MECHANICAL ENGINEERING

M.TECH (PRODUCT DESIGN AND MANUFACTURING)

(CBCS)

REGULATIONS, CURRICULUM AND SYLLABUS

(With effect from the Academic Year 2011 – 12)

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014.
1.0 ELIGIBILITY

Candidates for admission to the first semester of the four semesters M.Tech. Course in Mechanical Engineering with specialization in Product design and Manufacturing should have passed B.E/B.Tech in Mechanical / Production / Manufacturing / Automobile / Mechatronics / Aeronautical/ Metallurgy and Plastic Engineering or an examination of any University or Authority accepted by the Pondicherry University as equivalent thereto, with at least 55% marks in the degree examination or equivalent CGPA.

Note:
1. Candidates belonging to SC/ST who have a mere pass in the qualifying examination are eligible.
2. There is no age limit for M.Tech. programme.

2.0 ADMISSION

The admission policy of the M.Tech. programme shall be decided by the respective institute offering M.Tech. Programme subject to conforming to the relevant regulations of the Pondicherry University.

3.0 STRUCTURE OF M.Tech. PROGRAMME

3.1 General

3.1.1. The M.Tech. Programme is of semester pattern with 16 weeks of instruction in a semester.

3.1.2 The programme of specialisation will consist of:

(i) Core courses (Compulsory)
(ii) Electives
(iii) Laboratory
(iv) Directed Study
(v) Project work

3.1.3 The M.Tech. Programme is of 4 semester duration.

3.1.4. Credits will be assigned to the courses based on the following general pattern:

(i) One credit for each lecture period
(ii) One credit for each tutorial period
(iii) Two credits for practical course
(iv) Twenty three credits for Project work divided into 9 credits for Phase-I and 14 credits for Phase-II
(v) Three credits for directed study

One teaching period shall be of 60 minutes duration including 10 minutes for discussion and movement.
3.1.5 Regulations, curriculum and syllabus of the M.Tech. programme shall have the approval of Board of Studies and other Boards/ Committees/ Councils, prescribed by the Pondicherry University. The curriculum should be so drawn up that the minimum number of credits and other requirements for the successful completion of the programme will be as given in Table – 1.

Table 1: Minimum credits and other requirements

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Requirements M.Tech (Full-Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of semesters</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Min. number of credits of the programme</td>
<td>72</td>
</tr>
<tr>
<td>3</td>
<td>Max. number of credits of the programme</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Min. Cumulative Grade Point Average for pass</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Min. successful credits needed for registering in the next semester</td>
<td>Sem. I: 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sem. II: 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sem. III: 40</td>
</tr>
<tr>
<td>6</td>
<td>Min. period of completion of programme (consecutive semesters)</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Max. period of completion of programme (consecutive semesters)</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Number of core and Elective courses</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>Laboratory/ Seminar</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Directed study</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Project work (semesters)</td>
<td>2</td>
</tr>
</tbody>
</table>

3.1.6 A core course is a course that a student admitted to the M.Tech. programme must successfully complete to receive the degree. A student shall register for all the core courses listed in the curriculum. Core courses in a particular specialisation are offered by the department concerned.

3.1.7 Elective courses are required to be chosen from the courses offered by the department(s) in that particular semester from among the approved courses. A core course of one M.Tech. programme / department may be chosen as an elective by a student from other M.Tech. programme / department.

3.1.8 Each student is required to make a seminar presentation on any chosen topic connected with the field of specialization. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review and develop confidence to present the material by the student. The seminar shall be evaluated by a department committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester.
3.1.9  Project work is envisaged to train a student to analyze independently any problem posed to him/her. The work may be analytical, experimental, design or a combination of both. The student can undertake the project work in the department concerned or in an industry/research laboratory approved by the Chairperson/Vice-Chairperson. The project report is expected to exhibit clarity of thought and expression. The evaluation of project work will be a continuous internal assessment based on two reviews, an internal viva-voce and an external viva-voce examination.

3.1.10 Directed study is a theory course required to be credited by each student under the close supervision of a faculty member of the department. The title of the course and syllabus are to be formulated by the designated faculty member and approved by the vice-chairperson, taking into account the broad area in which the student proposes to pursue his/her project work.

3.1.11 A student who has acquired the minimum number of total credits for the award of Degree will not be permitted to register for more courses for the purpose of improving his/her cumulative grade point average (see Table 1).

3.1.12 The medium of instruction, examination, seminar, directed study and project work will be in English.

3.2 Grading

3.2.1 Based on the performance of each student in a semester, letter grades will be awarded to each course at the end of the semester. The letter grades, the corresponding grade point and the description will be as shown in Table – 2.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>POINTS</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>VERY GOOD</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>GOOD</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>ABOVE AVERAGE</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>AVERAGE</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>SATISFACTORY</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>FAILURE</td>
</tr>
<tr>
<td>FA</td>
<td>-</td>
<td>FAILURE DUE TO LACK OF ATTENDANCE/ FAILURE BY ABSENCE</td>
</tr>
</tbody>
</table>

3.2.2 A student is deemed to have completed a course successfully and earned the appropriate credit if and only if, he/she receives a grade of E and above. The student should obtain 40% of marks in end-semester examination in a subject to earn a successful grade. A subject successfully completed cannot be repeated at any time.

3.2.3 The letter grades do not correspond to any fixed absolute mark. Each student is awarded a grade depending on his/her performance in relation to the performance of other students taking or have taken the course. For example, S does not mean he/she has secured 100% or 95%, but, rather that he/she is in the top 5% of all the students who have taken / are taking the course, in the judgement of the teachers. Grades shall be awarded based on the absolute marks in a meeting of the M.Tech Programme Committee to be held not later than 10 days after the last day of semester examination. Normally,
not more than 5% of the students in any written/ laboratory course shall be awarded the grade S and not more than one–third awarded A grade. Average marks in the class shall normally be C grade excepting in the case of practical /project where it may be B grade.

4.0 REGISTRATION

4.1 Each student, on admission, shall be assigned a Faculty Advisor, who shall advise the student about the academic programme and counsel him/her on the choice of courses depending on his/her academic background and objective.

4.2 With the advice and consent of the Faculty Advisor, the student shall register for courses he/she plans to take for the semester before the commencement of classes. No student shall be permitted to register for courses exceeding 30 contact hours per week nor shall any student be permitted to register for any course without satisfactorily completing the prerequisites for the course, except with the permission of the teacher concerned in the prescribed format.

4.3 If the student feels that he/she has registered for more courses than he/she can handle, he/she shall have the option of dropping one or more of the courses he/she has registered for, with the consent of his/her Faculty Advisor, before the end of 3rd week of the semester. However, a student to retain his/her status should register for a minimum of 10 credits per semester.

4.4 Students, other than newly admitted, shall register for the courses of their choice in the preceding semester by filling in the prescribed forms.

4.5 The college shall prescribe the maximum number of students in each course taking into account the physical facilities available.

4.6 The college shall make available to all students a bulletin, listing all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the faculty offering the course, the time and place of the classes for the course.

4.7 In any department, preference shall be given to those students for whom the course is a core-course, if, the demand for registration is beyond the maximum permitted number of students.

4.8 Normally, no course shall be offered unless a minimum of 3 students are registered.

5.0 EVALUATION

5.1 Evaluation of theory courses shall be based on 40% continuous internal assessment and 60% end-semester examination. Evaluation of laboratory course shall be based on 50% internal assessment and 50% end-semester examination. In each course, there shall be a 3 hour end-semester examination.

5.2 The total marks for the project work will be 300 marks for phase-I and 400 marks for phase-II. The allotment of marks for external valuation and internal valuation shall be as detailed below:
Project work – (Phase – I): 300 Marks

<table>
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<th>Internal valuation</th>
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<tr>
<td>Guide</td>
<td>50 marks</td>
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<tr>
<td>First Evaluation</td>
<td>50 marks</td>
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<tr>
<td>Second Evaluation</td>
<td>50 marks</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>150 marks</strong></td>
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<table>
<thead>
<tr>
<th>External valuation</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Evaluation (External Examiner Only)</td>
<td>50 marks</td>
</tr>
<tr>
<td>Viva voce (50 for Ext. + 50 for Int.)</td>
<td>100 marks</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>150 marks</strong></td>
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Project work – (Phase – II): 400 Marks

<table>
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<tbody>
<tr>
<td>Guide</td>
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<tr>
<td>First Evaluation</td>
<td>50 marks</td>
</tr>
<tr>
<td>Second Evaluation</td>
<td>50 marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200 marks</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External valuation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation (External Examiner Only)</td>
<td>50 marks</td>
</tr>
<tr>
<td>Viva voce (75 for Ext. + 75 for Int.)</td>
<td>150 marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200 marks</strong></td>
</tr>
</tbody>
</table>

Internal valuation should be done by a committee comprising of not less than 3 faculty members appointed by the Vice-Chairperson.

5.3 The directed study shall be evaluated internally and continuously as detailed below:

- Test I: 15 Marks
- Test II: 15 Marks
- Assignment: 10 Marks
- Final test covering the whole syllabus: 60 Marks
- Total: 100 Marks

5.4 The end-semester examination as per the prescribed pattern shall be conducted by the department for all the courses offered by the department. Each teacher shall, in the 4th week of the semester, submit to the Vice-Chairperson, a model question paper for the end-semester examination as per the prescribed pattern. The end-semester paper shall cover the entire course.

5.5 The department shall invite 2 or 3 external experts for evaluating the end-semester examinations and grading. Each expert will be asked to set the question paper(s) for the course(s) he/she is competent to examine for the end-semester examination based on the model question paper submitted by the teacher concerned. The teacher and the expert concerned shall evaluate the answer scripts together and award the marks to the student. If, for any reason, no external expert is available for any paper, then, the teacher concerned shall set the question paper(s) for the end-semester examination, and the teacher himself/herself shall evaluate the papers and award the marks.

5.6 In the department, after the evaluation of the end-semester examination papers, all the teachers who handled the courses and the external experts together shall meet with
the M.Tech. Programme Committee (see 7.0) and decide the cut-offs for grades in each of the courses and award the final grades to the students.

5.7 Continuous internal assessment mark of 40 for a theory course shall be based on two tests (15 marks each) and one assignment (10 marks). A laboratory course carries an internal assessment mark of 50 distributed as follows: (i) Regular laboratory exercises and records – 20 marks (ii) Internal laboratory test – 20 marks and (iii) Internal viva-voce – 10 marks.

5.8 Every student shall have the right to scrutinize his/her answer scripts; assignments etc. and seek clarifications from the teacher regarding his/her evaluation of the scripts immediately after or within 3 days of receiving the evaluated scripts.

5.9 The department shall send all records of evaluation, including internal assessment for safe-keeping, to the college administration, as soon as all the formalities are completed.

5.10 At the end of the semester, each student shall be assigned a grade based on his/her performance in each subject, in relation to the performance of other students.

5.11 A student securing F grade in a core course must repeat that course in order to obtain the Degree. A student securing F grade in an elective course may be permitted to choose another elective against the failed elective course, as the case may be, in consultation with the Faculty Adviser.

5.12 A student shall not be permitted to repeat any course(s) only for the purpose of improving the grade in a particular course or the cumulative grade point average (CGPA).

5.13 In exceptional cases, with the approval of the Chairperson, PG Programme committee, make–up examination(s) can be conducted to a student who misses end-semester examination(s) due to extreme medical emergency, certified by the college Medical Officer, or due to time-table clash in the end-semester examination between two courses he/she has registered for, in that semester.

5.14 All eligible students shall appear for end-semester examinations.

5.15 No student who has less than 75% attendance in any course will be permitted to attend the end-semester examinations. However, a student who has put in 60-75% attendance in any course and has absented on medical grounds will have to pay a condonation fee of Rs.200/- for each course and produce a medical certificate from a Government Medical Officer not below the rank of R.M.O. or officer of equal grade to become eligible to appear for the examinations. A student with less than 60% attendance shall be given the grade of FA. He/She shall have to repeat that course if it is a core course, when it is offered the next time.

