SCHEME OF INSTRUCTION
AND SYLLABUS

For

M.Tech. (Machine Design)
(Four-Semester Course)
(w.e.f. 2009-2010 admitted batch)
M.TECH (MACHINE DESIGN)

REGULATIONS

(w.e.f.2009-2010)
REGULATIONS
(W.e.f. 2009-10 admitted batch)

1.0 ADMISSIONS

1.1 Admissions into M.Tech. (Machine Design) programme of GITAM University are
governed by GITAM University admission regulations.

2.0 ELIGIBILITY CRITERIA

2.1 A pass in B E / B Tech / AMIE or equivalent in Mechanical / Production / Marine /
Metallurgy / Automobile / Aeronautical Engineering

2.2 Admissions into M.Tech will be based on the following:

(i) Score obtained in GAT (PG), if conducted.
(ii) Performance in qualifying examination / Interview.

The actual weightage to be given to the above items will be decided by the authorities
before the commencement of the academic year. Candidates with valid GATE score shall
be exempted from appearing for GAT (PG).

3.0 STRUCTURE OF THE M.TECH. PROGRAMME

3.1 The Programme of instruction consists of:

(i) A core programme imparting to the student specialization of engineering branch
concerned.
(ii) An elective programme enabling the students to take up a group of departmental
courses of interest to him/her.
(iii) Carry out a technical project approved by the Department and submit a report.

3.2 Each academic year consists of two semesters. Every branch of the M.Tech programme
has a curriculum and course content (syllabi) for the subjects recommended by the Board
of Studies concerned and approved by Academic Council.

3.3 Project Dissertation has to be submitted by each student individually.

4.0 CREDIT BASED SYSTEM

4.1 The course content of individual subjects - theory as well as practicals – is expressed in
terms of a specified number of credits. The number of credits assigned to a subject
depends on the number of contact hours (lectures & tutorials) per week.

4.2 In general, credits are assigned to the subjects based on the following contact hours per
week per semester.

One credit for each Lecture hour.
One credit for two hours of Practicals.
Two credits for three (or more) hours of Practicals.
4.3 The curriculum of M.Tech programme is designed to have a total of 70 - 85 credits for the award of M.Tech degree. A student is deemed to have successfully completed a particular semester’s programme of study when he / she earns all the credits of that semester i.e., he / she has no ‘F’ grade in any subject of that semester.

5.0 MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the College / University.

7.0 CONTINUOUS ASSESSMENT AND EXAMINATIONS

7.1 The assessment of the student’s performance in each course will be based on continuous internal evaluation and semester-end examination. The marks for each of the component of assessment are fixed as shown in the Table 2.: 

Table 2: Assessment Procedure

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Component of assessment</th>
<th>Marks allotted</th>
<th>Type of Assessment</th>
<th>Scheme of Examination</th>
</tr>
</thead>
</table>
| 1     | Theory                  | 40             | Continuous evaluation | (i) Two mid semester examinations shall be conducted for 10 marks each.  
(ii) Two quizzes shall be conducted for 5 marks each.  
(iii) 5 marks are allotted for assignments.  
(iv) 5 marks are allotted for attendance  
|       |                         |                |                     | The semester-end examination in theory subjects will be for a maximum of 60 marks. |
|       | Total                   | 60             | Semester-end examination |                |
| 2     | Practicals              | 100            | Continuous evaluation | (i) 40 marks are allotted for record work and regular performance of the student in the lab.  
(ii) One examination for a maximum of 20 marks shall be conducted by the teacher handling the lab course at the middle of the semester  
(iii) One examination for a maximum of 40 marks shall be conducted at the end of the semester (as scheduled by the Head of the Department concerned).  |

(i) 50 marks are allotted for continuous evaluation of the project work throughout the
3. Project work 100  Project evaluation  
(ii) 50 marks are allotted for the presentation of the project work & viva-voce at the end of the semester. 

4. Comprehensive Viva 100  Viva-voce 100 marks are allotted for comprehensive viva to be conducted at the end of programme. 

* Head of the Department concerned shall appoint two examiners for conduct of the examination.

8.0 REAPPEARANCE

8.1 A Student who has secured ‘F’ Grade in any theory course / Practicals of any semester shall have to reappear for the semester end examination of that course / Practicals along with his / her juniors.

8.2 A student who has secured ‘F’ Grade in Project work shall have to improve his report and reappear for viva – voce Examination of project work at the time of special examination to be conducted in the summer vacation after the last academic year.

