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.

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REGULATIONS FOR POST GRADUATE (M.Tech.) PROGRAMME IN THE DISCIPLINE OF MECHANICAL ENGINEERING (CBCS)
(WITH EFFECT FROM JULY 2011)
M.Tech. (Product Design and Manufacturing)

1.0 ELIGIBILITY

Candidates for admission to the first semester of the four semesters M.Tech. Course in Mechanical Engineering with specilisation 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

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

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 2: Letter Grade and the Corresponding Grade Point

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

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

Internal valuation			
	Guide		50 marks
	First Evaluation		50 marks
	Second Evaluation		50 marks
		Total	**150 marks**
External valuation			
	Evaluation (External Examiner Only)		50 marks
	Viva voce (50 for Ext. + 50 for Int.)		100 marks
		Total	**150 marks**

Project work – (Phase – II): 400 Marks

Internal valuation			
	Guide		100 marks
	First Evaluation		50 marks
	Second Evaluation		50 marks
		Total	**200 marks**
External valuation			
	Evaluation (External Examiner Only)		50 marks
	Viva voce (75 for Ext. + 75 for Int.)		150 marks
		Total	**200 marks**

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:

(9 x 4 + 8 x 2 + 10 x 3 + 0 x 3)/ (4+2+3+3) =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 FA 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 1^{st} to 4^{th} semester should be considered and it is mandatory that the candidate should have passed all the subjects from 1^{st} to 4^{th} 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

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	ME 911	Computational Methods	3	1	0	4	40	60	100
2.	ME 912	Computer Aided Design	4	0	0	4	40	60	100
3.	ME 913	Product Design	4	0	0	4	40	60	100
4.		Elective – I	3	0	0	3	40	60	100
5.		Elective – II	3	0	0	3	40	60	100
6.		Elective – III	3	0	0	3	40	60	100
7.	ME917	CAD Laboratory	0	0	3	2	50	50	100
						23	290	410	700

SEMESTER – II

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	ME 914	Computer Aided Manufacturing	4	0	0	4	40	60	100
2.	ME 915	Advanced Materials and Processing	4	0	0	4	40	60	100
3.	ME 916	Design for Manufacture and Assembly	3	1	0	4	40	60	100
4.		Elective – IV	3	0	0	3	40	60	100
5.		Elective –V	3	0	0	3	40	60	100
6.		Elective – VI	3	0	0	3	40	60	100
7.	ME 918	CAM Laboratory	-	-	3	2	50	50	100
						23	290	410	700

SEMESTER – III

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	ME 919	Project Phase-I	-	-	16	9	150	150	300
2.	ME 971	Directed Study	-	-	3	3	100	-	100
						12	250	150	400

SEMESTER – IV

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	ME 920	Project Phase II	-	-	24	14	200	200	400
						14	200	200	400

List of Electives

Sl.No.	Code	Subject
1	ME 941	Advanced Finite Element Analysis
2	ME 942	Advanced Mechanism Design
3	ME 943	Advances in Casting and Welding
4	ME 944	Composite Materials Technology
5	ME 945	Computer Aided Inspection and Quality Control
6	ME 946	Elements of Fracture Mechanics
7	ME 947	Ergonomics and Manufacturing
8	ME 948	Finite Element Method
9	ME 949	Fuzzy Logic and Neural Networks
10	ME 950	Industrial Automation
11	ME 951	Industrial Robot Technology
12	ME 952	Integrated Materials Management
13	ME 953	Logistics & Supply Chain Management
14	ME 954	Maintenance and Safety Engineering
15	ME 955	Materials Sciences
16	ME 956	Micro- Electro- Mechanical Systems
17	ME 957	Nano Technology
18	ME 958	Machine Tool Design
19	ME 959	Optimization in Design
20	ME 960	Optimization Techniques in Manufacturing
21	ME 961	Principles of Tribology
22	ME 962	Product Reliability Engineering
23	ME 963	Project Management
24	ME 964	Quality Engineering And Robust Design
25	ME 965	Rapid Prototyping
26	ME 966	Simulation and its Applications in Manufacturing
27	ME 967	Surface Engineering in Tribology
28	ME 968	Total Quality Management
29	ME 969	Work Systems Design

ME 911 COMPUTATIONAL METHODS

Unit - I

Numerical Methods - Solution of Linear Simultaneous equations- direct methods of solution- Gauss elimination method, Gauss Jordon method, Crout's method - iterative methods of solution – Jacobi's method Gauss Seidal method. Determination of Eigen value by iteration – power method.