6.0 SUMMER TERM COURSE

6.1 A summer term course (STC) may be offered by the department concerned on the recommendations of M.Tech. Programme Committee. A summer term course is open only to those students who had registered for the course earlier and failed. No student should register for more than two courses during a summer term. Those students who could not appear for examination due to lack of attendance will not be allowed to register for the same course offered in summer, unless, certified by the Vice-Chairperson
concerned and the Principal.

6.2 Summer term course will be announced at the end of even semester. A student has to register within the stipulated time by paying the prescribed fees.

6.3 The number of contact hours per week for any summer term course will be twice that of a regular semester course. The assessment procedure in a summer term course will be similar to the procedure for a regular semester course.

6.4 Withdrawal from a summer term course is not permitted.

7.0 M.Tech. PROGRAMME COMMITTEE

7.1 Every M.Tech. Programme shall be monitored by a committee constituted for this purpose by the college. Each committee shall consist of all teachers offering the courses for the programme and two student members or 10% of students enrolled whichever is less. The HOD or a senior faculty in the rank of a Professor shall be the Vice-Chairperson, nominated by the Head of the Institution. There shall be a common Chairperson in the Rank of Professor nominated by the Head of the Institution for all the P.G. programmes offered by the institute. There can be a common co-coordinator in the rank of Professor nominated by the Head of the Institution.

7.2 It shall be the duty and responsibility of the committee to review periodically the progress of the courses in the programme, discuss the problems concerning the curriculum and syllabi and conduct of classes. The committee may frame relevant rules for the conduct of evaluation.

7.3 The committee shall have the right to make suggestions to individual teachers on the assessment procedure to be followed for his/her course. It shall be open to the committee to bring to the notice of the Head of the Institution any difficulty encountered in the conduct of the classes or any other pertinent matter.

7.4 The committee shall meet at least twice a semester – first at the beginning of the semester, and second at the end of the semester. In the second meeting, the committee excluding student members but with the external experts invited by the Chairperson PG Programme Committee, shall finalize the grades of the students.

8.0 MINIMUM REQUIREMENTS

8.1 To be eligible towards continuing the Programme, a student must have earned a certain number of successful credits at the end of each semester as given in Table – 1. If he/she fails to satisfy this criterion in any semester, he/she shall be placed on scholastic probation in the succeeding semester. If he/she fails to earn the number of credits by the end of that year (including courses taken in summer), then, he/she shall be asked to discontinue the Programme.

8.2 Students are expected to abide by all the rules of the college and maintain a decorous conduct. Any deviation will be referred to the Head of the Institution for suitable action.

8.3 No student who has any outstanding dues to the college, hostel, library or laboratory or against whom any disciplinary action is contemplated/ pending, will be eligible to receive his/her degree.
9.0 DECLARATION OF RESULTS, RANK AND ISSUE OF GRADE CARD

9.1 The PG Programme (CBCS) office shall display the grades as soon as possible after the finalization of the grades. The student shall have the right, for a look at the evaluated examination scripts and represent to the M.Tech. Programme Committee for review if he/she feels aggrieved by the evaluation within a week from the commencement of succeeding semester classes.

9.2 The College shall issue at the beginning of each semester a grade card to the student, containing the grades obtained by the student in the previous semester(s) and his/her Grade Point Average (GPA) and his/her Cumulative Grade Point Average (CGPA).

9.3 The grade card shall list:
   a) title of the course(s) taken by the student.
   b) credits associated with each course.
   c) grade secured by the student.
   d) total credits earned by the student in that semester.
   e) GPA of the student.
   f) total credits earned by the student till that semester and
   g) CGPA of the student.

9.4 The GPA shall be calculated as the weighted average of the Grade Points weighted by the credit of the course as follows:

   The product of the credit assigned to each course and the grade point associated with the grade obtained in the course is totaled over all the courses and the total is divided by the sum of credits of all the courses and rounded off to two decimal places.

   For example, a student securing grade A in a 4 credit course, grade B in a 2 credit course, grade S in a 3 credit course and grade F in a 3 credit course, will have a GPA as:
   
   \[
   \frac{9 \times 4 + 8 \times 2 + 10 \times 3 + 0 \times 3}{4+2+3+3} = \frac{82}{12} = 6.83/10.0
   \]

   The sum will cover all the courses the student has taken in that semester, including those in which he/she has secured grade F. Grades F A are to be excluded for calculating GPA and CGPA.

9.5 For computing CGPA, the procedure described in 9.4 is followed, except, that the sum is taken over all the courses the student has studied in all the semesters till then. If a student has repeated any course, the grade secured by him/her in the successful attempt only will be taken into account for calculating CGPA.

9.6 To convert CGPA into percentage marks, the following formula shall be used:

   \[
   \% \text{ Mark} = (\text{CGPA} - 0.5) \times 10
   \]

9.7 A candidate who satisfies the course requirements for all semesters and passes all the examinations prescribed for all the four semesters within a maximum period of 10 semesters reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

9.8 A candidate who qualifies for the award of the degree shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION** upon fulfilling the following requirements:
(i) Should have passed all the subjects pertaining to semesters 1 to 4 in his/her first appearance in 4 consecutive semesters starting from first semester to which the candidate was admitted.

(ii) Should not have been prevented from writing examinations due to lack of attendance

(iii) Should have secured a CGPA of 8.50 and above for the semesters 1 to 4.

9.9 A candidate who qualifies for the award of the degree by passing all the subjects relating to semesters 1 to 4 within a maximum period of 6 consecutive semesters after his/her commencement of study in the first semester and in addition secures CGPA not less than 6.5 shall be declared to have passed the examination in FIRST CLASS.

9.10 All other candidates who qualify for the award of degree shall be declared to have passed the examination in SECOND CLASS.

9.11 A student with CGPA less than 5.0 is not eligible for the award of degree.

9.12 For the award of University rank and gold medal, the CGPA secured from 1st to 4th semester should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 4th semester in the first appearance and he/she should not have been prevented from writing the examination due to lack of attendance and should not have withdrawn from writing the end-semester examinations.

10.0 PROVISION FOR WITHDRAWAL

A candidate may, for valid reasons, and on the recommendation of the vice-chairperson and chairperson be granted permission by the Head of the Institution to withdraw from writing the entire semester examination as one unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire programme. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank/ gold medal.