9.0 SPECIAL EXAMINATION

9.1 A student who has completed the stipulated period of study for the degree programme concerned and still having failure grade (“F”) in not more than 5 courses ( Theory / Practicals), may be permitted to appear for the special examination, which shall be conducted in the summer vacation at the end of the last academic year.

9.2 A student having ‘F’ Grade in more than 5 courses ( Theory/practicals ) shall not be permitted to appear for the special examination.

10.0 ATTENDANCE REQUIREMENTS

10.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She has to repeat the semester along with his / her juniors.

10.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the University college / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

11.0 GRADING SYSTEM

11.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 3.
Table 3: Grades & Grade Points

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade points</th>
<th>Absolute Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>A+</td>
<td>9</td>
<td>80 – 89</td>
</tr>
<tr>
<td>A</td>
<td>8</td>
<td>70 – 79</td>
</tr>
<tr>
<td>B+</td>
<td>7</td>
<td>60 – 69</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>50 – 59</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>40 – 49</td>
</tr>
<tr>
<td>F</td>
<td>Failed, 0</td>
<td>Less than 40</td>
</tr>
</tbody>
</table>

11.2 A student who earns a minimum of 5 grade points (C grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course. However, a minimum of 24 marks is to be secured at the semester end examination of theory courses in order to pass in the theory course.

12.0 GRADE POINT AVERAGE

12.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

\[
\text{GPA} = \frac{\sum [C \times G]}{\sum C}
\]

Where
- \(C\) = number of credits for the course,
- \(G\) = grade points obtained by the student in the course.

12.2 Semester Grade Point Average (SGPA) is awarded to those candidates who pass in all the subjects of the semester.

12.3 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student’s performance in all the courses taken in all the semesters completed up to the particular point of time.

12.4 The requirement of CGPA for a student to be declared to have passed on successful completion of the M.Tech programme and for the declaration of the class is as shown in Table 4.

Table 4: CGPA required for award of Degree

<table>
<thead>
<tr>
<th>Distinction</th>
<th>(\geq 8.0^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Class</td>
<td>(\geq 7.0)</td>
</tr>
<tr>
<td>Second Class</td>
<td>(\geq 6.0)</td>
</tr>
<tr>
<td>Pass</td>
<td>(\geq 5.0)</td>
</tr>
</tbody>
</table>

* In addition to the required CGPA of 8.0, the student must have necessarily passed all the courses of every semester in first attempt.
ELIGIBILITY FOR AWARD OF THE M.TECH DEGREE

13.1 Duration of the programme:
A student is ordinarily expected to complete the M Tech. programme in four semesters of two years. However a student may complete the programme in not more than four years including study period.

13.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

13.3 Project dissertation shall be submitted on or before the last day of the course. However, it can be extended up to a period of 6 months maximum, with the written permission of the Head of the Department concerned.

13.4 A student shall be eligible for award of the M.Tech degree if he / she fulfils all the following conditions.

   a) Registered and successfully completed all the courses and projects.
   b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.
   c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and
   d) No disciplinary action is pending against him / her.

13.5 The degree shall be awarded after approval by the Academic Council.
1. With regard to the conduct of the end-semester examination in any of the practical courses of the programme, the Head of the Department concerned shall appoint one examiner from the department not connected with the conduct of regular laboratory work, in addition to the teacher who handled the laboratory work during the semester.

2. In respect of all theory examinations, the paper setting shall be done by an external paper setter having a minimum of three years of teaching experience. The panel of paper setters for each course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council. The paper setters are to be appointed by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations.

3. The theory papers of end-semester examination will be evaluated by two examiners. The examiners may be internal or external. The average of the two evaluations shall be considered for the award of grade in that course.

4. If the difference of marks awarded by the two examiners of theory course exceeds 12 marks, the paper will have to be referred to third examiner for evaluation. The average of the two nearest evaluations of the three shall be considered for the award of the grade in that course.

5. Panel of examiners of evaluation for each course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council.

6. The examiner for evaluation should possess post graduate qualification and a minimum of three years teaching experience.

7. The appointment of examiners for evaluation of theory papers will be done by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations from a panel of examiners approved by the Academic Council.

8. Project work shall be evaluated by two examiners at the semester end examination. One examiner shall be internal and the other be external. The Vice Chancellor can permit appointment of second examiner to be internal when an external examiner is not available.