Unit - II

Ordinary differential equations, Taylor's method, Runge- Kutta method – Milne's predictor – correction method.
Classification of PDE's, one dimensional, Finite Difference Method for Laplace, Poisson's and elliptical equations.

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:

1. Miller and Freund, - Probability and statistics for Engineers, Prentice Hall of India, 1995.
2. Douglas C. Montgomery - Applied Statistic and Probability for Engineers, Wiley Higher Edn,1998 and George C. Runger
3. Elsgolts, L. - Differential equation and calculus of variations, Mir Publishers, Moscow, 1966.
4. Grewal. B.S. - Higher Engineering Mathematics, Khanna Publishers, 2000

ME 912 COMPUTER AIDED DESIGN

Unit - I

Principles of Computer Graphics - Point plotting, drawing of lines, Bresenham's circle algorithm. Transformation in Graphics: co-ordinate system used in Graphics and windowing , view port, views, 2D transformations – rotation, scaling, translation, mirror, reflection, shear - homogeneous transformations – concatenation, Viewing and windowing transformations – clipping algorithms- 3D Transformation – Projections – Orthographic – Isometric – Oblique – Technique (Description of techniques only).

Unit - II

Geometric Modeling Classification of Geometric Modeling – Wire frame, Surface and Solid Modeling, applications – representation of curves and surfaces – Parametric form – Design of curved shapes- Cubic spline – Bezier curve – B-spline – Hermite curve – Lagrangian – Design of Surfaces - features of Surface Modeling Package - Solid Primitives, CSG, B-rep and description of other modelling techniques like Sweep representation - Analytical solid modeling - Pure primitive instancing, cell decomposition, spatial occupancy enumeration.
An overview of modeling softwares like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

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

Finite Element Modeling - Introduction, Mesh Generation – mesh requirements, Semi-Automatic Methods- Node-based approach, Region based approach, Solid-modeling-based methods. Fully Automatic Methods- Element-based approach, Application. Utilizing symmetricity – symmetric and anti symmetric B.C, Factors considered for FE modeling - Sub modeling Concept.
Extending the Capabilities of CAD Parametric and variational modeling - Feature recognition - Design by features - Assembly and Tolerance modeling - Tolerance representation - specification, analysis and synthesis.

Unit – V

Introduction to optimization techniques – fundamentals – classifications, Classical methods – Calculus method – method of Lagrange multipliers , Unconstrained optimization methods – single variable – Exhaustive, Fibonacci, Golden section search methods – Newton Raphson method. Multi variable – Simplex search method – Steepest descent method. Constrained optimization method – cutting plane method. Introduction to genetic algorithm (description of method only).

REFERENCE BOOKS:

1. Chris Mcmahon and - CAD/CAM – Principle Practice and Manufacturing Management, Jimmie Browne Addision Wesley England , Second Edition,2000.
2. Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition,2000.
3. Radhakrishnan, P. - CAD/CAM/CIM, New Age International (P) Ltd.,

Subramanaya, S and.Raju V New Delhi.

4. Groover M.P. and Zimmers, EW. - CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 1992
5. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Pub.Co. Ltd., New Delhi, 1992.
6. Cook, R.D. John - Concepts and applications of Finite Element Analysis, Wiley and Sons, New York, Second Edition, 1981,.
7. Ibrahim Zeid - Mastering CAD/CAM – Tata Mc Graw Hill Publishing Co. Ltd.,
8. Kalyanmoy Deb – Optimization for engineering design (Algorithms and examples) Prentice Hall of India New Delhi, 2005.

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 brain storming - product specification.

Unit - II

Task - Structured approaches - clarification - search - external and internal -systematic exploration - concept selection – methodology and benefits.
The value of appearance - principles and laws of appearance - incorporating quality, safety and reliability into design. Man machine considerations - ergonomic considerations - Designing for ease of maintenance.

Unit - III

Modeling and simulation - the role of models in product design, mathematical modeling similitude relations - weighted property index.
Material selection: problems of material selection-performance characteristics of materials - the material selection process-economics of materials-cost versus performance relations-weighted property index.

Unit - IV

Strength Consideration : Principal Stress Trajectories - Balanced Design – Criteria and Objectives of Design – Designing for Uniform Strength – Tension vis –a-vis Compression.
Stiffness and Rigidity consideration: Mapping of Principal Stresses – Buckling and Instability – Plastic Design – Practical Ideas for Material saving in Design – Ribs, Corrugations, Laminates and Membranes.
Design for Production : Forging Design – Pressed Components Design – Casting Design – Design for Machining Ease – Design for PM Parts – Approach to Design with Plastics, Rubber, Ceramics.

Unit - V

Case studies – based on materials and manufacturing of Automobiles Components and Home appliances. Classes of exclusive rights - Patents - Combination versus aggregation - Novelty and Utility - Design patents - Paten disclosure - Patent application steps-Patent Office prosecution-Sales of paten rights- Trade marks-Copy rights.

REFERENCE BOOKS:

1. Karl.T.Ulrich and - Product Design and Development, McGraw-Hill International Edn., teven D.Eppinger 2004.
2. Benjamin W.Niebel and Alanb.Draper - Product Design and Process Engineering, McGraw Hill Book Co.,
3. Chitale, A.K. and Gupta, R.C- Product Design and Manufacturing, Prentice Hall, 2002.

ME 914 COMPUTER AIDED MANUFACTURING

Unit - I

CAM – Scope and applications – NC in CAM – Principal types of CNC machine tools and their construction features – tooling for CNC – ISO designation for tooling – CNC operating system – FANUC, SINUMERIK – HINUMERIK – Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

Unit - II

Single and mixed mode assembly lines – quantitative analysis of assembly systems. Material handling in CAM environment – types – Industrial Robots - AGVS – AS/RS – Swarf handling and disposal of wastes – case studies in assembly.

Unit – III

Concurrent Engineering and Design for Manufacturing, Quality Function Deployment – Process Planning – CAPP – Variant and Generative systems.
Computer Aided Production Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning

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 Stereo-lithography.

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:

1. Mikell P.Groover - Automation , Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India, 2002
2. Kant Vajpayee, S. - Principles of Computer Integrated Manufacturing, Prentice Hall of India, 1999
3. David Bed worth - Computer Integrated Design and Manufacturing, TMH, 1998
4. Ranky, Paul.G, - Computer Integrated Manufacturing, Prentice Hall International, 1986
5. Amitabha Ghosh, - Rapid Prototyping – A Brief Introduction, Affiliated East West Press Pvt. Ltd., 1997
6. Radhakrishnan.S Subramanian.S - CAD/CAM/CIM", Prentice Hall of India, 2000

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

Newer forming processes specifically with reference to applications – Super plastic forming, rubber forming, explosive, electro – hydraulic and magnetic pulse forming. Special metal joining processes – Ultrasonic welding, Friction welding, Explosive Welding, Electron Beam welding, Diffusion bonding.

Unit – IV

Special material removal processes – Chemical machining, Electro chemical machining, Electrical Discharge machining, wire EDM, Water Jet machining – High speed machining – Micro machining Casting of Non-Ferrous metals.

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:

1. Serope. Kalpakjian and Steven.R.Schmid - Manufacturing Engineering and Technology, Addison Wesley Longman (Singapore) Pvt. Ltd., New Delhi, 2000.
2. Carl Love, L. - Welding Procedures and Applications, Prentice Hall Inc.,1993.
3. H.M.T. - Production Technology, Tata McGraw Hill Publishing Co, 2002.
4 Heine, R.W.. Loper, C.R. and Rosenthal, P.C - Principles of Metal Casting, Tata McGraw Hill Publishing Co., 1991.

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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

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area - simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for capability - Design for accessibility - Design for assembly.

Unit - IV

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

Unit - V

Feature tolerances - Geometric tolerances - Assembly limits – Datum features - Tolerance stacks. Introduction to design for assembly, General approach to design for assembly- case studies.

REFERENCE BOOKS:

1. Boothroyd - Design for Manufacture
2. Robert Matousek - Engineering Design - A systematic approach, Blackie & Sons Ltd. 1963.
3. James G. Bralla - Hand Book of Product Design for Manufacturing, McGraw Hill Co.,1986.
4. Swift K.G. - Knowledge based design for manufacture, Kogan Page Ltd., 1987.
5. Daniel E. Whitney - Mechanical Assemblies - Their Design, Manufacture and Role in Product Development.
6. - Casting Design Hand Book.
7. Farag.M - Materials Selection for Engineering Design, Prentice Hall, 1997
8. Spotts.M.F. - Dimensioning and Tolerance for Quantity Production, Prentice Hall,1983
9. James G Bralla - Hand Book of Product Design for Manufacturing, McGraw Hill, 1983.

ME 917 CAD LABORATORY

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

ME 918 CAM LABORATORY

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:

1. Frank L. Stasa - Applied Finite Element Analysis for Engineers,CBS International Edition, 1985
2. Reddy J.N. - A Introduction to Finite Element Method, McGraw Hill, International Edition, 1993
3. Krishnamoorthy C.S - Finite Element Analysis - Theory and Programming, Tata McGraw Hill Publishing Company Ltd., 1998
4. Rao.S.S, - Finite Element Method in Engineering, Pergamon Press, 1989
5. Cook,Robert Devis - Concepts and Application of finite Element Analysis, Wiley John & Sons,1999
6. Buchaman,G - Schaum's Outline of finite Element Analysis, McGraw Hill, 1994

ME 942 ADVANCED MECHANISM DESIGN

Unit – I

Introduction - Review of fundamentals of kinematics - Mobility Analysis - Formation of one D.O.F. multi loop Kinematic chains, Network formula - Gross motion concepts.

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

Synthesis of mechanisms - Type synthesis - Number synthesis - Associated Linkage Concepts - Dimensional synthesis - function generation, path generation, motion generation. Graphical methods - Cognate linkage - Coupler curves synthesis, design of six-bar mechanisms- Algebraic methods - Application of instant center in linkage design. Cam Mechanisms –Determination of optimum size of Cams.

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 mechnisms 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:

1. Sandor G.N. and Erdman A.G. - Advanced Mechanism Design Analysis and Synthesis, Prentice Hall,1984.
2. Shigley, J.E. and Uicker, J.J. - Theory of Machines and Mechanisms, McGraw Hill, 1995
3. Amitabha Ghosh and Ashok Kumar Mallik - Theory of Mechanism and Mechines, EWLP, Delhi, 1999.
4. Norton R.L., - Design of Machinery, McGraw Hill, 1999.
5. Kenneth J, Waldron, - Kinematics, Dynamics and Design of Machinery, John Wiley &Sons, Gary L.Kinzel 1999.

ME943 ADVANCES IN CASTING AND WELDING

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, CO_2moulding, Centrifugal casting, Die casting and Continuous casting.

Unit – III

Welding metallurgy and design - Heat affected Zone and its characteristics - Weldability of steels, cast iron, Stainless steel, aluminium and Titanium alloys - Hydrogen embrittlement - Lamellar tearing - Residual stress - Heat transfer and Solidification - Analysis of stresses in welded structures - pre and post welding heat treatments - Weld joint design - Welding defects - testing of weldment.

Unit – IV

Unconventional and special welding processes - Friction welding - Explosive welding - Diffusion bonding - High frequency Induction welding - Ultrasonic welding -Electron beam welding - Laser beam welding.

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
2. Foundry Engineering Handbook , Utility publishers Ltd.,1989.
3. Titoun.D & Stepanov .YU.A- Foundry Practice, MIR Publishers,Moscow,1981.
4. Heine Loper & Rosenthal - Principles of Metal Casting, Tata McGraw Hill,1980
5. Mukherjee P.C. - Fundamentals of Metal casting Oxford - IBH,1979.
6. Iotrowski - Robotic welding-a guide to selection and application - Society of8 Mechanical Engineers,1987.
7. Schwariz . M. M., - Source book on Innovative Welding Processes - American society for metals (OHIO),1981.
8. Cornu. J. - Advaanced Welding systems -Volumes I,II and III,JAICO Publishers,1994.
9. Lancaster J.F. - Metallurgy of Welding - George Allen & Unwin Publishers,1980.
10. Serope Kalpakjian - Manufacturing Engineering and Technology(III Edition) – Addison Wesley Publishing Co.1995

ME944 COMPOSITE MATERIALS TECHNOLOGY

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

Metal Matrix Composites – Matrix selection, Reinforcement and reinforcement selection, Matrix reinforcement interface, Interaction zone, Interface bond strength.

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

Micro mechanics and macro mechanics of composites, monotonic strength and fracture, Fatigue and Creep, Applications of composites. Composites Processing.

REFERENCE BOOKS:

1. Krishan Chawla, K. - Composite Materials : Science and Engineering, Springer, 2001.
2. F.L.Mathews and Rawlings, R.D. - Composite Materials - Engineering and Science, RC Press, 2002.
3. Mallic P.K. -Fiber - Reinforced Composites : Materials, Manufacturing and Design, Marcel Dekker Inc, 1993.
4. Sanjay K.Mazumdar -Composites Manufacturing : Materials, Product and Process Engineering, CRC Press, 2002.

ME945 COMPUTER AIDED INSPECTION AND QUALITY CONTROL

Unit – I

Quality – definition- Traditional and modern QC – ISO 9000 and ISO 14000 standards- CAQC- Software required- Automatic Inspection: Inspection Fundamentals – Sampling versus 100% inspection - Contact Inspection techniques: CMM –Types- construction, operation and programming – software- applications and benefits- Flexible Inspection systems- Inspection probes on machine tools- Automatic shaft inspection.

Unit – II

Machine Vision, Image Processing and its Application in Inspection-optical inspection - Linear Array Devices, