitable scales prepared by sheet metal work.)

08.408 MACHINE SHOP - I (U)

L-T-P/D: 0-0-3  Credits: 3

General study of Lathe and Accessories, Tools used for different operations. Exercises involving plane turning, Groove cutting, form turning, taper turning, facing and thread cutting.
Study of shaping and slotting machines, and planning machines, exercises involving production of flat surfaces, grooves and key ways.
**SEMESTER V**

**08.501 ENGINEERING MATHS IV (CMPU)**

L-T-D: 3-1-0        Credits : 4

**Module I**
Discrete and continuous random variables and their probability distributions - Probability distribution (density) functions - Distribution functions - Mean and Variance - Simple problems. - Binomial, Poisson, uniform and exponential distributions - Mean and Variance of the above distributions - Normal distribution - Properties of normal distribution - Computing probabilities using Binomial, Poisson, uniform, exponential and normal distributions

**Module II**
Curve fitting - Principle of least squares - Fitting a straight line - Fitting a parabola - Linear correlation and regression - Karl Pearson’s coefficient of correlation - Sampling distributions - Standard error - Estimation - Interval estimation of population mean and proportions (small and large samples) - Testing of Hypothesis - Hypothesis concerning a mean, Equality of means - Hypothesis concerning one proportion, difference of two proportions.

**Module III**

**Reference**

**University Examination:**
The question paper shall consist of two parts. PartA (40 marks) shall contain 10 compulsory questions of 4 marks each. PartB (60 marks) will have 3 modules. There shall be 2 questions from each module (20 marks each) out of which one is to be answered
Module 1
DC Machines-principle of operation-emf equation-types of excitations.
Separately excited, shunt and series excited DC generators, compound
generators. General idea of armature reaction, occ and load characteristics-
simple numerical problems.
Principles of dc motors-torque and speed equations-torque speed
characteristics- variations of speed, torque and power with motor current.
Applications of dc shunt series and compound motors. Principles of starting,
losses and efficiency – load test- simple numerical problems.

Module II
Transformers – principles of operations – emf equation- vector diagrams-
losses and efficiency – OC and SC tests. Equivalent circuits- efficiency
calculations- maximum efficiency – all day efficiency – simple numerical
problems. Auto transformers constant voltage transformer- instrument
transformers.
Three phase induction motors- slip ring and squirrel cage types- principles of
operation – rotating magnetic field- torque slip characteristics- no load and
blocked rotor tests. Circle diagrams- methods of starting – direct online – auto
transformer – star delta and rotor resistance starting

Module III
Single phase motors- principle of operation of single phase induction motor –
split phase motor – capacitor start motor- stepper motor- universal motor
Synchronous machines- types – emf equation of alternator – regulation of
alternator by emf method. Principles of operation of synchronous motors-
methods of starting- V curves- synchronous condenser.
Electric traction – systems of power supply – functional schematic of ac
electric locomotives- types of motors used in traction systems. Methods of
speed control – methods of braking.

References:
2. Partab, Art and utilization of electric energy.
3. V.K. Metha, Principles of electrical and electronics.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer
questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2
questions of 20 marks each, from each module and student has to answer
one from each module (3 x 20=60)
MODULE I

1 Clutches: Necessity of clutch in a automobile, different types of clutches, friction clutches, cone clutch, Single plate - multi coil & diaphragm spring clutches, multi plate clutch, centrifugal clutches, electromagnetic clutches, hydraulic clutches, torque capacity of clutches, clutch facing, materials, clutch adjustments, over running clutches, necessity and field of application, sprag and roller clutches, locking devices.

2. Gear box: Need for a gear box, types of gear transmission, number of gear ratios, 3 speed and 4 speed transmission, determination of gear ratios for vehicles, performance curves in different gears, Types of gearboxes- Selective & progressive types, sliding mesh, constant mesh, synchromesh gear box, gear types & materials, gearbox oil seals- static & dynamic seals.

MODULE II


MODULE III


6. Automatic transmission: General description of working of typical automatic transmissions and their control system, components and parts of Automatic transmission, comparison with conventional transmission. Three speed and reverse Transaxle automatic Transmission, ECTi Automatic transmission with intelligent electronic control system.

Reference:

3. Herban Singh Royath: The automobile, S. Chand and CO. Ltd, Delhi.
4. W. Thomson: Fundamentals of automotive transmission, pitman and paperbacks publications
7. SAE Transactions 900550 & 930910.
Examination Duration: 3 hours  
Note: Question Paper consists of two parts.  
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)  
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

<table>
<thead>
<tr>
<th>MODULE-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electrical &amp; Electronic principles – Current, Voltage &amp; Resistance and measurements, common circuit symbols used in automobiles, series and parallel circuits, applications of electromagnetism, Inductance &amp; capacitance, Thyristor, Diodes &amp; LEDs, vehicle circuits &amp; systems, sizes and current ratings of wires used in automobile wiring harnesses, cable color coding, terminals &amp; connectors, Multiplex wiring systems, Basic concept of Controller Area Network (CAN), basic vehicle circuits.</td>
</tr>
<tr>
<td>2. Storage battery: Cell Electro chemical action, Principle of lead acid battery &amp; constructional details, effect of temperature on electrolyte, Battery characteristics-capacity &amp; efficiency of battery, cold cranking Amperes, battery charging methods. Tubular batteries, Maintenance free batteries, alkaline battery, Choosing the correct battery, Battery tests and battery maintenance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODULE - 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Ignition system: Types of ignition, magneto and coil ignition, constructional details, distributor, spark plugs, ignition coil, ignition timing, TAC (transistor assisted contact) ignition system, CD Ignition system, DTSi, Electronic / solid state ignition system, Microprocessor controlled ignition system, advantages, simplified operational diagram of a distributor less ignition system.</td>
</tr>
</tbody>
</table>
MODULE - III

6. Electronic / Microprocessor control systems: Concept of CPU and computer memory used in automobiles, sensors- Pressure sensor, Throttle position sensor, fuel flow sensor, thermistor sensor, oxygen sensor, speed sensors, knock detecting sensor, actuators solenoids and stepper motor, Electronic dash board instruments - Onboard diagnosis system, security and warning system.

7. Electronic fuel injection system: Types of gasoline fuel injection system, TBI, MPFI - L Jetronic and D jetronic systems, GDI, electrical fuel pump, electronically controlled fuel supply system, electronically controlled exhaust gas re-circulation system, Electronic fuel supply system in diesel engines - CRDI.

REFERENCES:

4. Bosch - Automotive Electrical, electronic system, SAE
5. P.L.Kohli - Automotive elettrical equipments, Tata McGraw hill publications
6. Barry Hollembeak - Automotive Electricity, Electronics and computer controls, Delmer publishers
7. Tom Denton - Automotive Electronics, SAE

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

08.505 MACHINE DESIGN (U)

L-T-P/D; 3-1-0 Credits 4

Module I

Module II

Detachable joints - Pins, Keys, Splines, coppers, set screws, threaded fasteners, power screws, shaft couplings, welded joints, types of joints, strength of welds fillet welds, stress distribution in welded joints - Eccentric loading - Bonded joints - Riveted joints - Types of rivets. Riveted joints Strength of rive joints for pressure vessels Structural; joints - Eccentric loading.

Module III


Note: (Design data book by Mahadevan is permitted for the University Examination)

Reference:
1. Design of Machine Elements: M.F. Spotts, Prentice Hall of India

Refer Elective Section:

08.507 PRODUCTION ENGINEERING LAB

L-T-D: 0-0-3  Credits : 3

General study of Lathe and Accessories, Tools used for different operations. Exercises involving plane turning, Groove cutting, form turning, taper turning, facing and thread cutting. Study of shaping and slotting machines, and planning machines, exercises involving production of flat surfaces, grooves and key ways.
1. OCC on a DC shunt generator- determination of critical resistance, critical speed, additional resistance required in the field circuit.
2. Load characteristics of a dc shunt generator.
3. Load characteristics of DC compound generator
4. Load test on DC series motor
5. Load test on DC shunt motor
6. Load test on single phase transformer
7. Starting of three phase squirrel cage induction motor by star delta switch, load test on three phase squirrel cage induction motor
8. Load test on three phase slip ring induction motor
9. V-I characteristics of diodes and zener diode
10. Input and output characteristics of CE and CB configurations of BJTs. Determination of $\beta$, input resistance and output resistance
11. Drain and transfer characteristics of JFET
12. Static V-I characteristics of SCR
13. Half wave and full wave rectifiers with and with out filters- observe the waveforms on CRO
SEMESTER VI

08.601 VEHICLE MAINTENANCE (U)

L-T-P/D: 4-0-0 Credits 4

MODULE I

Maintenance, Records and Schedules: Importance of maintenance, types of maintenance, Inspection, scheduled maintenance, Job card, PDI chart, requirement of service station, service station records (stores & maintenance), layout and personnel for service station, Typical maintenance schedule for two wheeler, LMV and HMV

Engine trouble diagnosis and tune-up: Overhauling of engine - types of overhauling (Top overhauling and major overhauling), specific tools used for overhauling, de-carbonizing and degreasing, engine time up, Engine fault diagnosing instruments, use of automobile stethoscope, computerized engine analyzers/scanners, OBD II usage for troubleshooting, troubles and trouble shooting related to engines.

MODULE II

Maintenance and Repair of chassis components: Servicing of clutch assembly, gear box, propeller shaft, troubles and trouble shooting chart on transmission, differential maintenance and repair, backlash adjustment, servicing of braking system, identification and rectification of brake faults, brake testing, steering system maintenance and repair, tyre rotation, tyre re-treading, checking and adjusting of suspension system, wheel balancing, wheel alignment

MODULE III

Maintenance and repair of fuel supply, Lubrication and cooling system: Fuel pump testing, Carburetor servicing and tuning, servicing of gasoline injection system, FIP calibration and phase setting, injector testing, types of engine oils and additives, engine oil change intervals, radiator service, checking of the thermostat, servicing of coolant pump.

Maintenance of Auxiliaries: Maintenance of starter motor, dynamo and alternator, regulator unit, battery maintenance, methods of testing & servicing various electrical accessories like horn, headlight (aiming and focusing), gauges, Testing the spark plug and ignition coil with special equipments, checking and setting the ignition timing in conventional engines.

REFERENCES:

6. Vehicle Service Manuals and reputed manufacturers.
7. G.B.S. Narang - Automobile Engineering, Khanna Publishers

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

Examination Duration: 3 hours
Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

**08.602 ENGINE AND DRIVE LINE DESIGN (U)**

L-T-P/D: 3-1-0 Credits 4

**MODULE-1**

1. Design of IC engine components: Design of cylinder, piston, connecting rod, Crank shaft, design of fly wheel- turning moment diagram, functions of flywheel, fluctuations of energy and speed in flywheel.


**MODULE-II**

3 Clutches & brakes: Design of single plate, multi plate, centrifugal and cone clutches, design factors for brakes, Design of internal expanding shoe brakes, Design of disc brakes, heat rejected during braking, torque transmitted by leading and trailing shoes during braking, braking force, weight shifted during braking, simple problems.

4. Axle & Steering systems: Design of front and rear axles - live and dead axles, Condition for true rolling, turning circle radius of wheels, angle of inside lock and outside lock - problems

**MODULE -111**

5. Design of gears: Nomenclature, Lewis equation and Lewis form factor, working stresses in gear teeth, dynamic load on gear teeth, design of spur gear, helical gear, bevel gear and worm gear, Lewis equation for strength and design- dynamic load, endurance load, wear load, AGMA standards.

6. Design of Gear box: Structure and ray diagram (upto 6 speeds), design of gear box.

References:

1. N.K. Giri- Automobile mechanics, Khanna Publishers, New Delhi
2. P.M. Heldt- Torque Converters, Chillon Book Co., 1952
3. P.M. Heldt- Automotive Chassis, Chillon Book Co., 1952
5. Dr. Sadhu Singh - Khanna Publishers, New Delhi, 1997
6. RS. Kurmi- Machine Design

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)

**08.603 COMPUTER AIDED DESIGN (MPU)**

L-T-D: 2-1-0 Credits : 3

Module –I

Computer Aided Design – Definition, Necessity for CAD, Benefits of CAD
Design process – Application of computers in Design- Geometric modeling, Engineering analysis, design review and evaluation, Automated drafting. Design for Manufacture.
Hardware in CAD- components, Data communications, Design workstation, Interactive display devices- CRT, directed beam refresh, DVST and raster scan displays, LCD and plasma discharge displays. User interaction devices, Design Database, graphic Standards, Data Exchange Formats.

Module II
2D and 3D Transformations- translation, scaling, rotation, mirroring, concatenation of transformations.
Windowing and Clipping- Cohen Sutherland line clipping algorithm. Hidden surface removal algorithms - z-buffer algorithm, scan line algorithm.
3D modeling: types of models- wire frame - surface and solid models, CSG and B-REP
Techniques - Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis.

Module III

References:
1. Mikell P Groover, CAD/CAM, Prentice Hall
5. Grigore Burdea, Philippe Coiffet, Virtual Reality Technology, John Wiley and sons
10. Daryl Logan, A First course in Finite Element Method, Thomson Learning
12. David V Hutton, Fundamentals of Finite Element Analysis, THM.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Convection heat transfer: Newton’s law of cooling-Dimensional analysis-Buckingham’s Pi theorem- Application of dimensional analysis to free and forced convection- empirical relations- problems using empirical relations Elementary ideas of hydrodynamics and thermal boundary layers.

Combined conduction and convection heat transfer - overall heat transfer coefficient - critical radius of insulation

Fins: Types of fins - Heat transfer from fins of uniform cross sectional area- Fin efficiency and effectiveness

Heat exchangers: Types of heat exchangers- LMTD method- effectiveness- NTU method

Boiling and condensation heat transfer (elementary ideas only)

Introduction to heat pipe

Module III

Radiation- Nature of thermal radiation-definitions and concepts- monochromatic and total emissive power-Intensity of radiation- solid angle- absorptivity, reflectivity and transmissivity-Concept of black body- Planck’s law- Kirchoff’s law- Wein’s displacement law-Stefan Boltzmann’s law- black, gray and real surfaces-Configuration factor (derivation for simple geometries only)- Electrical analogy- Heat exchange between black(gray surfaces- infinite parallel plates, equal and parallel opposite plates-perpendicular rectangles having common edge- parallel discs (simple problems using charts and tables)

Radiation shields(no derivation)


New age International publishers

References:

8. S.P.Venketashan, Heat Transfer, Ane books

University Examination

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction to kinematics: Terminology, definitions and assumptions. Mobility, Grashof’s law, kinematic inversion, concepts of mechanical advantage, transmission angle, coupler curve etc. Straight line mechanisms, steering mechanism, Hooke’s joint, Quick return mechanisms, intermittent motion mechanisms-Geneva mechanism, pawl and ratchet.

Static force analysis-introduction, Free body diagrams-Conditions for equilibrium. two and three force members, four force members, Analysis of mechanisms without considering friction, Analysis with sliding and pin joint friction. Method of virtual work.