9. The attendance marks (maximum 5) shall be allotted as follows:

<table>
<thead>
<tr>
<th>Percentage of Attendance</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>76% to 80%</td>
<td>1</td>
</tr>
<tr>
<td>81% to 85%</td>
<td>2</td>
</tr>
<tr>
<td>86% to 90%</td>
<td>3</td>
</tr>
<tr>
<td>91% to 95%</td>
<td>4</td>
</tr>
<tr>
<td>96% to 100%</td>
<td>5</td>
</tr>
</tbody>
</table>
M.Tech. (Machine Design)  
(Four-Semester Course)

FIRST SEMESTER  
Scheme of Instruction and Examination

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Name of the course</th>
<th>Periods per week</th>
<th>Duration of exam (hours)</th>
<th>Max. marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPRMD 101</td>
<td>THEORY OF ELASTICITY AND PLASTICITY</td>
<td>5 — 5</td>
<td>3</td>
<td>60 40 100</td>
<td>4</td>
</tr>
<tr>
<td>EPRMD 102</td>
<td>ADVANCED MECHANICS OF SOLIDS</td>
<td>5 - 5</td>
<td>3</td>
<td>60 40 100</td>
<td>4</td>
</tr>
<tr>
<td>EPRMD 103</td>
<td>MECHANICS OF MACHINERY</td>
<td>5 — 5</td>
<td>3</td>
<td>60 40 100</td>
<td>4</td>
</tr>
<tr>
<td>EPRMD 104</td>
<td>ADVANCED OPTIMIZATION TECHNIQUES</td>
<td>5 — 5</td>
<td>3</td>
<td>60 40 100</td>
<td>4</td>
</tr>
<tr>
<td>EPRMD 105</td>
<td>INTEGRATED COMPUTER AIDED DESIGN</td>
<td>5 — 5</td>
<td>3</td>
<td>60 40 100</td>
<td>4</td>
</tr>
<tr>
<td>EPRMD 121-124</td>
<td>ELECTIVE - I</td>
<td>5 — 5</td>
<td>3</td>
<td>60 40 100</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Name of the course</th>
<th>Periods per week</th>
<th>Duration of exam (hours)</th>
<th>Max. marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPRMD 111</td>
<td>CAD Lab</td>
<td>— 3</td>
<td>3</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>EPRMD 112</td>
<td>SEMINAR</td>
<td>— 3</td>
<td>3</td>
<td>—</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30 6</td>
<td>36</td>
<td>360</td>
<td>440</td>
</tr>
</tbody>
</table>
# DEPARTMENT OF MECHANICAL ENGINEERING

## Elective – I:

<table>
<thead>
<tr>
<th>Sno</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EPRMD 121</td>
<td>COMPOSITE MATERIALS</td>
</tr>
<tr>
<td>2</td>
<td>EPRMD 122</td>
<td>ROBOTICS</td>
</tr>
<tr>
<td>3</td>
<td>EPRMD 123</td>
<td>THEORY OF PLATES AND SHELLS</td>
</tr>
<tr>
<td>4</td>
<td>EPRMD 124</td>
<td>CONCURRENT ENGINEERING</td>
</tr>
<tr>
<td>Course No.</td>
<td>Name of the course</td>
<td>Periods per week</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>EPRMD 201</td>
<td>MECHANICAL VIBRATIONS</td>
<td>5 — 5</td>
</tr>
<tr>
<td>EPRMD 202</td>
<td>PRODUCT DESIGN</td>
<td>5 — 5</td>
</tr>
<tr>
<td>EPRMD 203</td>
<td>INSTRUMENTATION &amp; EXPERIMENTAL STRESS ANALYSIS</td>
<td>5 — 5</td>
</tr>
<tr>
<td>EPRMD 204</td>
<td>ADVANCED FINITE ELEMENT ANALYSIS</td>
<td>5 — 5</td>
</tr>
<tr>
<td>EPRMD 205</td>
<td>CREEP, FATIGUE AND FRACTURE MECHANICS</td>
<td>5 — 5</td>
</tr>
<tr>
<td>EPRMD 231-234</td>
<td>Elective – II</td>
<td>5 — 5</td>
</tr>
</tbody>
</table>

**Practical / Drawing**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Name of the course</th>
<th>Lec</th>
<th>Lab</th>
<th>Total</th>
<th>Exam</th>
<th>Ses</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPRMD 211</td>
<td>CAE Lab</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>EPRMD 212</td>
<td>INSTRUMENTAION &amp; STRESS ANALYSIS Lab</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Total: 30 6 36 — 360 440 800 28
<table>
<thead>
<tr>
<th>Sno</th>
<th>Course Code</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EPRMD 231</td>
<td>VEHICLE DYNAMICS</td>
</tr>
<tr>
<td>2</td>
<td>EPRMD 232</td>
<td>MECHATRONICS</td>
</tr>
<tr>
<td>3</td>
<td>EPRMD233</td>
<td>COMPUTATIONAL FLUID DYNAMICS</td>
</tr>
<tr>
<td>4</td>
<td>EPRMD 234</td>
<td>TRIBOLOGY</td>
</tr>
</tbody>
</table>
M.Tech. (Machine Design )
(Four-Semester Course)
THIRD SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Name of the Course</th>
<th>Periods per week</th>
<th>Duration of exam (hours)</th>
<th>Max. marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lec</td>
<td>Lab</td>
<td>Total</td>
<td>S</td>
</tr>
<tr>
<td>EPRMD 311</td>
<td>COMPREHENSIVE VOCE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>EPRMD 312</td>
<td>PROJECT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

FOURTH SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Name of the Course</th>
<th>Periods per week</th>
<th>Duration of exam (hours)</th>
<th>Max. marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lec</td>
<td>Lab</td>
<td>Total</td>
<td>S</td>
</tr>
<tr>
<td>EPRMD 411</td>
<td>PROJECT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

Total Credits: 80
M.Tech (Machine Design)
FIRST SEMESTER

EPRMD 101: THEORY OF ELASTICITY AND PLASTICITY

Periods per week: 4  End Examination: 60 Marks
Tutorials per week: 1  Sessionals: 40 Marks

UNIT I

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.
Problem in rectangular coordinates - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.

UNIT II

Problems in polar coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT III

Analysis of stress and strain in three dimensions - Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.
General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT IV

Plasticity: Plastic deformation of metals - Structure of metals - Deformation - Creep - Stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.

UNIT V

Bending of prismatic bars - Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.
Methods of solving practical problems - The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

References:
1. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N.
4. Theory of Plasticity by Hoffman and Sacks.
EPRMD 102: ADVANCED MECHANICS OF SOLIDS

Periods per week: 4  
Tutorials per week: 1  
End Examination: 60 Marks  
Sessionals: 40 Marks

Unit 1
**Flat plates:** Introduction - Stress resultants in a flat plate - Kinematics: Strain - Displacement relations for plates - Equilibrium equations for small displacement theory of flat plates - Stress-strain-temperature relations for isotropic elastic plates - Strain energy of a plate - Boundary conditions for plates - Solutions of rectangular and circular plate problems.

**Unit 2**
**Torsion:** Torsion of cylindrical bar of circular cross-section Saint-Venant's semi-inverse method - Linear elastic solution - The Prandtl elastic - Membrane (soap-film) analogy - Narrow rectangular cross-section - Hollow thin-wall torsion members: Multiply connected cross-section - Thin-wall torsion members with restrained ends - Fully plastic torsion.

**Unit 3**
**Beams on elastic foundation:** General theory - Infinite beam subjected to concentrated load: Boundary conditions - Infinite beam subjected to a distributed load segment - Semi-infinite beam subjected to loads of its end - Semi-infinite beam with concentrated load near its end - Short beams - Thin-wall circular cylinders.

**Unit 4**

**Unit 5**
**Contact stresses:** Introduction - The problem of determining contact stresses - Assumptions on which a solution for contact stresses is based - Notation and meaning of terms - Expressions for principal stresses - Method of computing contact stresses - Deflection of bodies in point contact - Stress for two bodies in contact over narrow rectangular area (line contact). Loads normal to area - Stresses for two bodies in line contact. Loads normal and tangent to contact area.

**References:**
UNIT I
Kinematics of complex mechanisms - Complex mechanisms, Low and high degree of complexity, Goodman's indirect acceleration analysis, Method of normal accelerations, Hall and Ault's auxiliary point method, Carter's method and comparison of methods.

UNIT II
Advanced kinematics of plane motion - The inflexion circle - Euler-Savary equation, Analytical and graphical determination of diameter of inflection circle - Bobbileier's construction, Collineation axis - Hartman's construction, Application of inflection circle to kinematic analysis - Polode curvature - General case and special case, Polode curvature in the four-bar mechanism - Coupler motion, Relative motion of the output and input links, Freudenstein's collineation axis theorem - Carter Hall circle, Circling-point curve (general case).

UNIT III
Introduction to synthesis (graphical methods) guiding a point through two, three and four distinct positions - Burmaster's curve, Function generation - Overlay's method, Path generation - Robert's theorem.

UNIT IV
Introduction to synthesis (analytical methods) - Freudenstein's equation - Precision point approximation - Precision derivative approximation - Method of components - Block synthesis and Reven's method.

UNIT V
Cam dynamics - Forces in rigid systems, Mathematical models, Response of a uniform - Motion undamped cam mechanism - Analytical method, Follower response by phase - Plane method - Position error, Jump, Crossover shock - Johnson's numerical analysis.

References:
UNIT I

UNIT II

UNIT III

UNIT IV
Stochastic Programming (S.P): Basic Concepts of Probability Theory, Stochastic linear programming

UNIT V
Unconventional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated Annealing, Neural Networks based Optimization.

References:
1. Operations Research- Principles and Practice, Ravindran, Phillips and Solberg, John Wiely
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd
EPRMD 105: INTEGRATED COMPUTER AIDED DESIGN

Periods per week: 4
Tutorials per week: 1
End Examination: 60 Marks
Sessionals: 40 Marks

UNIT I
Fundamentals of CAD: Introduction, Design process, Application of computer for design, Creating the manufacturing database, Benefits of CAD, Design work station, CAD hardware.
Geometric modeling: Geometric modeling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces, Solid modelers, Feature recognition.

UNIT II
Computer aided drafting: AutoCAD tools, 3D model building using solid primitives and boolean operations, 3D model building using extrusion, Editing tools, Multiple views: Orthogonal, Isometric.
Visual realism: Shading solids, Coloring, Color models, Using interface for shading and coloring.

UNIT III
Graphic aids: Geometric modifiers, Naming scheme, Layers, Grids, Groups, Dragging and rubber banding.
Computer animation: Conventional animation, Computer animation - Entertainment animation, Engineering animation, Animation types, Animation techniques.
Mechanical assembly: Assembly modeling, Part modeling, Mating conditions, Generation of assembling sequences, Precedence diagram, Liaison-sequence analysis.

UNIT IV
Mechanical tolerancing: Tolerance concepts, Geometric tolerancing, Types of geometric tolerances, Location tolerances, Drafting practices in dimensioning and tolerancing, Tolerance analysis.

UNIT V

References:
1. CAD/CAM Theory and Practice by Ibrahim Zeid.
EPRMD 121: COMPOSITE MATERIALS  
(Elective - I)

Periods per week: 4  
End Examination: 60 Marks
Tutorials per week: 1  
Sessionals: 40 Marks

UNIT I
Introduction: Historical background; definitions, classification of composites: fibrous composites, particulate composites, potential features of composites, idealization of composites, mechanics of composites, basic steps in FRP molding. Applications.

UNIT II
Raw materials: Resins: polyester, epoxy, phenolics, melamine and urea formaldehydes, polyimide and silicone, high temperature matrices, metal matrices.
Reinforcement: glass fibers, boron fibers, silicone carbide, carbon and graphite fibers, Kevlar, sisal and other vegetable fibers, whiskers, fillers and parting agents.

UNIT III
Fabrication methods: Hand lay-up: materials, molding, bag molding, mating molds, spray-up molding, matched - die molding, preform molding, premix and sheet molding, pre impregnation, filament winding, winding patterns and winding machines, pultrusion, centrifugal molding.

UNIT IV

UNIT V

References:
EPRMD 122: ROBOTICS
(Elective - I)

Periods per week: 4
Tutorials per week: 1
End Examination: 60 Marks
Sessionals: 40 Marks

UNIT I
Introduction, Transformations and kinematics: Historical development, A sense of mechanisms, Robotic systems, Classification of robots, Position, orientation and location of a rigid body, Mechanics of robot manipulators. Objectives, Homogeneous coordinates, Homogeneous transformations, Coordinate reference frames, Some properties of transformation matrices, Homogeneous transformations and the manipulator: The position of the manipulator in space, Moving the base of the manipulator via transformations, Moving the tool position and orientation.

UNIT II

UNIT III

UNIT IV
Jacobian analysis of serial manipulators: Differential kinematics of a rigid body, Differential kinematics of serial manipulators, Screw coordinates and screw systems, Manipulator Jacobian matrix.

UNIT V
Trajectory generation: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Geometric problems with Cartesian paths, Path generation at run time, Description of paths, Planning paths using the dynamic model, Collision-free path planning.

Robot Programming: Robot languages: AL, AML, RAIL, RPL, VAL, Demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).

References:
1. Robot Analysis - The Mechanics of Serial and Parallel Manipulators by Lung-Wen Tsai, John Wiley & Sons, Inc.
UNIT I
Bending of long rectangular plates to a cylindrical surface: Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported edges - Cylindrical bending of uniformly loaded rectangular plates with built-in edges
Pure bending of plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending - Strain energy in pure bending of plates.

UNIT II
Symmetrical bending of circular plates: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate concentrically loaded - Circular plate loaded at the center.
Small deflections of laterally loaded plates: The differential equation of the deflection surface - Boundary conditions - Alternate method of derivation of the boundary condition - Reduction of the problem of bending of a plate to that of deflection of a membrane

UNIT III
Simply supported rectangular plates: Simply supported rectangular plates under sinusoidal load - Navier solution for simply supported rectangular plates. Rectangular plates with various edge conditions: Bending of rectangular plates by moments distributed along the edges - Rectangular plates with two opposite edges simply supported and the other two edges clamped.
Continuous rectangular plates: Simply supported continuous plates - Approximate design of continuous plates with equal spans - Bending symmetrical with respect to a center.

UNIT IV
Deformation of shells without bending: Definition and notation - Shells in the form of a surface of revolution and loaded symmetrically with respect to their axis - Particular cases of shells in the form of surfaces of revolution - Shells of constant strength.

UNIT V
General theory of cylindrical shells: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels.

Reference:
1 Theory of Plates and Shells by Timoshenko, S. and Woinowsky-Krieger, S.
EPRM 124: CONCURRENT ENGINEERING  
(=Elective - I)

Periods per week: 4 
Tutorials per week: 1

End Examination: 60 Marks
Sessionals: 40 Marks

UNIT I
Introduction: Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.

UNIT II
Strategic approach and technical aspects of product design: Steps in the strategic approach to product design - Comparison to other product design methods - Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.

UNIT III
Basic issues in manufacturing system design: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.

UNIT IV
Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.

UNIT V
Assembly workstation design: Strategic issues - Technical issues analysis
Case studies: Automobile air conditioning module - Robot assembly of automobile rear axles.

Reference:
EPRMD 111: CAD LAB

Periods per week: 3
Semester End Examinations: 50 Marks
Continuous Evaluation: 50 marks

2D and 3D modelling and assembly modelling using modelling packages like AutoCAD, Auto Desk Mechanical desktop, ProEngineer, IDEAS.

EPRMD 112: SEMINAR

Periods per week: 3
Continuous Evaluation: 50 Marks
UNIT I
Introduction - Single degree freedom systems - free and forced vibrations –

UNIT II
Damping classification and damped systems - two degree freedom systems - Free, forced
damped and undamped motions - Use of influence coefficients, Matrix methods and
Lagrange's equations - Phenomenon of beat - Dynamic absorbers - Applications –

UNIT III
Transient (Shock) vibrations as applied to single and two degree freedom systems - Use
of mathematics and graphical techniques in the analysis (superposition integral, Laplace
transformations, phase plane techniques).

UNIT IV
Multi degree freedom systems - Free and forced motions in longitudinal, torsional and
lateral modes - damped and undamped, critical speeds of rotors.

UNIT V
Continuous systems - free and forced vibrations of string, bars and beams - Principle of
orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.

References:
1. Mechanical Vibrations by A.H. Church.
2. Vibration Problems in Engineering by Timoshenko and Young.
EPRMD 202: PRODUCT DESIGN

Periods per week: 4
Tutorials per week: 1
End Examination: 60 Marks
Sessionals: 40 Marks

UNIT-I:

Design philosophy: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability

UNIT-II:

Failure theories: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr’s theory, Modified Mohr’s theory, Fracture mechanics theory. Fatigue failure theories, Fatigue mechanisms, Fatigue failure models, Fatigue failure criteria, Methods to reduce fatigue, Design for fatigue, Modified Goodman Diagram, Gerber method, Soderberg line, Surface failure models. Lubrication, friction and wear.

UNIT-III:

Product Design: Product strategies, Product value, Product planning, product specifications, concept generation, concept selection, concept testing.

UNIT-IV:

Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood, Glass parts.