11.0 TEMPORARY DISCONTINUATION FROM THE PROGRAMME

If a candidate wishes to temporarily discontinue the programme for valid reasons, he/she shall apply to the Chairperson, PG Programme committee, through the Head of the department in advance and secure a written permission to that effect. A candidate after temporary discontinuance may rejoin the programme only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees. The total period of completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed 8 consecutive semesters including the period of discontinuance.

12.0 POWER TO MODIFY

12.1 Notwithstanding anything contained in the foregoing, the Pondicherry University shall have the power to issue directions/orders to remove any difficulty.

12.2 Nothing in the foregoing may be construed as limiting the power of the Pondicherry University to amend, modify or repeal any or all of the above.

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### M.TECH (PRODUCT DESIGN AND MANUFACTURING)

**CURRICULUM AND SCHEME OF EXAMINATION**

(Total number of credits required for the completion of the programme: 72)

#### SEMESTER – I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
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<tr>
<td>1.</td>
<td>ME 911</td>
<td>Computational Methods</td>
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<td>2.</td>
<td>ME 912</td>
<td>Computer Aided Design</td>
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<td>ME 913</td>
<td>Product Design</td>
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<td>7.</td>
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<td>CAD Laboratory</td>
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#### SEMESTER – II

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<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
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<td></td>
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<td>L</td>
<td>T</td>
<td>P</td>
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<td>Computer Aided Manufacturing</td>
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<td>ME 915</td>
<td>Advanced Materials and Processing</td>
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<td>Design for Manufacture and Assembly</td>
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<td>Directed Study</td>
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**SEMESTER – IV**

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<td>Advanced Finite Element Analysis</td>
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<td>Advanced Mechanism Design</td>
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<td>Advances in Casting and Welding</td>
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<td>Simulation and its Applications in Manufacturing</td>
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<td>Surface Engineering in Tribology</td>
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<td>28</td>
<td>ME 968</td>
<td>Total Quality Management</td>
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Unit - I


Unit - II


Unit - III

Curve fitting – Method of least squares, fitting straight line, parabola and exponential, polynomial of degree N, applications. Statistical methods - Statistical Inference- sampling distribution of statistics, standard error, point and internal estimation for population, mean, variance and least square estimate.

Unit - IV

Test of Hypothesis, Inference concerning means, variances and proportions for small and large samples, t, F, chi square tests, goodness of fitness, and test of independence.

Unit - V

Design of experiment – Analysis of variance, one way and two way classification, latin square design, factorial design, test of significance of main and interaction effects.

REFERENCE BOOKS:

ME 912 COMPUTER AIDED DESIGN

Unit - I


Unit - II


Unit - III

Graphics standard & Data storage - Standards for computer graphics GKS, Data exchange standards – IGES, STEP - Manipulation of the model - Model storage - Data structures - Data base considerations - Object oriented representations - Organizing data for CIM applications - Design information system.

Unit - IV


Unit – V


REFERENCE BOOKS:

3. Radhakrishnan, P. - CAD/CAM/CIM, New Age International (P) Ltd.,
ME 913 PRODUCT DESIGN

Unit - I

Definition - Design by Evolution and by Innovation - factors to be considered for product design - Production-Consumption cycle - The morphology of design - Primary design Phases and flow charting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly.

Product strategies, Market research - identifying customer needs - Analysis of product - locating ideas for new products, Selecting the right product, creative thinking, curiosity, imagination and brainstorming - product specification.

Unit - II

Task - Structured approaches - clarification - search - external and internal -systematic exploration - concept selection – methodology and benefits.


Unit - III

Modeling and simulation - the role of models in product design, mathematical modeling similitude relations - weighted property index.


Unit - IV


Unit - V


REFERENCE BOOKS:

Unit - I


Unit - II


Unit – III


Unit - IV

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples, Introduction to 3 - D RP techniques: Fusion Deposition Modeling, Laminated Object Manufacturing and Stereolithography.

Unit - V

Flexible manufacturing cells, systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects

REFERENCE BOOKS:

ME 915 ADVANCED MATERIALS AND PROCESSING

Unit – I

Introduction: Conventional materials, limitation, need for composites, classification and characteristics of composites, reinforcements, Polymer, ceramics and metal matrix composites – manufacturing of metal matrix composites, solid and liquid state processing-testing of composites- applications

Unit – II

Introduction to powder metallurgy (P/M) Processes – Design considerations for P/M tooling – Types of compaction – Sintering at different atmospheres – Liquid Phase sintering – Secondary processes – P/M applications specifically to cutting tool, bearing and friction materials – Nano materials and their applications.

Unit – III


Unit – IV


Unit – V

Surface Structure and properties – Surface coatings, Hard facing, Thermal spraying, Vapor deposition, Ion implantation, Hot dipping – Coating of Cutting and forming tools.

REFERENCE BOOKS:

ME 916 DESIGN FOR MANUFACTURE AND ASSEMBLY

Unit - I
General design principles, Effect of material properties on design, Effect of manufacturing process on design, mechanisms selection, evaluation method, Process capability

Unit - II
Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

Unit - III

Unit - IV
Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores.

Unit - V

REFERENCE BOOKS:

1. Boothroyd - Design for Manufacture
2. Robert Matousek - Engineering Design - A systematic approach, Blackie & Sons Ltd. 1963.
6. - Casting Design Hand Book.
I. PROGRAMMING

Computer aided design of machine elements - Development of programs using FORTRAN/C language for design, drawing & plotting of Machine Elements and Interfacing with packages like AutoCAD

1. Shaft
2. Couplings

Output of the program should create Auto CAD Script file. Run the Script file to show Design Drawing in the computer screen.