Module II
Dynamic force analysis: introduction, inertia and D’Alembert’s principle, analysis of mechanisms, principle of superposition, kinetically equivalent systems, shaking forces and moments.
Balancing: Static and Dynamic unbalance. Balancing of masses distributed on the shaft, balancing a single cylinder engine, balancing multi-cylinder engines including V-Engines. Balancing machines
Gyroscopes: Principle, analysis of gyroscopic action on vehicles-two wheelers, four wheelers, air planes and ships, Principle of gyroscopic stabilization of ships, and inertial guidance

Module III
Cams: Introduction, classification of cams and followers, displacement diagrams, graphical layout of cam profiles, derivations of follower motion, standard cam motions, matching derivatives of displacement diagrams, plate cam with reciprocating or pivoted flat-face follower or roller follower. Description of Tangent cam and circular arc cams.
Vibration Analysis: Undamped free vibrations, different methods of analysis, free vibrations with viscous damping, logarithmic decrement, forced vibrations, isolation and transmissibility, vibrometers and accelerometers and their characteristics. Critical speed of a shaft, Transverse vibration, Dunkerley’s method. Torsional vibrations

References
1. Shigley and Uicker, Theory of Machines and Mechanisms, McGraw Hill
2. Rao and Dukkipatti, Mechanism and Machine theory, Wiley Eastern
3. V. Ramamoorthi, Mechanics of Machinery, Narosa
5. S S Rattan, Theory of Machines, TMH
6. Holowenko, Dynamics of Machinery, John Wiley
7. Shigley and Uicker, Theory of Machines and Mechanisms, Mcgrawhill
8. Charles E Wilson and J Peter Sadler, Kinematics and Dynamics of Machinery 3rd ed, Pearson Education

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.606 ELECTIVE II

Refer Elective Section:

08.607 MACHINESHOP II (U)

L-T-P/D; 0-0-3 Credits 3

1. Study of Milling Machines and Milling Cutters
2. Study of Grinding machines, Surface Grinding and Cylindrical grinding machines – study of Drilling machines
3. Study of EDM.
4. Exercise on Milling machines-face milling, end milling – spur and helical gear cutting – milling of keyways
5. Exercise on Grinding and Drilling Machines.
6. Exercise on working with EDM.
7. Study of CNC machining (turning and milling) and exercises on using trainer kits/ CNC machines.

08.608 CAD MODELLING AND ANALYSIS LAB (U)

L-T-P/D; 0-0-3 Credits 3

1. Introduction to CAD packages. 2D Drafting and 3D modeling, assembly and surfacing.
2. Introduction to FEM packages. Linear static analysis of simple systems (one dimensional and two dimensional).
### Module- I
Evolution of Scientific management :- Principles and functions of scientific management, Concept of pre modern, modern and post modern management, Levels and skills of management.
Organisational structure:- Authority, responsibility and span of control - system concept of management – Line, Line and staff, project and matrix organization.
Formation of companies:- Proprietary Partnership and joint stock companies – private limited, public limited companies, cooperative organizations and Government organizations.

### Module- II
Facilities planning:- Selection of site- factors to be considered – plant layout, different types, process, product, fixed group technology layout. Layout planning, computerized planning techniques.

### Module III

### References:
3. O P Khanna, Industrial engineering and management.

### University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Micro Electro Mechanical Systems (MEMS): Fabrication methods - Working and applications of MEMS based accelerometer, pressure sensor and gyroscope

Module II
System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems.
Adaptive control of machine tools. Programmable Logic Controllers (PLC) – Architecture, input/output processing, development of simple ladder diagrams.

Module III
Case studies of mechatronics systems: Pick and place robot, automatic car park barrier system, automobile engine management system.

References

University Examination
The question paper shall contain two parts. Part A and Part B. Part A shall contain 10 compulsory questions of 4 marks each, covering the entire syllabus (10 x 4 = 40). Part B shall contain 2 questions of 20 marks each from module I, II and III. One full question from each module has to be answered (3 x 20 = 60)
08.703 VEHICLE DYNAMICS (U)

L-T-P/D; 3-1-0 Credits 4

MODULE-I

1. Performance of cars and light trucks: Vehicle drag-deformation of the wheel, deformation of the ground, Total resistance to a moving vehicle- air, rolling and grade resistance, power for propulsion, traction and tractive effort, Road performance curves- acceleration, gradability and drawbar pull, acceleration time and elasticity, fuel consumption and fuel economy, strategy for lowest fuel consumption, factors affecting fuel economy, CAFE, driving schedules – EPA urban and highway cycles, European driving cycles.

2. Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity,

MODULE-II

3. Vehicle handling: Steering angle, cornering force, low speed turning, high speed cornering, suspension effects on cornering, self righting torque, slip angle, over steer, under steer, steady state cornering, driving torques on steering, effect of camber, camber thrust, transient effects in cornering,


5. Road testing methods: Measurement of aerodynamic drag force in a coast – down test, cross wind tests, engine cooling road test, wind noise measurement on the road.

MODULE III

6. Suspension: Vehicle dynamics and suspension requirements, choice of suspension spring rate, chassis springs and theory of chassis springs, Gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system, Roll axis and the vehicle under the action of side forces.

7. Tyres: Tyre types, relative merits and demerits, tyre dimensions and specifications, Ride characteristics of tyres, wheel hop, wheel wobble, wheel wander, wheel shimmy, behavior while cornering, cornering force, power consumed by a tyre, effect of driving and braking torque, factors affecting tyre life, tread design.

References:

3. Wolf- Heinrich Hucho – Aerodynamics of road vehicles, SAE
5. P.M. Heldt- Automotive chassis, Chilton Co., New York, 1952
6. TY. Wong- Theory of ground vehicles, Johnwiley and sons Inc, New York
7. N.K. Giri- Automobile mechanics, Khanna Publishers, Delhi, 1986
9. R.P.Sharma- A course in Automobile Engineering, Dhanpat Rai publications

Note: Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40) Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
L-T-P/D: 4-0-0

Credits 4

MODULE I
Casting and Machining: Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburettor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

MODULE II
Forming Process: Forging - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles,

MODULE III
Gear Manufacturing: Gear milling, Hobbing and shaping - Gear finishing and inspection.
Welding: Oxy Acetylene flame welding, Resistance spot welding, laser beam welding applications in automobiles.
Recent Trends in Manufacturing of Auto Components: Powder injection moulding - Shotpeen hardening of gears - Production of aluminium MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze casting of pistons - aluminium composite brake rotors

References:

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULAR AUTOMOTIVE TECHNOLOGY (U)

L-T-P/D: 4-0-0

Credits 4

MODULE-I
Electric and Hybrid Vehicle technology: Introduction, LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles, Batteries suitable for electric vehicles, motor and controllers, constructional features, Basic factors to be considered for converting automobiles to electric vehicle, electric hybrid vehicle, types - series and parallel hybrid, layouts, comparison, Power systems and control systems, Different modes of operation for best usage. Regenerative braking, Recent Trends in Automotive Power Plants: Stratified charged / lean burn engines – Hydrogen Engines- Electric propulsion with cables – Magnetic track vehicles.

MODULE 11

Module III
Modem electronic and micro control systems in automobiles: Electronically controlled concealed headlight systems, LED and Audible warning systems Electro chromic mirrors, automatic review mirrors, OBD II, Day time running lamps (DRL), Head up display, Travel information systems, On board navigation system, Electronic climate control, Electronic cruise control, Anti-lock braking system, Electronically controlled sunroof, Anti-theft systems, Automatic door locks (ADL), engine management system, Electronic transmission control, chassis control system, Integrated system
Vehicle Operation and Control: Computer Control for pollution and noise control and for fuel economy-Transducers and operation of the vehicle like optimum speed and direction.

1. Bob Brant - Build your own electric vehicle
2. SAE - Electric and hybrid electric vehicles and fuel cell technology, SAE
3. Andrew Dicks - James Laminine - Fuel cell systems explained, SAE
4. SAE - Fuel cells and alternative fuels / Energy systems
5. SAE - Fuel cell power for transportation 2001
6. Rickard Stobart - Fuel cell Technology for vehicles - SAE
7. Barry Hollemeak - Automotive Electricity, Electronics and computer controls, Delmer publishers
8. Tom Denton - Automotive Electronics, SAE

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Refer Elective Section

08.707 VEHICLE RECONDITIONING LAB (U)

L-T-P/D; 0-0-2 Credits 2

Reconditioning work of the following engine components and accessories with the help of special tools and Machines
1. Engine Valve reconditioning: Valve grinding by using valve re-facing machine, valve seat grinding, lapping and valve angle measurement. (Work with Valve re-facing machine, valve seat cutting tool, lapping tools etc)
2. Cylinder reconditioning: Checking the cylinder bore, setting the tool, re-boring operation (Work with portable re-boring machine, bore dial gauge, vernier caliper, etc)
3. Checking the exhaust of gasoline vehicle with infra red gas analyzer and timing the carburetor. (Work with Infrared Exhaust gas analyzer)
4. Checking the emission of diesel vehicle with smoke meter. (Work with Diesel smoke meter)
5. Brake drum reconditioning: Brake drum skimming after ovality measurement and setting the tool. (Work with brake drum skimming Lathe)
6. Con-rod boring: Con-rod boring, groove cutting, setting the tools, machinery. (Work with co-rod re-boring machine)
7. Line boring: Setting the tool, line boring operation. (Work with line boring machine)
8. Wheel alignment: Checking the camber, caster, kingpin inclination, toe in & out with optical aligner or computerized wheel aligner. (Work with computerized wheel aligning machine)
9. Wheel balancing: Balancing of wheels by using computerized wheel balancing machine.
11. Vehicle testing - Performance Testing of vehicle with chassis dynamometers (2 and 4 wheelers)
12. Brake testers: Testing of brakes using brake testers
13. Testing auto electrical components:
   a) Battery testing - Specific gravity test, open volt test, HRD test.
   b) Testing generator and regulator - testing the generator for short circuit, open circuit, testing the regulator unit
   c) Testing and checking of spark plugs - Cleaning and testing the spark plug with spark plug cleaner & testing machine.
   d) Testing of ignition coil
   e) Checking of dwell angle and rpm.

08.708 MECHATRONICS LAB (U)

L-T-P/D; 0-0-2 Credits 2

1. Virtual instrumentation using Lab view
2. Programming and Interfacing with PLCs and Microcontrollers
3. Temperature, Flow, Liquid level, Pressure control
4. Motion Control Experiments using
   a). Stepper Motor
   b). Servo Trainer kit.
The Students shall do a project work, which can be the preliminary work of final project, and submit a report at the end of semester.
The students shall present a seminar on a topic which is of high relevance to Mechanical Engineering. (Stream Automobile Engineering).

A report on seminar also shall be submitted at the end of the semester. 25% credit should be given for Project, and 75% credit for Seminar.
SEMMESTER VIII

08.801 ENERGY MANAGEMENT (MPU)

L-T-D: 2-1-0 Credits: 3

Module I

Module II

Module III

References:
6. P.K. Nag, Power Plant Engineering, TMH.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II
Methods engineering: Analysis of work methods using different types of process chart and flow diagrams- Critical examination- Micro motion study and therbligs- SIMO chart- Principles of motion economy — determination of allowances and standard time. - Job evaluation and merit rating – Objectives and principles of job evaluation- merit incentive plan – Merit rating plans. Wages and Incentives- Primary wage systems- Time rate and piece rate system of wage payment- Incentive plans- essentials of a good wage incentive plan- Non monitory incentives. Industrial relations- Psychological attitudes to work and working conditions - fatigue-Methods of eliminating fatigue- Effect of Communication in Industry, causes effects of industrial disputes- Collective bargaining- Trade union – Workers participation in management.

Module III
Production planning and control- Importance of planning – job, batch and mass production- Determination of economic lot size in batch production- Functions of production control – Routing , Scheduling, dispatching and follow up- Gantt charts. Inventory Control, Inventory models -Determination of EOQ and reorder level, selective inventory control techniques. Quality control and Inspection- Destructive and non-destructive testing methods-process capability- Statistical quality control and control charts for X and R. (Simple problems without using SQC table) Acceptance sampling and operation characteristic curves- System reliability- life testing-Bath tub curve. Introduction to concepts of Bench marking, TQM, ISO, Six Sigma and Quality circles (Brief description only).

References:
1. O. P. Khanna, Industrial Engineering and Management.
2. Ralph and Barien, Time and Motion Study
3. Grant and leven Worth, Statistical Quality Control.
4. E. S. Buffa, Modern Production management.
7. B. Kumar, Industrial Engineering Khanna Pub.
8. Introduction to work study - ILO

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
Review of Air standard cycle (brief description regarding the concepts)-Fuel air cycle and their analysis-dissociation, effects of operating variables like compression ratio, fuel-air ratio on thermal efficiency and power. Actual cycle and their analysis-time loss factor, heat loss factor, exhaust blow down. Comparison of fuel air cycle and actual cycle.


MODULE II


MODULE-III

Modern developments in IC engines: Stratified charged engine, Stirling engine, Wankel engine, variable compression ratio (VCR) engine, lean burn engines and ceramic engines, variable valve timing, concept & working of E3 engines.

REFERENCES:
2. Mathur & Sharma — A course in IC engines, Dhanpat Rai & sons
4. Fundamentals of IC Engines- V.Ganesan

Note: Question Paper consists of two parts.
Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40)
Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
CIM- Meaning and scope of CIM, Nature of CIM systems, Types of manufacturing systems-Computers in manufacturing- needs of CIM- CAM software, CIM software- manufacturing automation protocol (MAP)- Date base technology-basic concepts, requirements, Types-Data base management-DBMS- RDBMS.
CAD-areas of application-benefits, CAE-CAPP-Elements of CAPP system, advantages of CAAP- MRP.

Module II
NC machines- Types – Point- to point, straight cut and continuous path type-
Ball screws, stepper motor, servo meter, I V and PIV drives-CNC and DNC, Adaptive controls.
Part programming: Manual part programming, Preparatory and miscellaneous codes, Interpolation and canned cycle, Tool compensation, APT, Simple problems on turning and drilling.

Module III
Role of management in CIM- Expert system, computer vision, concurrent Engineering.

References:
1. Mikell P Groover, CAD/CAM/CIM — PHI
2. P. Radhakrishnan & S. Subramoniam, CAD/ CAM/CIM.
3. S. Kant and Vajpayee, Principles of CIM, PHI

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>08.805</td>
<td>ELECTIVE IV</td>
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<td>08.806</td>
<td>ELECTIVE V</td>
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<td>08.807</td>
<td>INDUSTRIAL SEMINAR (MPU)</td>
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<tr>
<td>08.808</td>
<td>PROJECT AND VIVA VOCE (MPU)</td>
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**Refer Elective Section:**

**08.807  INDUSTRIAL SEMINAR (MPU)**

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<tr>
<th>L-T-D: 0-0-2</th>
<th>Credits: 2</th>
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The Student shall present a Seminar based on industrial visits under taken from V-VII semesters. A minimum of four visits are compulsory. A report on industrial visits shall be submitted. The institution shall arrange minimum four Seminars on latest topics by experts from Industry. The student shall be evaluated based on the report on industrial visits, presentation, interaction, performance in the class and general awareness on topics of expert lectures.