UNIT-V:


References:

EPRMD 203 : INSTRUMENTATION AND EXPERIMENTAL STRESS ANALYSIS

Periods per week: 4
Tutorials per week: 1
End Examination: 60 Marks
Sessionals: 40 Marks

UNIT I
Basic concepts - Calibration - Standards - Basic concepts in dynamic measurements - System response - Distortion.
Sensing devices - Bridge circuits - Amplifiers - Filter circuits - Oscilloscope - Oscillograph - Transducers - variable resistance transducers, LVDT - Capacitive and piezoelectric transducers.

UNIT II
Pressure measurement: Mechanical pressure measurement devices - Bourdon tube pressure gauge - Diaphragm and bellow gauges - Low pressure measurement - Mcland gauge - Pirani gauge - Ionization gauge.

UNIT III
Temperature measurement: Temperature measurements by mechanical effects, Electrical effects and by Radiation - Thermocouples; Force and torque measurement - Motion and vibration measurement.

UNIT IV

UNIT V
principal stresses static and dynamic instrumentation photo elasticity - Polariscope plane and circularly polarized light - Photo elastic materials - Calibration - Isochromatic fringes - Isoclines stress determination - Grid methods.

References:
1. Experimental Stress Analysis and Motion Measurement by Dove and Adams.
UNIT I

UNIT II
Element shape functions - Some general families of C continuity, curved, isoparametric elements and numerical integration. Some applications of isoparametric elements in two- and three dimensional stress analysis.

UNIT III
Bending of thin plates - A C continuity problem. Non-conforming elements, substitute shape functions, reduced integration and similar useful tricks. Lagrangian constraints in energy principles of elasticity, complete field and interface variables (Hybrid method).

UNIT IV
Shells as an assembly of elements, axisymmetric shells, semi-analytical finite element processes - Use of orthogonal functions, shells as a special case of 3-D analysis. Steady-state

UNIT V
field problems - Heat conduction, electric and magnetic potentials, field flow. The time domain, semi-discretization of field and dynamic problems and analytical solution procedures. Finite element approximation to initial value - Transient problems.

References:
1. The Finite Element Method by Zienkiewicz, O.C.
3. Concepts and Applications of Finite Element Analysis by Cook, R.D.
4. Applied Finite Element Analysis by Segerland, L.J.
EPRMD 205: CREEP, FATIGUE AND FRACTURE MECHANICS

Periods per week: 4
Tutorials per week: 1
End Examination: 60 Marks
Sessionals: 40 Marks

Unit – I
**Introduction:** Fracture behaviour of metals and alloys. The ductile/brittle transition temperatures for notched and unnotched components. Ductile rupture as a failure mechanism. Fracture at elevated temperature.


Unit – II

Unit – III
**Elastic/plastic fracture mechanics:** Elastic/plastic fracture mechanics: The crack opening displacement and $J$-integral approaches. R-curve analysis Testing procedures. Measurement of these parameters. RAD, Fail safe and safe life design approaches. Practical applications. Advanced topics in EPFM.

Unit – IV


Unit – V
**Creep:** Phenomenology, Creep curves, Creep properties. Multi-axial creep. Creep-fatigue interaction, Creep Integrals
**Text Books:**

3. Plasticity for structural Engineers by W.F Chen and D.J. Han, chapter 2 anfd Chapter 3
5. Fracture and fatigue control in structures, S.T.rolfe and J.M.Barsom, Printice Hall, Englewood cliffs, N.J.,
UNIT I


UNIT II

Mechanics of pneumatic tyres: Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.

UNIT III

Performance characteristics of road vehicle: Equation of motion and maximum tractive effort, Aerodynamic forces and moments, Vehicle power plant and transmission characteristics, Prediction of vehicle performance, Operating fuel economy, Braking performance.

UNIT IV

Handling and stability characteristics of road vehicles: Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.

UNIT V

Vehicle ride characteristics: Human response to vibration, Vehicle ride models, Introduction to random vibration - 1) Road surface profile as a random function, 2) Frequency response function, 3) Evaluation of vehicle vertical vibration in relation to ride comfort criteria, 4) Active and semi active systems, 5) Optimum design for ride comfort and road holding.

References:
EPRMD 232: MECHATRONICS  
(Elective - II) 

Periods per week: 4 
End Examination: 60 Marks 
Tutorials per week: 1 
Sessionals: 40 Marks 

UNIT I 
Mechatronics system design: Introduction to Mechatronics: What is mechatronics, 
Integrated design issues in mechatronics, Mechatronics key elements, The mechatronics 
design process, Advanced approaches in mechatronics. 