II. DRAFTING

Using Auto CAD Software draw

1. Orthographic views of the given 3D blocks
2. 3D blocks for the given orthographic views.

III. MODELLING

Using any modeling Softwares like ProE/CATIA/IDEAS generate

1. Solid modelling of given 3D blocks

IV. FE ANALYSIS

Using any FEA software packages like ANSYS / NISA etc solve for

1. Plane Stress Analysis on tooth profile.
2. 2D Asymmetric analysis to determine Hoop and longitudinal stress on thick cylinder

V. SIMULATION USING MATLAB

1. Effect of damping on a single degree damped vibrating system.
2. Transient heat transfer problem
List of Exercises

1. CNC part programming for simple turning operation
2. CNC part programming for box turning operation
3. CNC part programming for facing operation
4. CNC part programming for box facing operation
5. CNC part programming for step turning operation
6. CNC part programming for taper turning operation
7. CNC part programming for thread cutting operation
8. CNC part programming for end milling operation
9. CNC part programming for profile cutting in milling
10. CNC part programming for machining holes in milling
11. Generating G & M codes for the model created using solid edge package
12. Tool and die design for a plastic component
13. Pattern design for a casting component
14. Simple robot part programming for material handling
15. FMS programming for a simple layout
ME 941  ADVANCED FINITE ELEMENT ANALYSIS

Unit – I

3D problems in stress Analysis – Introduction, Finite element formulation for Tetrahedral elements, stress calculations-Application and Examples

Unit – II

Bending of plates and shells -Review of Elasticity Equations-Bending of Plates and Shells-Finite Element Formulation of Plate and Shell Elements-Conforming and Non Conforming Elements - Co and C1 Continuity Elements - Application and Examples

Unit – III

Dynamic analysis - Equation of motions - Mass matrices- lumped and consistent mass matrices - Free vibration analysis - Natural frequencies of Longitudinal –Introduction to Eigen buckling analysis-Application and Examples

Unit – IV

Introduction to 2D transient field problems.- element formulation Two point and three point recurrence schemes, -Application and Examples.

Unit – V

Non-linear problems- Introduction- Incremental and Iterative Techniques-Material non-Linearity- Elasto Plasticity-Plasticity-Visco plasticity-Geometric Non linearity-large displacement Formulation, Introduction to non linear buckling analysis -Application and Examples

REFERENCE BOOKS:

Unit – I


Kinematic Analysis - Position Analysis - Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical Methods for velocity and acceleration Analysis - Four bar linkage jerk analysis.

Unit – II

Path curvature theory - Fixed and moving centrodes, inflection points and inflection circles - Euler Savary equation, graphical constructions - Cubic stationary curvature.

Unit – III


Unit – IV

Dynamics of mechanisms - Static force analysis with friction - Inertia force analysis - Combined static and inertia force analysis, shaking force, Kinetostatic analysis. Introduction to force and moment balancing of linkages.

Unit – V

Spatial mechanisms and robotics - Kinematic Analysis of Spatial RSSR mechanism - Denavit - Hartenberg Parameters - Forward and inverse Kinematics of Robotic Manipulators - Study and use of mechanism software packages

REFERENCE BOOKS:

Unit – I

Casting metallurgy and design - Heat transfer between metal and mould-Solidification of pure metal and alloys - Shrinkage in cast metals, progressive and directional solidification - Principles of grating and rising - Degasification of the melt - Design considerations in casting - Designing for directional solidification and minimum stresses - casting defects.

Unit – II

Special casting processes - Shell moulding, Precision investment casting, CO₂moulding, Centrifugal casting, Die casting and Continuous casting.

Unit – III


Unit – IV


Unit – V

Recent advances in casting and welding - Layout of mechanised foundry - sand reclamation - Material handling in foundry - pollution control in Foundry - Recent trends in casting - Computer Aided design of Castings, Low pressure die casting, Squeeze casting, and full mould casting process. Automation in welding - Welding robots - Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

REFERENCE BOOKS:

1. ASM Metals of Hand book on Casting Revised Edn,1995
Unit - I

Definition – Need – General Characteristics , Matrices – Polymer, Metal, Carbon and Ceramic Matrices, Reinforcement – Types – fibers, whiskers and particles, Reinforcement materials, Selection, advantages and limitations.

Unit - II

Polymer Matrix Composites – Matrix Resins – Thermosetting resins, Thermoplastic resins, Polyacryl ethers (PAE), Thermoplastic Polyimides (TPI), Polyacrylene Sulfide, Molecularly ordered liquid Crystals (MOLC), Polyblends Alloys, Fibers and Laminar Composites.

Unit - III


Unit - IV

Polymer Matrix Production Methods – Bag Moulding, Compression Moulding, Pultrusion, Filament Winding, Metal Matrix Composites - Fabrication methods – Solid State Techniques and Liquid State Techniques

Unit - V


REFERENCE BOOKS:

Unit – I


Unit – II


Unit - III


Unit – IV


Unit – V

Computer Aided Quality Control–Objectives of CAQC- Computers in QC- CAQC Charts for Attributes and Variables – Study of CAQC Software like STAT- Introduction to six sigma - $6\sigma$ Methods and Tools - $6\sigma$ for manufacturing - $6\sigma$ for product development.

REFERENCE BOOKS

ME 946 ELEMENTS OF FRACTURE MECHANICS

Unit – I


Unit – II


Unit – III


Unit – IV


Unit – V


REFERENCE BOOKS
Unit – I

Introduction - Interdisciplinary nature of ergonomics, modern ergonomics – concepts.

Ergonomics and Manufacturing: Ergonomics and product design; ergonomics in automated Systems; Anthropomorphic data and its applications in ergonomic design; limitations of anthropomorphic data - use of computerized database - Case study.

Unit – II

Human Performance - Introduction - general approach to the man- machine relationship- workstation design - working position.

Information input and processing, factors affecting human performance, physical work load and energy expenditure, heat stress, manual lifting

Unit – III


Unit – IV

Design of equipment - Ergonomic factors to be considered, design of displays and controls, design for maintainability.

Unit – V

Design of environment - Illumination – Climate – Noise – Motion – Simple case studies.

REFERENCE BOOKS:

ME 948  FINITE ELEMENT METHOD

Unit – I

Basic Concept of FEM, discretisation, comparison with finite difference method, advantages and disadvantages, history of development, application. Variational and Weighted Residual Formation: Boundary value problems, approximated methods of solution, review of variational calculus, geometric and natural boundary condition, method of Weighted residuals, Rayleigh Ritz and Galerkin methods of finite element formulations and convergence criteria, weak formulation - simple problems.

Unit – II

One dimensional second order equations, discretisation of domain into elements, derivation of element equations, assembly of element equation, imposition of boundary conditions, solution of equations - post processing, Direct stiffness method (DSM)- Fundamental steps in DSM, Plane Truss, Calculation of Reaction, Internal forces and stresses. Extension of fourth order equations and their solutions – examples from solid mechanics, heat transfer.

Unit – III

Classification of C0, C1 continuous problems-Parameter functions, its properties- completeness and compatibility condition, One-dimensional elements, Global coordinates Two-dimensional elements, three noded triangular elements and four noded quadrilateral elements. Natural coordinate systems –Lagrangian Interpolation Polynomials- Serendipity Formulation - Difference between Superparametric, Subparametric and Isoparametric Elements, Isoparametric Elements Formulation, length coordinates– 1D bar elements, C0 continuous shape function, beam elements, C1 continuous shape function - 2D Triangular elements, Quadrilateral elements. – Area coordinates- Numerical integration – simple Problems using Gauss quadrature Technique.

UNIT – IV


Unit – V


REFERENCE BOOKS:
ME 949 FUZZY LOGIC AND NEURAL NETWORKS

Unit – I


Unit – II


Unit – III


Unit – IV

Hybrid Intelligence – Basic concepts of neural network – Inference and learning – Classification Models – Association models, Optimization models – Neural Network learning.

Unit – V


REFERENCE BOOKS:

Unit – I

Principles of automatic controls: Basic concepts of open and closed loop feedback control systems, block diagram representation of physical system, spring mass system, torsion system, hydraulic system, transfer function from block diagram for mechanical, electro-mechanical and hydraulic system. Controls and sensors used in machine tools.

Unit – II


Unit – III


Unit – IV


Unit – V


REFERENCE BOOKS:

ME 951  INDUSTRIAL ROBOTICS TECHNOLOGY

Unit - I


Unit - II


Unit - III

Methods of Robot programming – Lead through programming methods – capabilities and limitations, Textual Robot languages – Robot language structure – motion commands, end effectors and sensor commands, Robot programming functions, robot programming environment, On-Line and Off Line programming Languages

Unit - IV

Robot cell layouts – multiple Robots and machine interface, consideration in work cell design, interlocks, error detection and recovery, Robot cycle time analysis, simulation of Robot work cells.

Unit - V

Applications of robots in material transfer, machine loading and unloading, welding, assembly and inspection, safety, training, maintenance and quality aspects, Economics and social aspects of robotics

REFERENCE BOOKS:

Unit – I


Unit – II


Unit – III

Inventory Control : inventory models - purchase model with instantaneous replenishment and without shortages, manufacturing model without shortages, purchase model with shortage and manufacturing model with shortages – operation of inventory systems – quantity discounts - P & Q systems of inventory replenishment – multiple item model with shortage limitation – determination of stock level of perishable items under probabilistic condition – MRP I and II.

Unit – IV

Concepts of Physical distribution – need, importance and management – Warehouses - location and layout types - receiving and shipping procedures - Application of OR techniques (Transportation problems only).

Unit – V

New organizational paradigm – managing supply chain of the future – role of information in the virtual supply chain – route map to integrated supply chain.

REFERENCE BOOKS:

ME 953 LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Unit – I


Unit - II


Unit - III

Strategic Lead-Time Management: time based competition – concept of lead-time – logistics pipeline management – logistics value engineering – lead-time gap.


Unit - IV


Role of Information Systems and Technology in SCM : importance of information in an integrated SCM environment – inter organisational information systems (IOIS) – information requirements determination for a supply chain IOIS – information and technology applications of SCM.

Unit - V


Cases in SCM. - Future Challenges in SCM : greening of supply chain – design for SCM – intelligent information systems.

REFERENCE BOOKS:


ME 954 MAINTENANCE AND SAFETY ENGINEERING

Unit - I


Unit – II

Predictive Maintenance - vibration and noise as maintenance tool - wear debris analysis - Condition monitoring concepts applied to industries - Total Productive Maintenance (TPM) – Evaluation of O.E.E- Economics of Maintenance-Case studies.

Unit - III

Importance of maintenance management-types of maintenance organization- maintenance of stores and spare parts management – ABC analysis – Value analysis – Computer aided maintenance.

Unit - IV


Unit - V


REFERENCE BOOKS:

Unit - I

Elasticity in metals and polymers – Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors – Super plasticity – Deformation of non crystalline

Unit - II

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing and case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

Unit - III

Basic concepts of fracture mechanics for both Linear elastic and elastic – Plastic regions – crack growth – Deformation and fracture mechanism maps – Fatigue, low and high cycle Fatigue test – Crack initiation and propagation mechanism – Effect of Surface and metallurgical parameters on fatigue – Fracture of non metallic materials.

Unit - IV


Unit – V


REFERENCE BOOKS:

ME 956 MICRO- ELECTRO- MECHANICAL SYSTEMS

Unit - I


Unit - II

Lithography's Origins, Photolithography Overview, Critical Dimension, Overall Resolution, Sensitivity, Resolution Enhancement Technology Emerging Lithography Technologies

Unit - III

Dry Etching - Definitions- Plasmas or Discharges- Ion Etching or Sputtering and Ion-Beam Milling- Plasma Etching (Radical Etching)- Physical Etching.
Wet Isotropic And Anisotropic Etching- Alignment Patterns- Chemical Etching Models- Etching with Bias And/Or Illumination Of The Semiconductor- Etch-Stop Techniques- Problems.

Unit - IV

Physical and Chemical Vapor Deposition- Silk-Screening or Screen-Printing- Sol-Gel Deposition Technique, Doctors' Blade or Tape Casting, Plasma Spraying-Deposition and Arraying Methods of Organic Layers in BIOMEMS-Thin versus Thick Film Deposition- Selection Criteria for Deposition Method.
Introduction to LIGA and Micro molding- LIGA Background – LIGA and LIGA like process steps.

Unit – V

Surface Micromachining Processes, Poly-Si and Non-Poly-Si Surface Micromachining Modifications, Surface Micromachining Modifications- LIGA-Background, LIGA and LIGA-Like Process Steps.
Introduction and exposure to Nanotechnology- - Applications – Basics of nanofabrication, nano machining, nano assembly.