**08.808  PROJECT AND VIVA VOCE (MPU)**

<table>
<thead>
<tr>
<th>L-T-D: 0-0-5</th>
<th>Credits: 5</th>
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A project work of good quality should be done under the guidance of project guide(s) and a project report should be submitted. For internal assessment, 50% weightage to be given to the assessment of the guide and 50% to the committee assigned to assess the project work. For University examination a Viva-voce examination shall be conducted. Marks of Viva voce examination shall be based on the overall performance, Project report, Seminar reports, Subject knowledge and general awareness in the developments in Mechanical Engineering.(Stream Automobile Engineering).
LIST OF ELECTIVES

(Electives are common to Mechanical, Production and Automobile engineering branches unless otherwise specified in the title)

08. 506 Elective I

1. Communicative English and technical writing
2. Human aspects of management
3. Disaster Management
4. Glimpses of world thought
5. Professional ethics and human values
6. Environmental Science
7. Advanced Welding technology
8. Foundry Technology
9. Environmental Pollution Control
10. Advanced Fluid Mechanics
11. Composite Materials Technology
12. Internet Technologies
13. Non Destructive Testing
14. Powder Metallurgy
15. Vehicle Transport & Fleet Management
16. Automotive Airconditioning
17. Two And Three Wheeled Vehicles

08.606 Elective II

1. Advanced mechanics of solids
2. New Energy systems
3. Object Oriented Programming
4. Nuclear Engineering
5. Mechanical working Methods
6. Artificial Intelligence Systems
7. System Modeling & Simulation
8. Instrumentation and control
9. Materials Handling
10. Agro Machinery
11. Total Quality Management
12. Precision Engineering
13. Advanced Manufacturing Processes
14. Material Characterisation
15. Micromachining Methods
16. Tool Engineering (MU)
17. Vehicle Body Engineering
18. Vehicle Performance And Testing
19. Automotive Fuels & Alternate Fuels

08.706 Elective III

1. Computer Graphics
2. Advanced Thermodynamics
3. Industrial Heat Transfer
4. Plant Engg & Maintenance
5. Fracture Mechanics
7. Entrepreneurship Development
8. Industrial Hydraulics
9. Finite Element Methods
10. Metal Forming
11. Machine tool Technology
12. Non-conventional Machining Techniques
13. Turbo Machines
14. Experimental Methods in Engineering
16. Failure Analysis
17. Theory of Machining (MU)
18. Bio Materials
19. Concurrent Engineering
20. Industrial Automation
21. Alternate Energy Sources
22. Automotive Pollution and Control
23. Creativity, Innovation and New Product Development
<table>
<thead>
<tr>
<th><strong>08. 805 Elective IV</strong></th>
<th><strong>08. 806 Elective V</strong></th>
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<tbody>
<tr>
<td>1. Experimental Stress Analysis Techniques</td>
<td>1. Propulsion Engineering</td>
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<tr>
<td>2. Aerospace Engineering</td>
<td>2. Industrial Refrigeration</td>
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<tr>
<td>3. Facilities Planning</td>
<td>3. Industrial Quality Control</td>
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<tr>
<td>5. Non linear Dynamics and Chaos</td>
<td>5. Creativity &amp; Product Development</td>
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<td>7. Multiphase flow</td>
<td>7. Random vibrations</td>
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<td>8. Controls in Machine tools</td>
<td>8. Advanced Kinematics of Machines</td>
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<td>10. Tribology</td>
<td>10. Flexible Manufacturing Methods</td>
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<td>11. Value Engineering</td>
<td>11. Computational Fluid Dynamics</td>
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<td>12. Software Engineering</td>
<td>12. Technology Forecasting</td>
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<td>17. Product and brand management</td>
<td>17. Robotics</td>
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<td>18. Research Methodology</td>
<td>18. Logistics and Supply Chain Management</td>
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<tr>
<td>20. Automotive Technology (P)</td>
<td>20. Surface Engineering</td>
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<tr>
<td>22. Industrial Safety Engineering</td>
<td>22. Heating Ventilation and Air Conditioning Design</td>
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<tr>
<td>24. Tractors &amp; Farm Equipments</td>
<td>24. Off- Road Vehicles</td>
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ELECTIVE I

08.506.1 COMMUNICATIVE ENGLISH AND TECHNICAL WRITING

L-T-D: 3-1-0 Credits: 4

Module-I

Listening, Reading, Speaking and Writing skills.
Listening Skills: Listening for general content- Intensive listening-Listening for specific information.
Speaking Skills: Oral practice-Describing objects/situations/people-Role play-Just A Minute/Group Discussion- informal letters-essentials of telephonic conversation-invitations-minutes of a meeting.
Reading Skills: Skimming the text- exposure to a variety of technical articles, essays, graphic representation, and journalistic articles.
Writing Skills: Skills to express ideas in sentences, use of appropriate vocabulary -sentence construction-paragraphs development-note making-editing a passage and essay writing.

Basics of Technical Communication.
Technical communication- features, Distinction between general and technical communication- language as a tool of communication- levels of communication-interpersonal, organizational, mass communication-the flow of communication: upward, downward and lateral-importance of technical communication- barriers to communication.

Module-II

Forms of Technical communication.

Module III

A non-detailed study of the autobiography: “Wings of Fire-an autobiography by Dr. APJ Abdul Kalam”.
Students should read the book on their own and selected topics may be discussed in the class.

References.
4. Everyday Dialogues in English-Robert J Dixson, PHI.

University Examination:
Six short questions to be answered out of 8 questions from Module I. Each answer carries 5 marks. (30 marks). Questions to be limited to the topics
Writing Skills & Basics of Technical Communication. 2 questions out of 4 has to be answered from Module II. Each answer carries 15 marks. (30 marks). Two essays out of Four has to be answered from module III. Each answer carries 20 marks. (40 marks).
Module 1

Module 2
Organizational development, Concepts of QWL-strategies for improved QWL, Organizational change, Resistance to change, Goals of organizational change and organizational development, Concept of organizational climate-health and effectiveness. Organizational culture- nature and characteristics, types, impact of culture in organizational behaviour, Motivation of person across cultures, Managerial leadership across cultures, Case studies.

Module 3

References:
1. Fred Luthans ,Organizational Behaviour ,McGraw Hill.
2. Stephen P. Robbins, Organizational Behaviour ,Pearson Education.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3x20=60)
Module I

Module II
Preparedness and mitigation measures for earthquakes, floods, tsunamis, landslides and volcanoes with special reference to construction of residential buildings and public utility buildings. Disaster mitigation planning of human settlements and townships for earthquakes, floods, tsunamis, landslides and volcanoes.

Module III
Issues in the prediction of natural disasters, land use practices and disaster mitigation. Integration of rural development programmes with natural disaster mitigation and planning. Information systems and decision making tools in disaster management. Disaster management in India.

References
3. Murty, C.V.R. Earthquake tips

University Examination:
Duration: 3 hours
The question paper consists of Part A and Part B. Part A is for 40 marks. There will be 8 compulsory short answer questions of 5 marks each covering entire syllabus.
Part B is for 60 marks. There will be two questions from each module. The candidate has to answer one question of 20 marks from each module.
08.506.4  GLIMPSES OF WORLD THOUGHT

L-T-D: 3-1-0  Credits: 4

Module I

Introduction - Ancient Period - The History of ‘ideas’ - the earliest thinkers - East and West - Ancient Indian texts - Vedas, Sutras, Sastras and Upanishads - some early Greek thinkers - Anaxagoras, Ionians - other centres of learning in the ancient world - China, Egypt, South America - Mayans, Incas - Greek and Roman schools of thought

Medieval ages & Renaissance - The Dark Ages - Renaissance Thinkers - Leonardo, Copernicus and Kepler - art and literary movements (school of paintings and other forms of reputation) - The Philosophy of science and the development of the Scientific Method - Arts Vs. Science - the flowering of academic disciplines - the science of ‘knowledge’ - the great intellectual debates - technology and revolutions - industrial and scientific revolution

Module II

The major schools of thought - positivism, nihilism, dialectical materialism - Marxism and its social, cultural and economic dimensions - revolutions in human perception - theories of human evolution - theories of human betterment theories of social analysis (French Revolution, October Revolution) - the great inventors and discoveries and their relation to human thought (Darwin’s theory and growth of imperialism) - determinism, modernism and colonial theories.

Module III:

The modern era - structuralism - definition and implications in the various sciences - post-structuralism, post-modernism, Neo-Marxism and post-colonial theories - new disciplines - cognitive science - language, culture and cognition - current trends and issues - semiotics - the science of signs. Human values in Engineering.

References
1. Will Durrant, The Story of Philosophy, Simon & Schuster
2. Will Durrant, The Pleasures Philosophy, Silmon
3. Bertnard Russell, History of Western Philosophy, George Allen & Unwin
5. Will & Ariel Durrent, The Story of Civilisation, Volume I to XII
6. Edward Gibbon, The Rise and Fall of the Roman Empire
7. Oswald Spingler, Decline of the West
8. Dr Radhakrishnan S., The Creative Life
9. Dr Radhakrishnan S., The Present Crisis of Faith
10. Dr Radhakrishnan S., Our Heritage
11. Dr Radhakrishnan S., Religion and Culture
12. Dr Radhakrishnan S., Living With A Purpose
13. Dr Radhakrishnan S., True Knowledge
14. Dr Radhakrishnan S., Towards A New World
15. Dr Radhakrishnan S., Recovery of Faith
16. Dialogues of Plato
18. Alston, Philosophy of Language, Prentice Hall
19. Shaffer, Philosophy of Mind, Prentice Hall

**University Examination**

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4 = 40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20 = 60)
Module I

Module II
ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering as experimentation - Engineering as responsible experimenters – Codes of ethics – A balanced outlook on law – The challenger case study.

Module III
GLOBAL ISSUES: Multinational corporation – Environmental ethics – Computer ethics Weapons development – Engineers as managers – Consulting engineers and engineers as expert witness and advisor – Moral leadership – sample code of ethics like ASME, ASCE, IEEE – Institution of engineers (India) – Indian Institute of Materials Management – Institution electronics and telecommunication engineering (IETE) India etc.

References:
2. Mike W Martin and Schinzinger, Ethics in Engineering, Tata Mcgraw Hill.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3x20=60)
Module I

Module II

Module III
Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management.

REFERENCES:
1. Environmental Studies – Benny Joseph – Tata McgrawHill-2005

University Examination:
Question Paper consists of two parts. In Part A, 10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). In Part B, 2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I


Module II


Module III


REFERENCES:
4. Rossi, Welding Engineering.
5. Udin et al., Metallurgy of Welding.
6. Teo goisky, The electric welder.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 × 4 = 40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 × 20 = 60)
Module I
Casting as process of manufacture – Its advantages and limitations
Pattern making – Pattern materials – Factor effecting the choice of pattern materials – Pattern allowances – Types of pattern – Line diagram description and use of different types of patterns-colour codes of pattern.
Moulding process – Hand moulding tools and their uses – Different types of moulding boxes – Green sand moulds, dry hand moulds, Loan moulds, plaster moulds, cement bonded moulds – bench moulding, floor moulding and pit moulding.

Module II

Module III
Melting and pouring : Types of furnaces used for cast irons, steels and non ferrous metals – Composition, size and charge calculations – Details and calculations in Cupola charging – New developments in cupola design.
Mechanisation in foundry – Elementary ideas of machines used for sand conditioning, sand supply, moulding, core making, knockout and fettling.
Special moulding and Casting processes – Shell moulding, plaster mould casting – Investment casting, CO2 process – Graphite and ceramic moulds – Centrifugal casting – Continuous castings.

References
1. Hine and Resenthal, Principles of Metal Casting.
5. Russicof, Foundry practice.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Environmental aspects - Impact of environment - Environmental quality - Role of environmental engineer.
Air quantity - Definition, Characteristics and prospective - Types of our air pollutants - effect of air pollution on men and environment - Formation of air pollutants from combustion of fossil fuels and parameters controlling the formation.

Module II
Water pollution from tanneries and other industries - Engineered systems for waste water treatment and disposal - Control systems and instrumentation for pollution control.
Definition, characteristics - Types and sources of solid waste - Solid waste management - generation, collection, storage and processing techniques - Solid waste disposal.

Module III
Methods and equipment's for industrial waste treatment - Pollution thermal power plants and nuclear power plants - Sources and control methods - Emission from SI and CI engines - Evaporative emission control - Exhaust treatment devices - Noise pollution and their control.

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Description of fluid motion – Lagrangian and Eulerian approaches, Velocity, gradient of velocity, rate of strain, stress, Newton's law of viscosity, Stokes hypothesis, acceleration, temporal acceleration, convective acceleration. Reynolds transport theorem, derivation of continuity and momentum equations using Reynolds transport theorem, Navier-Stokes equation for incompressible flow, Stream function, rotation, vorticity, stream function-vorticity formulation, equation of potential flow.

Module-II
Derivation of Hagen Poissule equations for velocity and discharge through a pipe, derivation of friction factor for laminar flow, Couette flow for negative, zero and positive pressure gradients, flow in a rotating annulus, Viscometer based on rotating annulus. Potential flow, theory of complex variables, complex flow potential, complex flow potentials for source, sink, vortex and doublet. Potential flow past a cylinder, conformal mapping, flow over an ellipse, flow over a vertical flat plate, force and moment calculations (derivation of expression not required), Schawartz-Christoffel transformations, potential flow between two parallel plates, potential flow in a sector.

Module-III
Boundary layer theory, Boundary layer thickness, Displacement thickness and momentum thickness, Prandtl boundary layer equations, Blasius solution for flow over a flat plate, Momentum integral equations, Pohlhausen approximation solution of boundary layer for non zero pressure gradient flow, favorable and adverse pressure gradients, flow separation, vortex shedding, introduction to turbulent flow, mean and fluctuating components, concept of eddy viscosity, short notes of velocity measurement technique using (a) multi hole probes (b) Hot wire anemometers (c) LDV (d) PIV

References:
1. K Muralidhar, G Biswas, Advanced Engineering Fluid Mechanics
2. H. Schlichting, K. Gersen, Boundary layer theory.
3. V.L.Streetor, Fluid mechanics
4. Vuan, Elements of fluid mechanics.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Composite Materials:- Definition, characteristics, Classifications based on structure and matrices, Structural, functional sensory and smart composites, Advantages and limitations, History, Industrial scene, Applications.
Introduction to micro-mechanics-unidirectional lamina – laminar stresses– inter laminar stresses - static mechanical properties - fatigue properties - impact properties - environmental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes. Failure predictions - design considerations - codes - design examples.

Module II
Fiber reinforced plastics: Reinforcement fibres:- High strength man made (glass, carbon, aramid) and natural fibres, Structure, characteristics, Properties and applications.
Whiskers:- Characteristics, properties and applications
Polymer matrix composites (PMC):- Thermo set, thermoplastic and elastomeric polymers, their properties, characteristics and utilisation as matrices. Manufacturing methods for thermo set thermoplastic and elastomeric PMC. Their characteristic features. Properties of composites made and their applications.
Metal Matrix Composites (MMC): Metals. Inter-metallics and alloys used for MMC and their properties, Manufacture of MMC, their properties-characteristics and applications.

Module III
Ceramic Matrix Composites (CMC):- Classification of ceramics and their potential role as matrices. Ultra structure processing of ceramics, Manufacture, properties and applications of CMC using fine ceramics, carbon, glass, cement and gypsum as matrices.
Post processing operations:- Machining, cutting, polishing, welding of thermoplastic PMC. bonding, riveting and painting. Advanced post processing methods like ultrasonic welding, plasma coating, waterjet cutting and laser machining. Quality, inspection and non-destructive testing.

References
7. Chawla KK., Ceramic Matrix Composites Chapman & Hall

**University Examination**

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
Information Technology – Introduction – applications – The Internet and World wide web – the GPS.

MODULE II
Spread sheet applications – Data base applications – Queries – Internet connectivity.

MODULE III

REFERENCES

Note :- This course is intended to provide an overview of fundamentals and concepts of IT useful to an undergraduate student in Mechanical Engineering only.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
L-T-D: 3-1-0

Module I

Module II
Ultrasonic testing of materials: Advantages, disadvantages, Applications, Generation of Ultrasonic waves, general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.