UNIT II 
Modelling and simulation of physical systems: Simulation and block diagrams, Analogies 
and impedance diagrams, Electrical systems, Mechanical translational systems, 
Mechanical rotational systems, Electromechanical coupling, Fluid systems. 

UNIT IV 
Signals, systems and controls: Introduction to signals, systems and controls, System 
representation, Linearization of nonlinear systems, Time delays. 
Real time interfacing: Introduction, Elements of a data acquisition and control system, 
Overview of the I/O process, Installation of the I/O card and software. 

UNIT V 
Advanced applications in mechatronics: Sensors for condition monitoring, Mechatronic 
control in automated manufacturing, Artificial intelligence in mechatronics, Microsensors 
in mechatronics. 

References: 
UNIT I
BASIC CONCEPTS

UNIT II
TRANSONIC RELAXATION TECHNIQUES
Small perturbation flows, Transonic small perturbation (TSP) equations, Central and backward difference schemes, Conservation equations and shock-point operator, Line relaxation techniques. Acceleration of convergence rate, Jameson's difference scheme, Stretching of coordinates, Shock fitting techniques, Flow in body fitted coordinate system.

UNIT III
PANEL METHODS
Elements of two and three dimensional panels, Panel singularities. Application of panel method to incompressible, compressible, subsonic and supersonic flows.

UNIT IV
TIME DEPENDENT METHODS
Stability of solution, Explicit methods, Time split method, approximate factorization scheme, Unsteady transonic flow around airfoils, Some time dependent solutions of gas dynamic problems

UNIT V
CONTROL VOLUME METHOD
Basic concepts - Staggered grid application - SIMPLE & SIMPLER algorithms - Application of the methods to practical flow problems.

References:
UNIT I
Historical background - Viscosity - Viscometry - Effect of temperature on viscosity - Effect of pressure in viscosity - Other physical properties of mineral oils - The generalized Reynolds equation - Flow and shear stress - The energy equation - The equation of state - Mechanism of pressure development.

UNIT II

UNIT III
Elastohydrodynamic lubrication: Theoretical consideration - Grubin type solution - Accurate solution - Point contact - Dimensionless parameters - Film thickness equations - Different regimes in EHL contact - Deep-groove radial bearings - Angular contact bearings - Thrust ball bearings - Geometry - Kinematics - Stress and deformations - Load capacity.

UNIT IV
Surface topography - Surface characterization - Apparent and real area of contact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings

UNIT V

Reference:
Introduction to Tribology of Bearings by Maju EPRMDar, B.C.
EPRMD 211: COMPUTER AIDED ENGINEERING LAB

Periods per week: 3
End Examination: 50 Marks
Continuous Evaluation: 50 Marks

Linear and non-linear static and dynamic analysis using any FEA package
Like ANSYS / CAEFEM / NASTRAN etc.
EPRMD 212: INSTRUMENTATION AND EXPERIMENTAL STRESS ANALYSIS LAB

Periods/week: 3.

Semester End Examinations: 50 Marks

Continuous Evaluation: 50 marks

List of Experiments:
1. Measurement of strain by using strain gauges.
2. Calibration of Rotameter.
3. Calibration of Thermocouples.
4. Experiment with constant voltage/current Hot-wire Anemometer.
5. Experiments with piezo-electric pick-up, Inductive pick-ups. Determination of characteristics - Displacement, Velocity and Acceleration.
6. Experimental determination of undamped and damped frequencies of spring-mass system.
7. Ultrasonic flaw detector.
8. Experiment on photoelastic bench (Plain polariscope, Circular polariscope).
10. Photo elastic analysis of Ring under diametric compression.
EPRMD 311: COMPREHENSIVE VIVA-VOCE

Instruction: Whole semester
End Semester Viva-voce - Examination: 100 Marks

EPRMD 312: PROJECT

Instruction: Whole semester
Continuous Evaluation: 50 Marks
End Semester Viva-voce - Examination: 50 Marks

M.Tech (Machine Design)
FOURTH SEMESTER
EPRMD 411: PROJECT

Each student is required to submit a detailed Thesis report about the work on topic of Thesis as per the guidelines decided by the department. The Thesis work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time.

The candidate has to present/publish one paper in national/international conference/seminar/journal of repute is must before submission. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.