REFERENCE BOOKS:

1. David G.Alciatore and Mecheal. B.Histand
2. HMT
3. Lawrence J.Kamm
4. Marc Madou
   - Fundamentals of Micro fabrication, CRC Press, 1997,
5. Trimmer, W. (Ed.)
6. Elwenspoek M.
UNIT – I


UNIT – II

Properties of Nanomaterials - Metal and Semiconductor Nanomaterials, Quantum Dots, Wells and Wires, Molecule to bulk transitions, Bucky balls and Carbon Nanotubes, Nano structures - Electronic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, one-dimensional and two dimensional nanostructures.

UNIT – III

Synthesis of Nanomaterials - Synthesis of bulk nano-structured materials –sol gel processing – Mechanical alloying and mechanical milling- Inert gas condensation technique , Nanolithography, CVD, chemical synthesis, Wet Deposition techniques, Self-assembly (Supramolecular approach), Molecular design and modeling.

UNIT – IV

Characterization - Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, X-ray diffraction, Fluorescence Microscopy and Imaging, STM - AFM and their application in nanotechnology, Nanoindentation principles.

UNIT – V


REFERENCE BOOKS:

5. Dupas, C. Houdy, P., Lahmani, M - Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg,
ME 958 MACHINE TOOL DESIGN

UNIT I

General principles of Machine Tool Design-Parameters defining working motions of a machine tool- Machine tool drives- mechanical and hydraulic transmission and its elements- engineering design process applied to machine tools.

UNIT II

Regulation of speed and feed rates – design of gear box – design of feed box – special cases of gear box design – classification of speed and feed boxes – determining the number of teeth of gears.

Unit III

Design of machine tool structures – design criteria for machine tool structures – materials for machine tool structures- design of beds, columns, housings, bases and tables, cross rails, arms, saddles and carriages, rams.

UNIT IV


UNIT V


REFERENCE BOOKS:

4. Yoram Koren & Joseph Ben-Uri - Numerical Control of Machine Tools, Khanna publishers, Delhi, 2005
ME 959 OPTIMIZATION IN DESIGN

Unit – I

Introduction - General characteristics of mechanical elements, adequate and optimum design, principles of optimization, Formulation of objective function, design constraints-classification of optimization problem. - Single variable unconstraint optimization – Golden section and Brent’s method.

Unit – II

Optimization with Equality and Inequality constraints-Direct methods-Indirect methods using penalty functions, Lagrange’s multipliers, Geometric Programming and Stochastic Programming

Unit – III

Multi variable unconstraint optimization- Conjugate gradient with line minimization – Quasi Newton Method with line search. Multi objective optimization, - Goal attainment- Introduction to Genetic algorithms and Simulated Annealing techniques.

Unit – IV

Structural applications-Design of simple truss members. Design applications-Design of simple axial, Transverse loaded members for minimum cost, maximum weight-Design of shafts and Torsionally loaded members-Design of Springs

Unit – V

Dynamic applications-Optimum design of single ,two degree of freedom systems, Vibration absorbers. Application in Mechanisms-Optimum design of Simple linkage mechanisms

REFERENCE BOOKS:

ME 960  OPTIMIZATION TECHNIQUES IN MANUFACTURING

Unit - I

Introduction to Linear programming Formulations and solutions- Graphical, Simplex and Revised Simplex methods- Integer Programming-Algorithms- Cutting plane and Branch and Bound techniques, zero-one implicit enumeration- Non-linear programming- Lagrangean method, Kuhn – Tucker Conditions, Quadratic and separable programming.

Unit - II

Inventory- need and problems- Probabilistic models – continuous review, single and multi-period models Decision under certainty, decision under Risk – expected value criterion and expected value – variance criterion, decision under uncertainty – Laplace, Maxmin, minimax, savage minmax regret and Hurwicz criteria. Decision tree.

Unit - III


Unit - IV


UNIT - V


REFERENCE BOOKS:

ME 961 PRINCIPLES OF TRIBOLOGY

UNIT-I

Introduction to tribology-Factors influencing Tribological phenomena-Engineering surfaces-Surface characterization, Computation of surface parameters. Surface measurement techniques-Apparent and real area of contact. Introduction to nano tribology.

UNIT-II

Genesis of friction-Various laws and theory of friction-friction in contacting rough surfaces-sliding and rolling friction-frictional heating and temperature rise.

UNIT-III


UNIT-IV


UNIT-IV

Surface modification techniques-Improving wear resistance-Surface coating techniques such as electrochemical depositions, anodizing, thermal spraying, Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), etc. and their applications.

REFERENCE BOOKS:

ME 962 PRODUCT RELIABILITY ENGINEERING

Unit – I


Unit – II


Unit - III

Reliability tests – types – Component reliability from test data – reliability models for series, parallel, stand by and k-out-of-m systems.

Unit - IV


Unit - V

Significance of availability and maintainability concepts in reliability evaluation – Importance of maintainability in design and manufacturing – reliability and associated costs – economics of reliability - reliability management.

REFERENCE BOOKS:

Unit - I
Indian project management scenario, Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting : Capital cost-time-value (CTV) system, managing project resources flow.

Unit - II
Stages - Opportunity studies - General opportunity studies, specific opportunity studies, pre-feasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal : Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment.

Unit - III

Unit - IV

Unit - V
Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network, Scheduling based on the availability of Resources (Manpower and Release of Funds). Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects.

REFERENCE BOOKS:
4. UNIDO - Series on Project Management.
ME 964  QUALITY ENGINEERING AND ROBUST DESIGN

Unit – I

Basic Concepts – Fundamentals of experimental design, Selection of an appropriate design, Criteria for evaluation, Factors and levels, Review of statistical inference – Importance of optimized design – Functional design – Parametric design

Unit – II

Single factor experiments: Completely randomized design, Analysis of variance (ANOVA), Effect of total sum of Squares, Randomized block design, Randomized incomplete block design, Latin square design.

Unit – III


Unit – IV


Unit – V


REFERENCE BOOKS:

ME 965  RAPID PROTOTYPING

Unit - I


Unit - II

Product Development Cycle – Data requirements, Modeling, Data representation, part orientation and support, from CAD / CAM, STL format, Slicing, Post Processing.

Unit - III

Engineering Manufacturing, Overview of existing technologies of prototyping and tooling, General features and classification of Generative Manufacturing process (GMP) for Rapid Prototyping.

Unit - IV

Two-Dimensional Layer – by Layer Techniques- Steriolithography (SL), Solid Foil Polymerization(SFP), Selective Laser Sintering (SLS), Selective Powder Building (SPB), Ballistic Particle Manufacturing (PM), Fused Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Solid Ground curing (SGC)

Unit - V

Direct three Dimensional Techniques – Beam Interference Solidification (BIS), Ballistic Particle Manufacturing, Programmable Moulding, Comparison of GMP characteristics, considerations for adopting RP technology.

REFERENCE BOOKS:

Unit - I


Unit – II


Unit - III

Simulation of manufacturing systems – models, goals and performance measures issues - some preliminary case studies of simulation of manufacturing - study of Softwares available in the market – SIM FACTORY II.5, ProModel, AutoMod, Arena, AIM, Witress, Taylor - II.

Unit - IV


Unit - V

Analysis of simulation data - nput data models, Collection of data, identification of statistical distribution, estimating parameters and testing for goodness of it. Verification and validation of simulation models - Face validity, Validation of assumptions, Input - Output validation.

REFERENCE BOOKS:

UNIT-I

Introduction—nature of surfaces—physico-chemical characteristics of surface layers—surface contamination—fractional film defects—heat of adsorption theory—effect of surface films

UNIT- II

Introduction—surface roughness—sampling length—asperities—quantification of roughness parameters—traditional and latest surface parameters—standardized methods of measurement—various roughness measurement techniques—statistical analysis of surfaces—PDF-ACF-Spectral density-fractal-BAC etc.

UNIT- III

Introduction—geometry of non-conforming surfaces in contact—surface and subsurface stresses—surface traction—contact of rough surface—surface temperature in sliding—apparent and real area of contact—frictional heating—an idealized rough surface—a realistic rough surface

UNIT- IV

Adhesion—fundamentals—solid to solid contacts—bonding between surface—types of bonding—free surface energy theory of adhesion—liquid mediated contact

UNIT- V

Introduction—surface modification—various types—surface hardening—carburizing—nitriding—carbonitriding—surface coating—PVD-CVD—Nanocoatings

REFERENCE BOOKS:

2. Williams, J.A. - Engineering Tribology, Oxford University Press, 1994
Unit - I


Unit – II

Tools and Techniques – The seven management tools - Technique for analyzing a quality process – Statistical process Control

Unit – III

Cost of quality – Taguchi’s quality loss function – House keeping concepts for industries, tool room, production shop – processing industries.

Unit – IV


Unit – V


REFERENCE BOOKS:

2. Patrick J. Sweeney (Editor) - TQM for Engineering, Quality Resources, Newyork, 1993.
ME 969  WORK SYSTEMS DESIGN

Unit - I

Introduction - Productivity and living standards, Productivity measurement, work design and Productivity.

Unit - II

Operations analysis - Total time for a job or operation, total work content and ineffective time, methods and motions, graphic tools.

Unit – III

Work measurement - Stop watch time study, Standard data, methods time measurement (MTM), Development of Production standards, learning effect.

Unit – IV

Applied work measurement - Work sampling, measurement of Indirect labour, organisation and methods (O & M), Wage incentive plans.

Unit - V

Human factors in work system design - Human factors Engineering / Ergonomics, human performance in physical work, anthropometry, design of work station, design of displays and controls.

REFERENCE BOOKS:

INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH (PRODUCT DESIGN AND MANUFACTURING)

1. INFRASTRUCTURE:

(i) Building Infrastructure

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Building Details</th>
<th>Area (Sq.m)</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Class/Tutorial Room</td>
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<tr>
<td>2.</td>
<td>Laboratory</td>
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<td>3.</td>
<td>Project Lab</td>
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(ii) Equipment Infrastructure

<table>
<thead>
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<th>Facilities/Equipment/Accessories</th>
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<tbody>
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<td>2.</td>
<td>Surface Roughness Measuring Instrument</td>
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<td>3.</td>
<td>CNC Trainer Lathe</td>
<td>1</td>
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<tr>
<td>4.</td>
<td>CNC Trainer Milling Machine</td>
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<tr>
<td>5.</td>
<td>CNC Bench Trainer lathe</td>
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<tr>
<td>6.</td>
<td>Wind Tunnel</td>
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<td>7.</td>
<td>Gear Hobbing Machine</td>
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<td>8.</td>
<td>Mould Strength Testing Machine</td>
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<tr>
<td>9.</td>
<td>FFT Analyser</td>
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<tr>
<td>10.</td>
<td>Gas Analyser</td>
<td>1</td>
</tr>
<tr>
<td>11.</td>
<td>Computer Systems connected with LAN</td>
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<tr>
<td>13.</td>
<td>ANSYS 12 version</td>
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<tr>
<td>14.</td>
<td>AUTO CAD 2002</td>
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<tr>
<td>15.</td>
<td>UTM Machine</td>
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<tr>
<td>16.</td>
<td>Plotter 450</td>
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<td>17.</td>
<td>HP Laser Printer 1000</td>
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<tr>
<td>18.</td>
<td>HP Laser Printer 1023</td>
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19. LIBRARY:

Number of books : 100
Titles : As required by the curriculum
Journals : 5 related International journals

20. FACULTY REQUIREMENT:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Cadre</th>
<th>No.</th>
<th>Qualification</th>
<th>Specialization</th>
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<tr>
<td>1.</td>
<td>Professor</td>
<td>1</td>
<td>As per AICTE norms</td>
<td>Production/Manufacturing/Machine Design/Tribology</td>
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<tr>
<td>2.</td>
<td>Associate Professor</td>
<td>1</td>
<td>As per AICTE norms</td>
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<td>Assistant Professor</td>
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<td>As per AICTE norms</td>
<td>Production/Manufacturing/Machine Design</td>
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</tbody>
</table>

4. TEACHER TO STUDENT RATION : 1:15

5. STUDENT TO COMPUTER RATIO : 1:1