Module III

REFERENCES:
1. Non-Destructive Testing by P. Halmshaw

University Examination:
Question Paper consists of two parts. In Part A, 10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). In Part B, 2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60).
L-T-D: 3-1-0

Module I

Module II

Module III
Manufacturing and application of important P/M components: Porous bearing, Electrical contact materials, Metallic filters, Cemented carbides, magnets, Friction materials and Composites.

REFERENCES:
1. Powder Metallurgy-ASM Vol. II.
3. Powder Metallurgy-Thumler
5. Powder Metallurgy-Gopal S. Upadhayay
6. Cemented Tungsten carbide Production, properties and testing,-
   Gopal S.Upadhyay.

University Examination:
Question Paper consists of two parts. In Part A, 10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). In Part B, 2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60).
Module I
Organization and management- Forms of ownership, principle of transport, management, internal organization, centralized & decentralized condition (Engineering, traffic and administration), administration, recruitment and training, welfare, health and safety.
Management Training and Operations- Basic principles of supervising, Organising Time and people, Job instruction training - Training devices and techniques - Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing.

Module II
Route planning and Scheduling: Sources of traffic, town planning, turning points, stopping places, survey of rout, factors affecting frequency, direction of traffic flow, estimated traffic possibility, time table layout, use of flat graph method, preparation of vehicle and crew schedules, duty roaster, use of vehicle running numbers, determination of vehicle efficiency, checking efficiency of crew, duty arrangements, duty of drivers and conductors.

Module III
Fleet Management, Data Processing And Fare Structure : Fleet management and data processing - Data processing systems - Software Model - Computer controlling of fleet activity - Energy management, Basis of fares, effect of competition and control, calculating average charge, zone systems, straight and tapered scales fare structure - Methods of fare collection - Preparation of fare table.
Motor vehicle act: Importance of motor vehicle act, Schedules and sections - Registration of motor vehicles - Licensing of drivers - Control of permits - Limits of speed - traffic signs - Constructional regulations - types of driving licenses, procedure for obtaining driving license, registration of vehicle, types of permits, procedure for obtaining permits, third party insurance.

References:
1. Rev. W. Faulks -Road and Coach Operation
5. Kadiyali.L.R., " Traffic engineering and Transport Planning ".

University Examination:
Question Paper consists of two parts. In Part A, 10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). In Part B, 2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60).
MODULE I
Airconditioning Fundamentals: Definition of Air Conditioning, Psychrometry and air composition Adiabatic saturation and Thermodynamic wet bulb temperature Basic air conditioning system - Location of air conditioning components in a car - Schematic layout of a refrigeration system. Compressor components - Condenser and high pressure service ports. Thermostatic expansion value - Expansion value calibration - Controlling evaporator temperature - Evaporator pressure regulator - Evaporator temperature regulator.

MODULE II
Refrigerant: Containers - Handling refrigerants - Tapping into the refrigerant container - Refrigeration system diagnosis - Diagnostic procedure - Ambient conditions affecting system pressures.

MODULE III
Air Routing & Temperature Control: Objectives - Evaporator care air flow through the Dash recirculating unit - Automatic temperature control – Duct system - Controlling flow - Vacuum reserve - Testing the air control and handling systems.
Air Conditioning Service: Air conditioner maintenance and service - Servicing heater system Removing and replacing components. Trouble shooting of air controlling system – Compressor service.

References:
5. Leslie. F. Gamines &Boyce L. Dwiggins - Automotive Air Conditioning
6. Damkundwar - Refrigeration and Air Conditioning
7. C.PArora - Refrigeration and Air Conditioning -

University Examination:
Question Paper consists of two parts. In Part A, 10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). In Part B, 2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60).
MODULE-I
General Introduction: Motor cycles, scooters, mopeds and three wheeled vehicles, classification, different arrangement of cylinders, carburetion system and operation. Power plants: Two stroke and four stroke, arrangements, engine ports, reed valves, valves and valve actuating mechanisms, valve timing, Types of scavenging processes, merits and demerits, scavenging efficiency. Scavenging pump, Rotary valve engine lubrication and fuel supply systems in two wheelers, constructional features and types of oil seals, mufflers & silencers, Catalytic converters.

MODULE-II
Power transmission: Clutches, necessitites, centrifugal clutch, multiple disc clutch, selective and progressive gear boxes, different types of synchronizers, gear drive, shaft drive and variable drive mechanisms and their constructional aspects. Electrical systems: Magneto ignition system, high tension and low tension magneto ignition, comparison with battery ignition system, electronic ignition systems like CDI, microprocessor controlled ignition system etc, starting motor, accessories horn, lighting system.

MODULE-III
Case study of two and three wheelers: Salient features of modern two wheelers, Three wheelers – different types, layouts, transmission

References:
6. Service Manuals of popular Indian two and three wheeled vehicles

University Examination:
Question Paper consists of two parts. In Part A, 10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). In Part B, 2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60).
Module I
Analysis of stress; State of stress at a point; Rectangular stress components; stress components on an arbitrary plane; Principal stress and Principal planes; Planes of maximum shear; State of pure shear; Differential equations of equilibrium in rectangular co-ordinates; Analysis of stress in two dimensions; Plane stress and plane strain. Transformation of stresses. Analysis of strain, strain-displacement relations–Principal strains and principal axes. Compatibility conditions. Stress-Strain relations.

Module II
Energy methods; Reciprocal relations; Maxwell-Betti-Rayleigh reciprocal theorem; Castigliano’s I theorem; Fictitious load method; Theorem of virtual work; Castigliano’s II theorem; Engessers theorem.
Bending of beams; Straight beams and asymmetrical bending; shear centre; shear stresses in thin walled open sections; Bending of curved bars (Winkler–Bach formula)

Module III
Torsion -Torsion of General prismatic bars; Torsion of circular, elliptic and equilateral triangular bars; Membrane analogy. Torsion of thin- walled tubes. Torsion of bars with narrow rectangular cross-section. Torsion of thin- walled multiple cell closed sections, Torsion of rolled sections, Center of twist and flexural centre.

References:
1. L.S Srinath, Advanced Mechanics of Solids, T.M.H
2. Timoshenko and Goodier, Theory of Elasticity, Mc Graw Hill.
3. S.M.A Kazimi , Solid Mechanics,T.M.H.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Principle of MHD Generators – Choice of generator parameters – Applications.

Module II
Nuclear fusion- Fusion fuels and reactions- Sustained fusion reaction- Production and containment of plasma – Fusion – breeder concept.

Module III
Hydrogen- Introduction and Applications- Production, Storage and Transportation – production and application of methanol.

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
OOPS and Java basics - Java virtual machine - Java platform API - extended security model - applet classes - exceptions and abstract classes - Java applet writing basics - GUI building with canvas - applet security - creating window applications - writing console applications - utility and math packages

Module II
Swing programming - working with swing components - using the clipboard - input/output streams - printing - working with 2D and 3D Graphics - using audio and video - creating animations
Java beans development kit - developing beans - notable beans - network programming - client and server Programs - naming and directory services - working with Java management APIS

Module III
Distributed application architecture - CORBA - RMI and distributed applications - working with remote objects - object serialization and Java spaces - Java IDL and ORBs, connecting to database - using JDBC - integrating database - support into web applications - Java servlets - JSDK - JAR files - Java native interface

References:
3. Holzner S., Java 2, Swings, Servlets, JDBC & Java Beans Programming, IDG Books

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Review of Elementary nuclear physics: Atomic structure – nuclear energy and nuclear forces – Nuclear fission.
Nuclear reactions and radiations – Principles of radio active decay interactions of an ray with matter – Neutron cross sections and reactions – The fission process – Chain reactions – Basic principles of controlled fusion.

Module II

Boiling water reactor . Description of reactor system – Main components – Control and safety features .

Module III

Reactor heat removal / equations of heat transfer as applied to reactor cooling – Reactor heat transfer systems – Heat removed in fast reactors.

References

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.606.5 MECHANICAL WORKING METHODS

L-T-D: 3-1-0 Credits: 4

MODULE I
Introduction: Elements of mechanical processing systems – Definition of mechanical working – Hot and cold working – Comparison with other processing systems.
Need for preheating- Need for heat treatments after mechanical working – Heat treatment methods – Furnaces for pre heating and heat treatment

MODULE II
Materials for mechanical working – A brief survey of the characteristics and composition of the common ferrous and non ferrous alloys and non metallic materials used for mechanical working – Rolling Metals – Fundamental principles of metal rolling classification of rolled products, types and sizes – Basic principles of draughting schedule design and roll pass design (simple examples) Roll load and power required in rolling – Problems encountered and defects in rolling practice.

MODULE III
Forging , Extrusion and Wire drawing – Principles of product design and die design in forging – Calculation of forging loads and selection of hammers and process for forging – Design of extrusion and wire – drawing dies – Computation of power requirements problems encountered and defects in the above processes.
Press working of metals – Description and classification of the processes – Product and die design for shearing, blanking drawing and bending – Compound and progressive dies – Computation of capacities and tonnage requirements for blanking, piercing and drawing operations – Process selection and selection of process problems and defects in press working.

References:
1. Cambell, Principles of Manufacturing Materials and processing.
4. ASTME, Fundamentals of tool design.
5. Richard Little, Metal Working Technology.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3x20=60)
08.606.6  ARTIFICIAL INTELLIGENCE SYSTEMS

L-T-D: 3-1-0        Credits : 4

Module I
Definition - history and applications - propositional calculus - predicate calculus - inference rules - structures and strategies for state space search - heuristic search algorithms - heuristics in games - complexity issues - control and implementation of state space search - production systems - planning - the blackboard architecture

Module II
Knowledge intensive problem solving - expert system technology - rule-based expert systems - model based reasoning - case based reasoning - knowledge representation problem - reasoning with uncertain or incomplete information - statistical approach - non-monotonic systems - fuzzy sets - knowledge representation - languages - issues - network representation - conceptual graphs - structured representation

Module III
Languages and programming techniques for AI - overview of LISP - search - higher order functions and procedural abstractions - search strategies - pattern matching - recursion - interpreters - logic programming in LISP - streams and delayed evaluation - expert system shell in LISP - network representations and inheritance - CLOS
Introduction to understanding natural language - introduction to automated reasoning - introduction to machine learning

References:
1. Luger G.F. & Stubblefield W.A., Artificial Intelligence, Addison Wesley
3. Elain Rich & Kevin Knight, Artificial Intelligence, Tata McGraw Hill
5. Winston P.H., LISP, Addison Wesley

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
L-T-D: 3-1-0  
Credits: 4

Module I
System concepts - components of a system - discrete and continuous systems - types of system study - system analysis - system design and system postulation - system modelling - types of models - system simulation - steps in a simulation study - comparison of simulation and analytical models - Monte Carlo simulation - examples of simulation of single server, single queue systems and simple inventory systems - concepts in discrete event system simulation - event scheduling/time advance algorithm - modelling world views

Module II
Random number generation - techniques for generating random numbers - tests for random numbers - frequency tests - the Kolmogorov-Smirnov test and the Chi-square test - random variate generation - inverse transformation method - exponential, uniform and empirical discrete and empirical continuous distributions - Input modelling for simulation - data collection - identifying the distribution using histograms - parameter estimation - Chi-square goodness of fit test Verification and validation of simulation models - verification of simulation models - calibration and validation of models - face validity - validation of model assumptions and validating input-output transformations - output analysis for a single model - types of simulations with respect to output analysis.

Module III
Simulation modelling and analysis of manufacturing systems - objectives - performance measures - issues in simulation of manufacturing systems - simulation of simple job shop manufacturing systems - Introduction to simulation software for manufacturing applications - salient features of simulation languages such as general purpose simulation system (GPSS) and simulation language for alternative modelling (SLAM) - salient features of simulators such as WITNESS and ARENA

References:
University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
L-T-D: 3-1-0

MODULE- I
Measurement: Aims- Fundamental methods- Measurement systems-
Functions of Instrument- Static and dynamic Measurements, Terminology,
Time element, Errors in measuring Instruments, Sources of error, Error
distribution- Sensing element: Types- Sensors for motion- Angular motion,
Speed, Force, ** Electrical transformation, Simple transducer elements-
Types of transducers- Voltage and current generating Analog type, Variable
parameter Analog type, Frequency and pulse generating transducers-
Specification for transducers.
Measurement of Temperature- Temperature scales, Basic fixed point-
Measuring devices and their ranges- Electrical type and mechanical type-
Measuring system for resistance thermometers and Thermocouples- Bridge
circuits- Calibration- Filled system thermometers- Ambient temperature
compensation.

MODULE – II
Measurement of pressure- Force balance principles- Deformation of elastic
members- Ring balance – Impulse line layout- Calibration Low pressure
measuring devices.
Measurement of flow- Head flow meters- Primary elements – Secondary
elements- Fleat monometers- squire root extraction- Flow transducers- Area
flow meters- Rotameter- Measurements of liquid level- Direct methods-
Inferential methods- Boiler drum- Level indicator.

MODULE – III
Control system- Classification of control system- Block diagram- Rule of Block
diagram algebra- Transfer functions, Set point- Identification of plat
Charactersitics- First order proportional and second order proportional
elements- Dynamic response – Analogues circuits stability of control systems-
Routh – Hurvitz criterion- Nyquist criterion.

REFERENCES:
1. R.K. Jain, Mechanical and Industrial Measurements.
4. A. E. Pribanco, Industrial Instrumentation.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer
questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2
questions of 20 marks each, from each module and student has to answer
one from each module (3 x 20=60)
MODULE I
Importance of Materials Handling: Principles of Materials Handling – Principal groups of Materials handling equipments – General characteristics and applications of materials handling equipments – Modern trends in Materials handling.

MODULE II

MODULE III

REFERENCES
1. Rudanko, Material Handling Equipments.
3. A. Spivakovsky and V. Dyachkov, Conveying Machines - I.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.606.10  AGRO MACHINERY

L-T-D: 3-1-0 Credits : 4

MODULE I

MODULE II

MODULE III

References:
3. A. Guruvech and B. Sorekin- Tractors, MI1R Publishers Moscow, 1975
4. Geleman and M. Maskovin- Farm tractors, MIR. Publishers, Moscow, 1975
6. Herbert Nicholas- Moving the earth.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module 1

Module II

Module III

REFERENCES

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II
Static stiffness and its influence and inaccuracy due to thermal effects in the machine tools: Overall stiffness of a lathe-compliance of work piece-errors caused by cutting forces deformation in turning-boring-milling-heat sources-thermal effects-rate of thermal expansion.
Dimensioning accuracy and surface finish: Definition of terms – dimensional chains – dimensional stepped shaft-assigning tolerances in the constituent dimensions-dimensional chains – concepts of precision machining-finish turning-boring-grinding.

Module III

REFERENCES:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Advances in casting: Newer casting processes - plaster mold and ceramic mold casting – vacuum casting – Evaporative pattern casting, ceramic shell investment casting, slush casting, squeeze casting and semisolid metal forming-Rapid solidification for Amorphous alloys.

Module II

Module III

REFERENCES

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Scope of metallographic studies in materials science. Understanding image formation, resolution of a microscope, numerical aperture, magnification, depth of field and depth of focus. Important lens defects and their correction, principles of phase contrast. Bright field and dark field contrast, sample preparation. Optical microscopy, interference and polarized light microscopy, quantitative analysis using optical microscopy (inclusion analysis, grain size determination volume fraction of phases etc.)

Module II
Production and properties of X-rays, X-ray diffraction, Bragg’s law of diffraction, Scattering of an electron by an atom, by a unit cell, structure factor and intensity calculations. Stereographic projection, Effect of texture, particle size, micro and macro strain on diffraction lines. Indexing of powder photographs. Chemical analysis by X-rays, Stress measurement, Particle size determination

Module III

References:
2. Elements of X-Ray diffraction :B.D Cullity , publishers addition ,Wesley publishing company.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II

Module III
Precision Grinding-Partial ductile mode grinding- Ultraprecision grinding-Binderless wheel – Free form optics.

REFERENCES:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I

MODULE II

MODULE III

References:
1. Cysil Donaldson, Tool Design, TMH
2. William and Boyes, Jig and Fixture Design Hand Book.
4. V.Koraskove Mir., Fundamentals of Fixture Design.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE-I
Modern materials for vehicle design: Introduction, Structure and manufacturing technology of automotive materials, Mechanical and physical properties of automotive materials, Material selection for automotive components, Body design: coach and bus body styles, typical layout of bus and coach bodies, typical layout of commercial vehicle types, passenger car body styles, Chassis design and analysis: chasis type, structural analysis by simple structural surface method, body frame construction, unitized frame and body construction, FR, FF, & MR body structure details

MODULE-II
Ergonomics method and tool to promote occupant accommodation: standards guidelines and recommendations, Anthropometry, 2-dimentional manikins, package drawing, Quick and dirty mock ups, vehicle seating configuration(based on SAE). Crash testing: Human testing, Crash worthiness, Compliance testing, Component testing, Competitive race testing. The role of endurance and durability studies in the manufacturing of vehicles. Introduction, Failure and reliability, Testing and failure prediction, importance of avoiding failures

MODULE-III
Introduction to vehicle safety: Basic concept of vehicle safety-underlying principles, safety factors, warning and instructions, shielding, interlocking. Minor auto body repairs: types of body fillers and its application, repairing rust damage, Painting: Corrosion and anticorrosion method .Paint and painting process Diagnosing major collision damage: impact and its effect on a vehicle, determining the conditions of the collision, Porto power, the dozer technique, operation of conventional Porto power, operation of dozers, body bay systems (flexi-force), general repair techniques. Body alignment- straightening equipment, in-floor systems, chainless anchoring systems

References:
1. Pauloski- Vehicle Body Engineering
3. J. Fairbrother – Principles and practice of Vehicle body repair, Hutchinson
4. S.P. Page- Body Engineering
5. Paul Browne- Auto care manual
8. Julian happian-smith An introduction to modern vehicle design-SAE 2004

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.606.18 VEHICLE PERFORMANCE AND TESTING

L-T- D; 3-1-0 Credits 4

MODULE-I
Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc, engine analyzers- for petrol and diesel engines, FIP calibrating and testing, exhaust gas analyzers - various types- Orsat apparatus, infrared gas analyzers, smoke meter.
Vehicle testing on chassis dynamometers: two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, wheel alignment testing, wheel balancing, brake testers, head light alignment testing.

MODULE- II
Noise vibration and Harshness: Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.

MODULE-III
Vehicle performance: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, CAFE standards.
Road and track testing: Initial inspection, PDI, Initial free services, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks.

References:
3. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009
4. SAE Transaction papers- 831814,820346,820367,820371 and 820375
5. Julian Happian-Smith – An introduction to vehicle design – SAE, 2004

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module-I
Introduction: Physical, chemical & combustion properties of IC engine fuels, structure of petroleum, petroleum refining process-thermal cracking, catalytic cracking, polymerisation, alkylation, Isomerisation, reforming & blending, products of refining process, Indian standard for gasoline, gasoline blends, non-petroleum fuels, fuel additives.
Fuels for SI engines: Requirements of an Ideal gasoline, volatility of liquid fuels, effect of volatility on engine performance-ASTM distillation curve, winter and summer gasoline, knock rating of SI engine fuels, octane number and octane number requirement, sensitivity & performance number, numerical examples- volumetric and gravimetric analysis, a/f ratio, air requirement.

Module-II
Diesel engine fuels: Requirements for diesel fuel, handling & storage-properties of diesel, smooth and efficient burning – volatility, ignition quality, cetane number, diesel index, cleanliness, diesel blends, Indian standard for diesel.
Gaseous fuels: LPG as an IC engine fuel, natural gas – CNG and LNG, advantages of gaseous fuels, biogas, producer gas, engine modifications to run on gaseous fuels, dual fuel and multi fuel application.

Module-III
Alternate fuels: Alcohols for SI engines- manufacture of methanol, manufacture of ethanol, comparison of properties of alcohols and gasoline as SI engine fuels, engine performance with pure alcohols, alcohol gasoline fuel blends-gasohol- E85
Alternate fuels for Diesel engines: Alcohols as diesel fuels, vegetable oils as diesel fuels, straight vegetable oils and biodiesels, performance properties of engines with biodiesel, Indian specification for biodiesel,

References:
1. Mathur & Sharma – IC engines, Dhanpatrai publications
2. Dr.N.K.Giri- Automobile technology, khanna publications
4. David Powell and Richard P. Brennan- The Automobile technology and society Printice Hall.
7. Energy research group- Alternate liquid fuels Willey Eastern Ltd
8. T.N Vezgirigiu- Alternative energy sources

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
ELECTIVE III

08.706.1  COMPUTER GRAPHICS

L-T-D: 3-1-0   Credits : 4

Module – I
Introduction to computer Graphics, Description of graphic devices -  Graphic standards. Colour graphic display techniques.
Graphic primitives- Circle generation algorithms – text generation. Polygons, Polygon filling

Module – II
Transformation: Simple problems on 3D transformations and applications, Viewing transformations, Windowing, Clipping, Cohen-Sutherland outcode algorithm, Sutherland-Hodgman Algorithm, Clipping of polygons.
Projections - Perspective geometry – Orthographic and Oblique projections – perspective transformations.

Module – III
Mathematical formulations on: Plane curves – Non parametric curves – space curves – Representation of space curves – cubic spline – Bezier curves , B- Spline curves, Fractals, NURBS etc..

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
Review of the fundamentals of classical thermodynamics – Multi phase and multi component systems – Free energy functions – Applications of free energy functions to phase changes – Clausius – Clayperon equations – Binary systems containing liquid and solid phases.
Thermodynamics of reactive mixtures – Bond energy, heat of formation, heat of reaction – Adiabatic flame temperature entropy changes for reacting mixtures – Chemical equilibrium – Equilibrium criteria – Evaluation of equilibrium constants and equilibrium composition – Simple numerical solutions.

MODULE II

MODULE III

REFERENCES
1. J.P.Holman, Thermodynamics.
2. Van Wylon, Thermodynamics.
3. Lay, Thermodynamics.
4. Myron Tribus, Thermostatics and Thermodynamics.
5. Kennath Wark, Thermodynamics

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
One-dimensional steady state heat conduction with uniform internal heat generation. Plane wall with heat sources, cylinder with heat sources. Transient and periodic conduction (One-dimensional). Lumped heat capacity system. Simple analytical methods. Use of Heisler charts. Principles of Convection – Viscous flow, different hydrodynamic boundary layer flow regimes and flat plates – Laminar boundary layer on a flat plate – Momentum equation of the laminar boundary layer with constant properties – Internal Momentum analysis of laminar boundary layer. Energy Equations – Significance of Prandtl Number. Flat plate heat transfer – Conduction by integral methods (Simultaneous development of hydrodynamic and thermal boundary layer only)

MODULE II

MODULE III
Boiling heat transfer, forced convection boiling curve saturated forced convective boiling in a round tube. The two phase forced convection and nucleate boiling regions. Critical heat flow in forced convective flow – Elementary concepts. The basic processes of condensation – Liquid formation, nucleation of drops at solid surfaces, droplet growth – Film condensation on a vertical flat plate - Nusselt equation for a laminar film – Improvements to the original Nusselt theory – The influence of turbulence – Condensation of horizontal tubes – Condensation within a vertical tube - Drop wise condensation. Elementary concepts of : Heat transfer in magneto fluid dynamic ( Transpiration cooling , low density heat transfer and ablation .) (Description only).

REFERENCES

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II

Module III
Recent Developments in maintenance methods-RCM- CBM –DMS – TPM etc.

REFERENCES

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Linear elastic fracture mechanics (LEFM): Elastic stress field approach - mode I elastic stress field equations - expressions for stresses and strains in the crack tip region - finite specimen width - superposition of stress intensity factors (SIF) - SIF solutions for well known problems such as centre cracked plate, single edge notched plate, and embedded elliptical cracks
Crack tip plasticity: Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behaviour

Module II
Energy balance approach: Griffith energy balance approach - relations for practical use - determination of SIF from compliance - slow stable crack growth and R-curve concept - description of crack resistance
LEFM testing: Plane strain and plane stress fracture toughness testing - determination of R-curves - effects of yield strength and specimen thickness on fracture toughness - practical use of fracture toughness and R-curve data
Elastic plastic fracture mechanics (EPFM): Development of EPFM - J-integral - crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard Jc test and COD test

Module III
Fatigue crack growth: Description of fatigue crack growth using stress intensity factor - effects of stress ratio and crack tip plasticity - crack closure - prediction of fatigue crack growth under constant amplitude and variable amplitude loading - fatigue crack growth from notches - the short crack problem
Sustained load fracture: Time-to-failure (TTF) tests - crack growth rate testing - experimental problems - method of predicting failure of a structural component - practical significance of sustained load fracture testing
Practical problems: Through cracks emanating from holes - corner cracks at holes - cracks approaching holes - fracture toughness of weldments - service failure analysis - applications in pressure vessels - pipelines and stiffened sheet structures

References:
4. Prashant Kumar, Elements of Fracture Mechanics, Wheeler Publishing
University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction to marketing - concept of market and marketing - marketing environment - controllable factors - factors directed by top management - factors directed by marketing - uncontrollable factors - demography, economic conditions, competition, social and Marketing planning - marketing planning process - Boston consultancy group model - marketing mix - marketing mix variables. Developing, testing and launching of new products.

Module II
Market segmentation and market targeting - introduction to segmentation - targeting and product positioning. Marketing research - need and scope - marketing research process - research objectives, developing research plan, collecting information, analysis, and findings - consumer behaviour - factors influencing consumer behaviour - perceived risks - product life cycle - marketing strategies for different stages of product life cycle

Module III
Marketing communication - marketing mix variables - steps in developing effective communication - identification of target audience - determination of communication objectives - designing the message - selecting the communication channels - promotion mix evaluation - advertising and sales promotion - factors in advertising - sales promotion tools. New trends in marketing- Brand management - significance of branding to consumers and firms

References:
5. Majumdar R., Marketing Research, Text, Applications and Case Studies, New Age International (P) Limited Publishers
6. Robert, Marketing Research, Prentice Hall of India

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Entrepreneurial perspectives - understanding of entrepreneurship process - entrepreneurial decision process - entrepreneurship and economic development - characteristics of entrepreneur - entrepreneurial competencies - managerial functions for enterprise

Module II

Process and strategies for starting a venture - stages of small business growth

Module III

Entrepreneurship in international environment - achievement motivation - time management - creativity and innovation structure of the enterprise - planning, implementation and growth.
Technology acquisition for small units - formalities to be completed for setting up a small scale unit - forms of organizations for small scale units - financing of project and working capital - venture capital and other equity assistance available - break even analysis and economic ratios technology transfer and business incubation

References:
5. Dr Patel V.G., Seven Business Crisis, Tata McGraw Hill

University Examination

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.706.8  INDUSTRIAL HYDRAULICS

L-T-D: 3-1-0 Credits: 4

MODULE I


MODULE II


MODULE III

Industrial hydraulic circuits – Circuit design for – shaper, grinder, material-handling equipments processes – Miscellaneous circuits.

REFERENCES
1. John Pippon and Tylor Hicks, Industrial Hydraulics.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module-II
One dimensional elasticity problems - discretisation of domain into elements - generalised coordinates approach - derivation of elements equations - assembly of element equations - transformation matrices - global equations, load vector, properties of stiffness matrices, imposition of Boundary conditions - penalty and elimination approach, multi-point constraints. Finite element formulation of plane trusses, beams and beams on elastic supports.

Module-III

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II
Processes - drawing and extrusion - process classification - lubrication - temperature effects - analysis of the processes of drawing and extrusion of wire and strip through friction less dies and dies with friction - production of seamless pipe and tubes - analysis - residual stresses in rods - wires - tubes, deep drawing
Classification of rolling processes - hot rolling - cold rolling - rolling of bars and shapes - analysis of rolling process in conditions of plane strain.
Classification of forging process - open die forging - closed die forging - analysis of forging process in conditions of plane stain - forging allowances and tolerances - sheet metal forming, shearing, blanking, bending and stretch forming

Module III
Slip line field theory - incompressible two-dimensional flow - slip lines - equilibrium equations referred to slip lines - Henkeys theorem - hodographs - simple slip line field analysis in extrusion - compression of block between parallel plates - strip load on semi-infinite body - lower and upper bound theorems with proofs and applications

References:
4. Chen W.F. & Han D.J., *Plasticity for Structural Engineers*, Springer Verlag

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I

MODULE II
Hydraulic power, Transmission systems used in machine tools and their various elements – A few common hydraulic circuits used the effect movement of tools slide and work tables. Miscellaneous – Copying devices – Automates of various kinds feasibility determination for automation – Automatics and assembly line layout – unit heads and transfer machines – Vibration isolated tool holders – Friction and lubrication in machine tools.

MODULE III

REFERENCES
2. Design principles of metal cutting machine tools – Koenisberger
4. The Design and Construction of Machine tools – M.C. Town
5. Machine tools design course – Central Machine tool Institute
6. Machine tools design Volume 1,2,3,4 – N. Acherkan

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
The need of the process-classification - Energies employed in the processes-EDM, EC, USM, LBM, PAM, AJM, WJM etc. Electrical Discharge Machining Process, operating principles-Breakdown mechanism-Dielectric fluid-Electrode material-Tool wear – Power generator circuits- Process parameters - Metal removal rate - wire out EDM - Recent Developments in EDM. Applications

Module II

Module III

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

Module II
Centrifugal fans and blowers: Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.
Centrifugal Compressors: Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Module III
Axial flow compressors: Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.
Axial and radial flow turbines: Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I

MODULE II
MODULE III


REFERENCES:
1. J.P. Holman, Experimental Methods for Engineers.
3. Donald P. Eckman, Industrial Instrumentation.

University Examination

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I

MODULE II

MODULE III

REFERENCES
4. Tee. Hinkle and Morse, Mechanical Vibrations.
8. C.Harris, Hand Book on Noise control.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Introduction: Objectives of failure investigation, Collection of background data-service history, photographic records, Selection of samples for various conditions, Preliminary examination of the failed part – visual inspection and non destructive techniques for failure investigation– Magnetic particle inspection, Liquid penetrant inspection, Eddy current inspection, ultrasonic inspection, radiography, acoustic emission inspection, experimental stress analysis, Mechanical testing, limitations of tensile testing, Selection preservation and cleaning of fracture surfaces- cleaning, sectioning, opening secondary cracks


Chemical analysis- Analysis of bulk materials, analysis of surfaces and deposits, spot tests, Applications of fracture mechanics: Fracture mechanics concepts- Linear elastic fracture mechanics, Elastic-Plastic fracture mechanics (basic concepts), plane stress and plane strain, Fatigue crack growth rate their use in failure analysis, fracture toughness testing- Plane strain fracture toughness test, COD test, Simulated service testing, Analyzing the evidences formulating conclusions and report writing, Case studies of failures: failures of shafts, failures of heat exchangers

References:
1. ASM Handbook Volume 11: Failure analysis and Prevention
2. Fracture Mechanics by Prashant Kumar Wheeler Publishing
3. Mechanical Metallurgy by Dieter, McGraw Hill

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
General classification of Cutting Tool-single point multi point cutting tools and form tools-Cutting tool nomenclature, systems-types of single point cutting tools-Left hand , right hand ,straight shank, bent shank-offset and stepped. Geometry-Cutting tool signature-Effect of cutting tool geometry in metal cutting .Mechanism of metal removal-Mechanism of chip formations-classes of chips Friction in metal cutting –Methods of reducing friction –Chip control and chip breaker-Primary deformations on shear zone-secondary deformations on rake face.

MODULE II

MODULE III

References:-
1. Sen and Bhattacharya, Principle of metal cutting.
2. Shaw M.C, Metal cutting principles.
5. Production Technology, HMT
7. Tool Manufacturing Engineers Hand Book, ASTME

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I


Module II

Ceramic and composite biomaterials: Introduction, Bio inert Bio Ceramics, Biodegradable ceramics, Bioactive ceramics, deterioration of ceramics, manufacturing techniques, Biocompatibility and Application of Composite Biomaterials.


Module III


REFERENCES

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Extensive definition of Concurrent Engineering (CE) - CE design methodologies - Organizing for CE - CE tool box collaborative product development. IT support - Solid modeling - Product data management - Collaborative product commerce.
Artificial Intelligence- Expert systems - Software hardware co-design.

Module II

Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints. Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system. JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning –

Module III


REFERENCES

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction: Basic concept of Automation, Types of Automation, Feasibility etc. Industrial Hydraulics: Introduction, basic concepts, Hydraulic fluids, Classification and properties of hydraulic fluids, Contaminates in hydraulic system, control and cleanliness standards, Fluid power generators, i.e. Gear, Vane, Piston pumps, linear and Rotary Actuators, Direction Control Valves, types, actuation methods, pressure control valves; pressure reducing valves, pressure relief valve, Unloading valve, Sequence valve, Counterbalance valve, Flow control valves simple and pressure compensated type.

Module II
Pneumatics: Introduction, Basic components, Source, storage and distribution, treatment of compressed air, linear and Rotary actuators, Direction control valves – types, actuation methods, pressure control valves, logic devices – twin pressure valve, shutter valve, time delay valve, Pneumatic circuit design and analysis, conventional as well as computer aided design. Robotics: Basic concepts, classification based on Geometry, programming, drives, work volume of robots world and joint coordinates various joints, DOF, end effectors – Types and uses, Sensors in Robots, programming – Teach pendant and Computer programming, Introduction to forward and inverse kinematics, Applications of Robots.

Module III

Reference

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.706.21 ALTERNATE ENERGY SOURCES

L-T- D; 3-1-0

Credits 4

MODULE-I

Introduction: Need for non-conventional energy sources, energy conservation in transportation sector, alternative energy, alcohol, hydrogen, biomass, and electric energy

Alcohol: Methanol and Ethanol production methods, properties of methanol and ethanol as engine fuels, use of alcohols in SI engines, performance of methanol and gasoline blends. Combustion characteristics of alcohols in S.I engines, use of alcohols in CI engines, different methods of use- Alcohol Diesel emulsions, dual fuel systems, Flex fuel Vehicles (FFV)


MODULE-II


Vegetable oil: Vegetable oil properties, Production of Bio-diesel, esterification of vegetable oil, Soya bean diesel, rapeseed oil, rice bran oil etc., diesel and vegetable oil blends, and engine performance with vegetable oil.

MODULE-III

Solar power: Collection and storage of solar energy, collection devices, flat plate collectors, concentrating type collectors, principle and working photovoltaic conversion, application to automobiles

Electric vehicles: Design considerations, limitations, batteries for electric vehicles, types & capacities, driving requirements, applicability of electric cars, comparative use of fuel and energy recharging, Hybrid vehicles - types and layouts.

References:
2. David Powell and Richard P. Brennan- The Automobile technology and society Printice Hall.
4. Tom Koppel- Powering the future, SAE
6. Bob Brant.- Build your own Electric Vehicle, SAE
7. SAE papers: 73802, 750121, 750118, 741008
8. Energy research group- Alternate liquid fuels Willey Eastern Ltd, New Delhi, 1990
9. T.N Vezipirigiu- Alternative energy sources

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module-I
Introduction: General Scenario on automotive Pollution, Pollutants-sources-formation-effects on human beings and environment, Green house gases and global warming, transient operational effects on pollution, Engine Combustion and Pollutant Formation: HC, CO, NOx, Particulate Matters, Aldehyde emissions, Effect of operating variables on emission formation.

Module-II
Control Techniques for SI and CI: Basics of diesel combustion - Smoke emission in diesel engines - NO emission from diesel engines – Particulate emission in diesel engines. Color and Aldehyde emissions from Diesel engines - Effects of operating variables on emission formation.
Design changes, optimization of operating factors, Control of Crankcase emission, Evaporative emission, Canisters, Exhaust emission - exhaust gas recirculation, air injector PCV system, thermal reactors, catalytic converters

Module-III

References:
7. Automobiles and Pollution SAE Transaction, 1995

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module-I
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.
Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).

Module-II

Module-III
Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.
Design of proto type - testing - quality standards - marketing research - introducing new products.
Creative design - Model Preparation - Testing - cost evaluation - Patent application

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
ELECTIVE IV

08.805.1 EXPERIMENTAL STRESS ANALYSIS TECHNIQUES

L-T-D: 3-1-0 Credits : 4

MODULE I


MODULE II


MODULE III


REFERENCES
1. Photo elasticity - M.M.Frocht
2. Experimental stress analysis – J.W.Dally and W.P.Railey
3. Applied stress Analysis – Durelli and Philips
5. Moire Fringes Strain Analysis – Pericles Theocaries

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
The atmosphere-characteristics of troposphere, stratosphere, thermosphere, and ionosphere-pressure, temperature and density variations in the atmosphere. Application of dimensional analysis — aerodynamic force — model study and similitude. 2D aero foils — Nomenclature and classification — pressure distribution in inviscid and real flows — momentum and circulation theory of aerofoil — characteristics. 3D or Finite aero foils — effect of releasing the wing tips — wing tip vortices — replacement of finite wing by horse shoe vertex system — the lifting line theory — wing load distribution — aspect ratio, induced drag — calculation of induced drag from momentum considerations. Skin friction and from drag — changes in finite wing plan shape.

Module II
Propellers — momentum and blade element theories — propeller coefficients and charts. Aircraft performance — straight and level flight — power required and power available graphs for propeller and jet aircraft — gliding and climbing — rate of climb — service and absolute ceilings — gliding angle and speed of flattest glide — take off and landing performance — length of runway required — aircraft ground run — circling flight — radius of tightest turn — jet and rocket assisted take off — high lift devices — range and endurance of airplanes — charts for piston and jet engine aircrafts.

Module III

References:
1. Mechanics of flight. A. C. Kermode
2. Aerodynamics for Engineering Student Houghton and brock.
3. Fundamentals of Aerodynamics Anderson

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.805.3  FACILITIES PLANNING

L-T-D: 3-1-0  Credits: 4

Module I
Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning – Design of Assembly lines, Line balancing methods, Computer applications in layout designs.

Module II
Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air etc. – Plant safety, Elements off Industrial safety- Causes and prevention of accidents – Pollution and environmental consideration.

Module III
Material handling system and equipment – Material handling in Plants, Stores and warehouses, Receiving and dispatching area – Choice of material handling equipment – Cost control in material handling. Equipment replacement – Repair, replacement depends on technical and economical consideration. Use of DCF techniques.

REFERENCE
1. Plant layout and Material Handling- John A Sehbin
2. Plant layout and Material Handling - James A Apple
3. Plant layout and Material Handling - A W Peymberton
4. FF & Control - G Aysan

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Development of operations research as a branch of knowledge since 2nd world war – Fields of application of operations. Queuing theory – Birth and death processes – Basic queuing process – Single server and multiple server models – Poison input and exponential service – Limited source, limited queue etc. Priority disciplines – Practical applications.

MODULE II

MODULE III

REFERENCE
1. Introductions to operations research – Hillier and Lieberman, Holden day.
2. Introductions to operations research – Wagner and Pranti, Philips and Ravindran
5. Operations research – Taha, Mc graw Hill.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

**Introduction to dynamical systems**: discrete time systems - continuous time systems - autonomous and non autonomous systems - phase space and flows - attracting sets - concepts of stability

**Equilibrium solutions**: fixed points and stability of continuous - time systems - classification and stability of equilibrium solutions - fixed points of maps and their stability - local and global bifurcation of continuous systems - static and dynamic bifurcations - bifurcation of maps

Module II

**Periodic solutions**: periodic solutions of continuous - time dynamical systems - autonomous and non autonomous systems - limit cycle - floquet theory - poincare’ maps - bifurcation - symmetry breaking - cyclic fold - period doubling - transcritical and Hopf bifurcations

**Quasiperiodic solutions**: Poincare’ maps - circle map - construction of quasiperiodic solutions

**Chaotic solutions of maps**: dynamics of logistic equation - bifurcation diagram of one-dimensional maps - feigenbaum number - Henon map

**Chaotic solutions of continuous systems**: Duffing’s equation - Rossler equations - period doubling and intermittency mechanisms

Module III

**Experimental methods in chaotic vibrations**: experimental system to measure the Poincare’ map of a chaotic physical system

**Fractals and dynamical systems**: Koch curve - cantor set - fractal dimension - measures of fractal dimension - capacity dimension - correlation dimension and Information dimension - fractal dimension of strange attractors

**Tools to identify and analyze motions**: time history - state-space and pseudo state space - embedding dimension and time delay - Fourier spectra, Poincare’ sections and maps - lyapunov exponents

References:

University Examination

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction - purpose of work holding devices - principles of jig and fixture design - construction methods and materials used - process planning and typical operation layout product considerations - pre-design analysis - product analysis - operation analysis - machine analysis - operator analysis and cost analysis - examples of pre-design analysis - principles of locating and positioning - definition of location - basic principles - methods of location - pin and button locators - plane, concentric, spherical, radial and V-locators - redundant locators

Module II
Design and mechanics of clamping devices - principles of clamping - standard fixture components - types of clamps - strap, swing, hinge and two-way (multiple) clamps - wedge, pinch and magnetic clamps - latch and self locking clamps - pneumatic, hydraulic and pneumo-hydraulic clamps - design considerations in work holder design and selection - design calculations of lever type clamp - hook type clamp - wedge type clamp - screw clamps - mandrels and collet - chucks - worked examples

Module III
Fixtures - milling fixtures - slot and key-way milling fixtures - fixture for milling flanges - straddle milling fixtures - indexing fixture - face milling fixture with equalizers - profile milling fixtures - universal fixture for profile milling - boring and lather fixtures - fixture design - examples of design and drawing of milling fixtures for machining of simple components - fixtures for inspection testing and assembly - welding fixtures - economics
Drill Jigs - definition - drill guide bushings - jig feet and legs - types of drill jigs - template - vise - leaf box and tumble jigs - indexing jigs - jaw chucks - drive chucks - magnetic chucking devices - mandrels - machine vices - indexing tables and worktables - examples of design and drawing of drill jig for machining of simple components

References
1. Kempster M.H.A., "An Introduction to Jig and Tool Design", ELBS
2. ASTME, Fundamentals of Tool Design
7. Cole B., "Tool Design", Taraporevala

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.805.7 MULTIPHASE FLOW

L-T-D: 3-1-0  Credits: 4

Module I
Basic equations and empirical correlations for multi-phase flow - flow patterns - identification and classification - flow pattern maps and transition - momentum and energy balance - homogeneous and separated flow models - correlations for use with homogeneous and separated flow models - two phase flow through inclined pipes and singularities - void fraction and slip ratio correlations - influence of pressure gradient - empirical treatment of two phase flow - drift flux model - correlations for bubble, slug and annular flows - pressure losses through enlargements, contractions, orifices, bends and values

Module II
Boiling and multiphase heat transfer - vapour-liquid equilibrium mechanisms - pool boiling convective boiling - heat transfer in partial and fully developed sub-cooled boiling - void fraction and pressure drop in sub-cooled boiling - saturated boiling heat transfer - two phase forced convection laminar and turbulent flow solutions for film heat transfer - empirical equations for film boiling and transition boiling - burnout mechanism and correlations - critical coefficient in nucleate and convective boiling

Module III
Condensation - basic processes of condensation - mechanism of evaporation and condensation - film condensation on a planar surface - dropwise condensation - pressure gradient in condensing systems - methods of improving heat transfer coefficient in condensation. Critical multiphase flows - mathematical models - critical flow criterion - compatibility conditions and their physical interpretation - experimental observations - propagation of small disturbances - pressure drop limitation effect - graphical representation of critical flow conditions

References:
1. Collier J.G., Convective Boiling and Condensation, McGraw Hill
2. Hsu Y.Y. & Graham R.W., Transport Processes in Boiling and Two Phase Systems, Hemisphere
4. Tong L.S., Boiling Heat Transfer and Two Phase Flow, Wiley

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE-I
Hydraulic control- Hydraulic principles- elements of hydraulic systems- pumps filters, seals, valves, accumulators etc. Study of their functional & design characteristic. Analysis and study of typical hydraulic circuits in machine tools. Design of systems for specific requirements- Introduction to servo systems- maintenance of hydraulic systems- Pneumatic and hydro pneumatic circuits.

MODULE- II

MODULE-III
Programming- manual and computer aided programming- Programming languages- APT, ADAPT, EXAPT, Economics of numerically controlled machines, adaptive control principles.

REFERENCES:
1. Industrial Hydraulics- John Pippinger
3. CAD/CAM- Mikel P Groover
4. NC Machines & CAM- Kundra. C. K, P. N. Rao, N. K. Temeri

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Methods for determining stresses - Terminology and Ligament Efficiency - Applications.
Stresses in pressure vessels: Stresses in a circular ring, cylinger - Membrane stress Analysis of Vessel Shell components - Cylindrical shells, spherical shells, torispherical heads, conical heads - Thermal stresses - Discontinuity stresses in pressure vessels.

Module II
Design of vessels: Design of tall cylindirical self supporting process columns - supports for short vertical vessels – stress concentration - at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement - pressure vessel design.

Module III
Bucking and fracture analysis in vessels: Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick walled cylinders or tubes under external pressure - effect of supports on Elastic Buckling of cylinders - Buckling under combined External pressure and axial loading - Control and significance of Fracture Mechanics in Vessels - FEM application.

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I

MODULE II
Lubrication: Role of lubrication in present day practice – Fundamentals of viscosity and viscous flow – Flow through capillary tubes – Parallel plates – Radial flow between parallel circular plates – Continuity equation and Raynold’s equation.

MODULE III
Analysis of hydrostatic oil pads – Load carrying capacity – Oil flow – Power loss – Application to thrust bearing, use of restrict hydro static squeeze films.
Analysis and application of Hydrodynamic Lubrication – Load carrying capacity, power loss and friction in ideal journal bearings – Use of linkage factors – Significance of Sommerfeld number – Eccentricity ratio – Unit load

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

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction: History, Basic concepts of value engineering, development and scope of value management, value analysis, functions and value-Basic functions, Secondary functions values-Use value, Esteem value, Cost value and Exchange value Costing Vs Value engineering, principles of costing &cost estimation, benefits.
Steps in value engineering process-preparation problem selection, information, evaluation. Creation, selection and presentation, implementation and follow up.

Module II
Selection of project, team members, general phase, information phase, Creation phase, evaluation phase, investigation and implementation phase, audit. Project work: work sheets, objectives, techniques, guidelines, Checklist, cost worth model, role of creativity.
Approaches-job plan, DARSIRI, FAST Diagram as a tool, examples on usage of these tools

Module III
Value Engineering cases: Value Engineering raises production and productivity, Value Engineering is intensive cost search, Value Engineering prevents unnecessary uses of resources. Methodology, Industrial cases - Product manufacturing, Chemical processing, Automated Production, Semi – Automated production.

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Introduction - FAQs about software engineering - professional and ethical responsibility - system modelling - system engineering process - the software process - life cycle models - iteration - specification - design and implementation - validation - evolution - automated process support - software requirements - functional and non-functional requirements - user requirements - system requirements - SRS - requirements engineering processes - feasibility studies - elicitation and analysis - validation - management - system models - context models - behaviour models - data models - object models - CASE workbenches

Software prototyping - prototyping in the software process - rapid prototyping techniques - formal specification - formal specification in the software process - interface specification - behaviour specification - architectural design - system structuring - control models - modular decomposition - domain-specific architectures - distributed systems architecture

Module II

Object-oriented design - objects and classes - an object oriented design process case study - design evolution - real-time software design - system design - real time executives - design with reuse - component-based development - application families - design patterns - user interface design - design principles - user interaction - information presentation - user support - interface evaluation. Dependability - critical systems - availability and reliability - safety - security - critical systems specifications - critical system development - verification and validation - planning - software inspection - automated static analysis - clean room software development - software testing - defect testing - integration testing - object-oriented testing - testing workbenches - critical system validation -

Module III

Software evolution - legacy systems - software change - software maintenance - architectural evolution - software re-engineering - data re-engineering

Software project management - project planning - scheduling - risk management - managing people - group working - choosing and keeping people - the people capability maturity model - software cost estimation - productivity estimation techniques - algorithmic cost modeling, project duration and staffing quality management - quality assurance and standards - quality planning - quality control - software measurement and metrics - process improvement - process and product quality - process analysis and modeling - process measurement - process CMM - configuration management - planning - change management - version and release management - system building - CASE tools for configuration management

References:
1. Ian Sommerville, Software Engineering, Pearson Education Asia
University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE –I
Introduction to Cryogenic Systems, Historical development, Low Temperature properties of Engineering Materials, Mechanical properties- Thermal properties- Electric and magnetic properties –Cryogenic fluids and their properties. Applications of Cryogenics: Applications in space, Food Processing, super Conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry. Law temperature properties of engineering materials:

MODULE –II

MODULE –III
Cryogenic Refrigeration systems: Ideal Refrigeration systems- Refrigeration using liquids and gases as refrigerant- Refrigerators using solids as working media; cryogenic fluid storage and transfer systems: Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems Pressure flow-level and temperature measurements.— Types of heat exchangers used in cryogenic systems. Cryo pumping Applications.

References:
3. Cryogenic Engineering , R. B. Scott
4. Cryogenic Engineering, J. H. Boll Jr

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.805.14 BIO MEDICAL ENGINEERING

L-T-D: 3-1-0 Credits: 4

MODULE I
Transducers, Leads & Electrodes: Transducers - transducers for biological applications - principles, different types - active and passive transducers, implantable transducers.

MODULE II
Biodynamics:- Mechanics of lower limb during standing and walking, Dynamics and analysis of human locomotion.
Introduction (Brief description only) to Diagnosis and Therapeutic equipments: Diagnosis equipments - BP monitors, ECG machine, EEG machine, EMG machine, PH meter. Therapeutic equipments - Pacemakers, Defibrillator, Heart - lung machine.

MODULE III

References

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module 1

Module II

Module III
Undesirable Airflow Reversals - High-Power Cabinet Effects of Altitude on Heat Exchanger Performance - Different Altitude and Power Conditions.


Cooling: direct cooling and indirect cooling - heat sink, forced liquid system cooling, solid state thermoelectric cooling, heat pipe, jet impingement cooling, spray cooling.

Environment stress screening techniques: damage during thermal cycling and vibration, single axis and multi-axis vibration, orientation of circuit boards within the chassis.

References:
1. Ralph Remsberg, Thermal design of electronic equipment, CRC Press LLC
2. Dave S. Steinberg Cooling Techniques for Electronic Equipment, John Wiley & Sons, Inc
4. J.P. Bardon, E.Beyna, J.B. Sauliniar, Thermal management of electronic systems
7. Frank P. Incropera and David P. Dewitt, Heat and Mass Transfer, John Wiley and sons

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4 = 40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20 = 60)
Module 1
Continuum Theory - The Continuum Concept, Continuum Mechanics
Essential Mathematics - Scalars, Vectors, and Cartesian Tensors, Tensor
Algebra in Symbolic Notation, Summation Convention, Indicial Notation,
Matrices and Determinants, Transformations of Cartesian Tensors, Principal
Values and Principal Directions of Symmetric, Second-Order Tensors, Tensor
Fields, Tensor Calculus, Integral Theorems of Gauss and Stokes

Module 2
Stress Principles - Body and Surface Forces, Mass Density, Cauchy Stress
Principle, The Stress Tensor, Force and Moment Equilibrium, Stress, Tensor
Symmetry, Stress Transformation Laws, Principal Stresses, Principal Stress
Directions, Maximum and Minimum Stress Values, Mohr's Circles for Stress,
Plane Stress, Deviator and Spherical Stress States, Octahedral Shear Stress
Kinematics of Deformation and Motion - Particles, Configurations,
Deformation, and Motion, Material and Spatial Coordinates, Lagrangian and
Eulerian Descriptions, The Displacement Field The Material Derivative,
Deformation Gradients, Finite Strain Tensors, Infinitesimal Deformation
Theory, Stretch Ratios, Rotation Tensor, Stretch Tensors, Velocity Gradient,
Rate of Deformation, Vorticity, Material Derivative of Line Elements, Areas,
Volumes

Module 3
Fundamental Laws and Equations - Balance Laws, Field Equations,
 Constitutive Equations, Material Derivatives of Line, Surface, and Volume
Integrals, Conservation of Mass, Continuity Equation, Linear Momentum
 Principle, Equations of Motion, The Piola-Kirchhoff Stress Tensors,
Lagrangian Equations of Motion, Moment of Momentum (Angular Momentum)
the Clausius-Duhem Equation, Restrictions on Elastic Materials by the
Second Law of Thermodynamics, Invariance, Restrictions on Constitutive
Equations from Invariance, Constitutive Equations. Linear Elasticity -
Elasticity, Hooke's Law, Strain Energy, Hooke's Law for Isotropic Media,
Elastic Constants, Elastic Symmetry; Hooke's Law for Anisotropic Media,
Isotropic Elastostatics and Elastodynamics, Superposition Principle, Plane
 Elasticity, Linear Thermoelasticity, Airy Stress Function, Torsion, Three-
Dimensional Elasticity

References:
5. J.H. Heinbockel, Introduction to Tensor Calculus and Continuum
Mechanics.
6. Y.C. Fung, First Course in Continuum Mechanics (1993) -

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer
questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2
questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Definition of a product - product concepts - product mix concepts - product classification
Product planning: Marketing plan - portfolio analysis - Market potential and demand forecasting.
Product market strategies - product life cycle - product lifecycle stages and corresponding strategies

Module II
New product development - The challenges of product development - Identification of customer needs - Phases in product development - Opportunity identification and selection - concept generation - concept/project evaluation - Development - Launch (Brief description only)

Module III
Understanding brands: Brands vs. products - Benefits of branding - brand attributes - significance of branding to consumers and firms - selecting brand name.
Brand awareness - types of brand awareness - Brand image - Brand identity - brand personality - brand positioning - creating core brand values - Bringing brand to life - growing and sustaining brand equity - customer based brand equity - sources of brand equity - managing brands - building branding strategies - brand extensions - branch licensing and franchising - global branding.

References:
2. Donald Lehman: Product management, Tata MacGraw Hill.
3. Keller, Kevin Lane: Strategic Brand management, Building, measuring and managing Brand equity.
5. Chunnawalla: Product Management, Himalaya publishing House

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module 1
Introduction – meaning of research- objectives of research-motivation in research- types of research-research approaches – significance of research- research methods Vs methodology – criteria for good research
Defining research problem- what is a research problem- selecting the problem- necessity of defining the problem- literature review – importance of literature review in defining a problem- critical literature review – identifying gap areas from literature review

Module II
Research design– meaning of research design-need-features of good design- important concepts relating to research design- different types – developing a research plan
Method of data collection–collection of data- observation method-interview method- questionnaire method – processing and analyzing of data- processing options- types of analysis- interpretation of results

Module III

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction and scope-Classification of nanostructures: Quantum dots, quantum wires, quantum wells, nanoclusters, nanotubes, super lattices, nanocrystalline materials-Effects of nanometer length scale – Changes to the system total energy, changes to the system structures- Effect of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.

Module II
Fabrication methods: Top down and bottom up approaches-Top down processes: Milling, Lithographics, machining process, pulsed laser methods- Bottom up processes: Vapour phase deposition methods, PVD, CVD, electrodeposition, plasma assisted deposition process, MBE, chemical methods, colloidal and solgel methods

Module III
Applications of Nanotechnology (nano materials and devices)-Applications of nanocomposites, nanocrystalline materials, nanolayered structures, nanomagnetic materials-magneto resistance- Carbon nanotubes: SW, MW, nanostructured coatings- nano sensors: order from chaos, characterization, perception, nanosensor based on quantum size effect, Electrochemical sensors, Sensors based on physical properties, Nanobiosensors, smart dust-nanomachines: covalent and non covalent approaches, Molecular motors and machines, molecular devices, single molecular devices, practical problems with molecular device- nanofluids: nanoparticles, preparation of nanofluids, thermophysical properties of nanofluids in comparison with base fluid- nanoswitches - nano computers- nanofilters

References:
1. Nano science and Technology, V.S.Muralidharan, A Subramnya, Ane books Pvt Ltd
4. Nanomaterials, A.K. Bandyopdhyay, New age international publishers
5. Nanotechnology, Jeremy Ramsden
7. Nanotechnology, Gregory Timp, Springer-Verlag,
8. Introduction to Nanotechnology, Charles P Poole, Frank J Owens, John Wiley and Sons.
9 Springer Handbook of Nanotechnology, Bharat Bhushan
University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Cooling system: Methods of cooling – coolant types.

Module II
Brakes: Mechanical, hydraulic, vacuum and air brakes – antilock braking systems.

Module III
Types of wheel: Integrated rim – flat base rim alloy wheel – wheel balancing.
Tyres: Tubeless tyres – ply ratings – radial tyres.

References:
2. Practical Automobile Engineering, Station Abby, (Asia Publishing House).
4. Automotive Emission Control, W. H. Crouse
5. Internal Combustion Engine and Air Pollution, Edward F. Obert.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Creep: Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.
Design for creep resistance: Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

Module II
Fracture: Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.
Oxidation and hot corrosion: Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

Module III
Super alloys and other materials: Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

REFERENCES:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II

Module III

REFERENCES:
3. “Occupational safety manual” – BHEL.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2
questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module-I

Module-II
Material selection, Performance characteristics of materials, Material selection process, Evaluation methods for materials, value analysis, weighted property index, cost versus performance relations, design examples, Role of processing in design, Design for Casting, Design for Machining, Design for welding, residual stresses in design, Design for assembly, Design for brittle fracture and fatigue fracture, design for corrosion resistance, designing with plastics.

Module-III
Economic decision making, cost comparison, depreciation, profitability, inflation, sensitivity and break even analysis, Cost evaluation, categories of cost, method of developing cost estimates, how to price a product, life cycle costing, cost models
Failure analysis, Causes of failures, Failure modes, Techniques for failure analysis, Nondestructive testing methods, Probabilistic approach to design, Reliability theory, Design for reliability, Communicating the design, recording of results and writing technical reports, visual aids and graphics.

REFERENCES
2. Design Engineering Harry Cather, Richard Morris, Mathew Philip, Chris Rose Elsevier Science and Technology books
4. Mechanical Engineering Design, Shigley

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
General Design of Tractors: Classification of tractors - Main components of tractor - Safety rules. Layout of wheeled tractor, , hydraulic control system, power take off, tractor stability and ride characteristics. Layout of crawler tractors, crawler details, methods of selection of equipments, selection of machines, basic rules for matching machines, selection of equipments including the nature of operating selection based on the type of soil, selection based on haul distance, selection based on weather conditions.

MODULE II

MODULE III
Control System of Tractors: Power transmission, steering system, brakes and braking system, wheels, rims and tyres and accessories of wheeled tractors, power transmission, steering clutch and braking system in crawler tractors. Agricultural Implements: Working attachment of tractors - Farm equipment - Classification - Auxiliary equipment - Trailers and body tipping mechanism.

References:
3. A. Guruvech and B. Sorekin- Tractors, MI1R Publishers Moscow, 1975
4. Geleman and M. Maskovin- Farm tractors, MIR. Publishers, Moscow, 1975

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE - I

MODULE - II
Assembly language programming construct of the language programming - assembly format of 8085 - assembly directive - multiple precision addition and subtraction - bcd to binary and binary to bcd, multiplication, division, code conversion using look up tables - stack and subroutines. Data transfer schemes interrupt structure - programmed i/o - interrupt driven i/o, dma - serial i/o.

MODULE - III
Interfacing devices types of interfacing devices - input / output ports 8212, 8255, 8251, 8279. octal latches and tristate buffers - a/d and d/a converters - switches, led's rom and ram interfacing. Applications data acquisitions - temperature control - stepper motor control - automotive applications engine control, suspension system control, driver information systems), development of a high speed, high precision learning control system for the engine control.

References:
4. SAE Transactions, 1986 Sec 3.
5. Jabez Dhinagar.S., " Microprocessor Application in Automobiles ".

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE - I
Vehicle frame and suspension study of loads - moments and stresses on frame members. computer aided design of frame for passenger and commercial vehicle - computer aided design of leaf springs - coil springs and torsion bar springs. 
Clutch torque capacity of clutch. computer aided design of clutch components, design details of roller and sprag type of clutches.

MODULE - II
Front axle and steering systems analysis of loads - moments and stresses at different sections of front axle. determination of bearing loads at kingpin bearings. wheel spindle bearings. choice of bearings. determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

MODULE - III
Gear box computer aided design of three speed and four speed gear boxes. Drive line and read axle computer aided design of propeller shaft. design details of final drive gearing. design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings.

References:

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Module- I

Module II

Module- III

References.
1. Rocket Propulsion elements- G. P. Sutton
2. Mechanics and Thermodynamics of propulsion- Hill and Peterson
3. Gas Turbines and Jet and Rocket Propulsion- Mathur and Sharma

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Brief Review of the methods of refrigeration – Air vapor compression and vapor absorption refrigeration systems. Review of the components of a vapor compression system.
Methods of Food Preservation: Microbiology of foods. Theories and methods of chilling and freezing.

Module II


Module III

Introduction to Automatic control systems – components of control systems. Control systems diagram. Heating and ventilating control. single duct variable air temperature and volume controls. Elementary ideas of the controls used in chilled water plants.

References

1. Principles of Refrigeration – Dossat
2. ASHRAE Date Book- (3 Volumes)

University Examination

Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module 1

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart. Control chart for attributes – control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

Module II

The concept of Acceptance sampling, Economics of inspections ,Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – The Operating characteristic curve– producer’s Risk and consumer’s Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans. Minimum inspection per lot, Formulation of Inspection lots and selection of samples.

Module III


References:

2. L.S.Srinath, “Reliability Engineering”, Affiliated East west press

University Examination

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Module I

Module II

Module III

References:
University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4 = 40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20 = 60)
Module I
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.

Module II
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques).

Module III
Design of prototype - testing - quality standards - marketing research - introducing new products.
Creative design - Model Preparation - Testing - cost evaluation - Patent application

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE - I
Introduction to Materials management – Importance of material management and its role in industries. The need for the integrated approach in Material management

MODULE - II
Inventory control – Basic methods in Inventory – Assumptions used in deriving models. Inventory costs and EOQ model. Price breaks and quantities – Effects of variations in lead-time and demand. Effects of shortage cost on EOQ. Systems of Inventory control, Design of Inventory control systems. Development of Computer Programme for forecasting.
Classification systems and selective Inventory control – ABC, VED, FSN, HML, and MUSIC, 3-D approaches, Coverage analysis in Material management.

MODULE -III
Introduction to JIT philosophy – Features and impact in Materials Management.
Material handling devices used in stores – Application of Computers in Material handling – Design of informatic systems for procurement and storage using computer.

REFERENCES
1. Scientific Inventory Management - Bnchan & Kbenigsberg
2. Inventory Management - Starr & Miller
4. Integrated Material management - P.Gopalakrishnan
5. Principles of Inventory management - Tershine

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Basic probability concepts - events and probability - elements of set theory - simple events and combination of events - Venn diagram - mutually exclusive events and collectively exhaustive events - De Morgan’s rule - basic axioms of probability - conditional probability - statistical independence - theorem of total probability - Bayes’ theorem - definition of a random variable - probability distribution and probability distribution and probability density of discrete and continuous random variables - main descriptors of a random variable (mean, mode, median, variance, standard deviation, coefficient of variation, skewness and kurtosis) - absolute moments and central moments - moment generating functions, characteristic functions and log characteristic functions. Useful probability distributions - normal distribution - standard normal distribution - lognormal distribution - binomial distribution - geometric distribution - negative binomial distribution - Poisson process and Poisson distribution - hypergeometric distribution - beta distribution - gamma distribution - extreme value distributions - joint and conditional probability distributions - covariance and correlation mean and variance - functions of single random variable - single function of multiple random variables - multiple functions of multiple random variables - moments of functions of random variables

Module II
Random processes - introduction - ensemble averages and correlation functions - time averages and correlation functions - weakly stationary and strongly stationary random processes - ergodic random processes - probability density and distribution functions - properties of autocorrelation functions - Fourier transforms - power spectral density functions - Wiener-Khintchine equations - properties of spectral density functions - spectral classification of random processes (narrow band, wide band, white noise) - level crossing - expected frequency and amplitude of narrow band Gaussian processes - Rayleigh distribution

Module III
Response to random excitations - introduction - impulse response and frequency response function as Fourier transform pair - response of a linear system function to stationary random excitation - response of a single degree of freedom system to random excitation - contour integration - joint probability distribution of two random variables - joint properties of stationary random processes - joint properties of ergodic random processes - cross-correlation functions for linear systems - response of multi-degree of freedom system to random excitations - response of one -dimensional continuous systems to random excitations

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4 = 40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20 = 60)
08.806.8 ADVANCED KINEMATICS OF MACHINES

L-T-D: 3-1-0  Credits: 4

MODULE I
Kinematics Pairs: Classifications of kinematics pairs – Number of points of support in a plane – Subdivision of higher pairs – Kinematics chains – Classification of Kinematics chains – Coupler curves: Definition and Equation – Roberts law – Cognate linkages – Cognate of the slider crank – Double points of a coupler curve – Coupler curve atlas.

MODULE II
The Euler – Savarg equation and its graphical representation – Determination of the Centre of Curvature of the path of a point – Euler savarg equation for points between the instantaneous centre and the inflexion point – General form of the Euler – Savarg equation – Relation between the position of a point in the movable plane and the centre of the curvature of its path – The inflection circle – Envelops and generation curves – Transformation of Euler – Savarg equation – Graphical construction – Construction of the inflexion centre if the centre of the curvature of both centrodes are known.

MODULE III
Kinematics chains of n-links: Number of lines of centres – Kinematics chains with constrained motion – Minimum number of hinges in one link in a closed chain with constrained motion – General analysis of Kinematics chains – Transformation of kinematics chain by the use of higher hinges – Replacement of turning pairs by sliding pairs – Criterion of constrained motion for Kinematic chain with higher pairs.
An Introduction to the Synthesis of mechanism: Two position of link – Three position of a link – The pole triangle and practical application.

REFERENCES
1. Kinematics of Mechanism - Rosenouver and Willis
2. Linkage Design - Jr. Hall

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction - finance and related disciplines scope of financial management - functions - objectives of financial management - an overview on Indian financial system
Financial analysis - financial statement analysis - ratio analysis

Module II
Statement of change in financial position - working capital basis only
Capital budgeting: nature - evaluation techniques - traditional technique - discounted cash flow techniques (NPV & IRR)

Module III
Working capital: nature - determinants - computation of working capital
Sources of corporate finance - capital market - stock exchanges - equity - debt - other financial instruments - foreign investments and financing sources - Euro currency market, Euro issues, GDR, ADR etc.

References:
2. Prasanna Chandra, "Financial Management", TMH
3. Shapiro A.C., "Modern Corporate Finance", Max well Macmillan

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction Computer technology - hardware - types of memory - input/output devices – software - mini/micro computers and programmable controllers - computer aided design - fundamentals of CAD - the design process - application of computers for design - manufacturing data base.
Numerical control of machine tools- basic components of NC systems - NC coordinate systems - motion control system - application of numerical control - NC part programming - punched tape - tape coding and format - manual part programming - computer assisted part programming - APT language - NC programming with interactive graphics

Module II
Manufacturing systems - development of manufacturing system - components of FMS - FMS work station - Job coding and classification - group technology - benefits of FMS - tools and tooling - machining centres - head indexers - pallets - fixtures - work handling equipments - system storage - automated guided vehicles - industrial robots - programming of robots - assembly & inspection

Module III
Flexible manufacturing system management - FMS control software - manning of FMS - tool management - controlling precision - simulation and analysis of FMS - approaches to modelling for FMS - network simulation - simulation procedure - FMS design - economics of FMS - artificial intelligence

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Introduction to CFD, Historical background, applications, advantages. Basic steps of CFD. Meshes, Structured and unstructured mesh, Classification of structured grids. Governing equations: continuity and momentum equations. Equation of transport of a scalar. Potential, Euler and Navier-Stokes equations. - Steady and unsteady flows. Typical boundary conditions such as Dirichlets and Neumann conditions. TDMA method., Numerical problem up to four unknowns using TDMA.

Module II

Module III

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
Introduction and Historical Background – Examples of notable successes and failures.

MODULE II
Trend extrapolation: Curve fitting – Envelops, constraints and scales – intensive and extensive micro variables – The inertia of trend curves.
Heuristic forecasts: Extrapolation of dependant variables and constrained variables – analogies, metaphors and structural models – Phenomenological models – Operational models and simulations.

MODULE III
Introduction to technology assessment: TA and its relevance – History of TA in Government and Industry – Steps in TA – The MITRE Methodology – Brief review of techniques which can be used in TA including cross impact analysis, systems analysis, cost benefit analysis and formal models – Case studies – (Suggested projects: To be a TA project relevant to the Kerala context)

REFERENCES
1. Technology forecasting - Rober U Ayres, Mc Graw Hill
2. Selected readings on Technology assessment – IIT Bombay and Dept. of Science and Technology, New Delhi.

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
Introduction to Information Systems - Challenges of Information Systems - Contemporary approach to Information systems - Computer based Information Systems - Types and examples of Information systems. OAS, TPS, MIS, DSS and ESS. Information technology Infrastructure- Hardware, Software, Database, People and Procedures - Data Communication network- Modems, Types of Communication Channels, Channel configurations, Channel sharing devices, Types of networks.
System concept: Organisation as a system- The strategic role of information in Organisational Management; Technical foundations of information systems

MODULE II

MODULE III
System Design, Structured system design, Input design and control, Output system design, File and data base design, System Development, System control, Documentation, Coding techniques- Detection of errors – verification and validating- System Implementation and control - testing –Software quality assurance-software metrics- Security.

REFERENCES
7. Information Systems for Modern management, Murdick and Ross

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2
questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Demand forecasting:- basic models, Long and Short-term demand forecasting methods, Regression analysis and smoothing methods, Estimation of trend, cycle, and seasonality components, Analysis of forecast error and computer control of forecasting systems, multi item forecasting, slow-moving item forecasting. Basic inventory models:- assumptions, performance measures, multi-item joint replacement model. Inventory systems under risk:- service levels, safety stock, joint determination of Q and R, time-varying demands. Aggregate inventory management:- Exchange curves, stock out situations, safety stock policies, distribution inventory systems.

Module II
Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning – Design of Assembly lines, Line balancing methods, Computer applications in layout designs. Routing problems:- algorithms, Dispatching

Module III

References:
1. Production Planning and Inventory Control – Narasimhan et al., PHI
6. Inventory Management and Production Planning and Scheduling – Silver, Pyke & Peterson – John Willey & Sons

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I
Concept of a project-classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time) project priority matrix- work break down structure.
Capital budgeting process- Planning- Analysis- Selection- Financing- Implementation- Review.
Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis.

Module II
Basic techniques in capital budgeting-non discounting and discounting methods- pay back period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk.
Social cost benefit analysis and economic rate of return. Non-financial justification of projects.

Module III
Project administration- progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off.
Introduction to various Project management softwares.

References:
4. Project Management – Gopalakrishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Peason Publication

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
08.806.16 DESIGN OF IC ENGINES

L-T-D: 3-1-0 Credits: 4

MODULE I

MODULE II
Two stroke engines-introduction-advantages and disadvantages-Scavenging- various methods of scavenging and charge induction. -Terminologies like reference mass, delivery ratio, scavenge ratio, trapping efficiency, scavenging efficiency, and charging efficiency, relative cylinder charge. Scavenging models-perfect displacement and complete mixing model-scavenging efficiency-simple problems. Supercharging, Design of Intake and Exhaust port calculations (with the help of charts) Study of transducers for IC engine application (only brief description about various types)

MODULE III
Design of IC engines-Basic decisions, Preliminary analysis, Cylinder number, size and arrangement - Detailed design procedure for piston, connecting rod, crank shaft, poppet valves, cylinder and cylinder head- Materials and manufacturing process of main components of engines. Measurement aspects related to IC engines-speed measurement, torque measurement (only dynamometers), airflow measurement, exhaust gas measurement and treatment.

References:
1. IC Engine theory and practise – C.F Taylor, Vol.1 and Vol.2
2. IC Engines - Lickty
3. IC Engines – Heywood
4. IC Engine design –Richard James
5. Scavenging of 2 stroke engines – Schweitzer
6. Fundamentals of IC Engines- V.Ganesan
7. IC Engines – Shyam K Agarwal

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module I

Module II

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

Industrial Applications: Application of robots in machining, welding, assembly, and material handling.

References
7 Industrial Robots, Yu.Kozyrev
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Module I

Module II

Module III

References:

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Module I

Module II

Module III

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Module I

Tribology: Introduction to tribology, Wear: Types of wear - adhesive, abrasive, oxidative, corrosive, erosive and fretting wear, roles of friction and lubrication and wear testing.


Module II

Hardfacing processes: SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal spray, flame spray processes - HVOF, Detonation gun and jet kote processes, hard facing consumables.


Module III


Structure, properties and applications.

High energy modification and special processes: Electron beam hardening/glazing, Laser beam hardening / glazing ion implantation, Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electro spark deposition, fused carbide cloth, thermal / chemical, Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates.

REFERENCES:


University Examination

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Module I
Introduction to Group Technology (GT), Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT. Cellular Manufacturing System (CMS) planning and design: Problems in GT/CMS.

Module II
Design of CMS - Models, traditional approaches and non-traditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks. Implementation of GT/CMS: Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.

Module III

REFERENCES

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Module I

Module II
Cooling and heating load calculation - selection of design temperatures - sources of heat load - heat transfer through structures - solar radiation - Infiltration and ventilation - Heat generation inside the conditioned space - heat storage, Diversity and stratification.
Design of air conditioning system. Continuity equation, Bernoulli’s equation, pressure losses, Duct design - pressure drop in ducts, pressure drop by graphical method - method of duct design - Arrangements of ducts, fan – design, thermal insulation

Module III
Heating systems - warm air systems - hot water systems - steam heating systems - panel and central heating systems - heat pump circuit. Applications - comfort air conditioning - effective temperature - thermal analysis of human body - Air conditioning systems - evaporate cooling - low humidity applications - Automobile and Train car air conditioning.

References:
1. C. P. Arora, *Refrigeration and Air Conditioning*.
3. W. P. Jones, *Air-conditioning Engineering*
4. Carriers Handbook system design of Air Conditioning

University Examination
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MODULE-I

MODULE-II
Shape optimization of cars - front end modification - front and rear wind shield angle - boat tailing - hatch back, fast back and square back - dust flow patterns at the rear - effects of gap configuration - effect of fasteners.
Wind tunnels for automotive aerodynamic introduction - principle of wind tunnel technology - limitation of simulation - stress with scale models - full scale wind tunnels - measurement techniques - equipment and transducers - road testing methods - numerical

MODULE-III
Vehicle handling the origin of forces and moments on a vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics under side winds - the effects of forces and moments - characteristics of forces and moments - dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

References:

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
MODULE I
Introduction: Power plants, chassis and transmission, Multiaxle vehicles. Heavy duty petrol engines and high speed diesel engines, air cooled and water cooled engines and air filters as in off highway vehicles. Performance characteristics of vehicles, resistance to digging and motion, tractive effort, power required, number of speeds and gear ratios desirable, double reduction arrangements. (Only theory with out any numerical problems)
Land Clearing Machines: Construction and working of Bush cutter, stampers, Tree dozer, Rippers.

MODULE II

MODULE III
Shovels and Ditchers: Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels. Construction & Industrial Equipments: Construction and operational aspects of mobile cranes, road rollers, elevators / Man lifters, Fork Lifters

References:
1. K. Abrosimov, A. Bromberg and F. Kaloyer- Road making machinery, MIR Publishers, Moscow
2. Herbert Nicholos- Moving the earth
3. Jagman Singh- On and with the earth

University Examination
Question Paper consists of two parts. Part A-10 compulsory short answer questions for 4 marks each, covering the entire syllabus (10 x 4=40). Part B-2 questions of 20 marks each, from each module and student has to answer one from each module (3 x 20=60)
Module-I
Introduction - heat of reaction - measurement of urp - measurement of hrp - adiabatic flame temperature: complete combustion in c/h/o/n systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature - isentropic changes of state.
Diesel engine simulation multi zone model for combustion, different heat transfer models, equilibrium calculations, simulation of engine performance, simulation for pollution estimation.

Module-II
SI engine simulation with air as working medium deviation between actual and ideal cycle - problems, SI engine simulation with adiabatic combustion, temperature drop due to fuel vaporization, full throttle operation - efficiency calculation, part-throttle operation, super charged operation.

Module-III
Progressive combustion SI engines simulation with progressive combustion with gas exchange process, heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance. SI engine simulation

References:

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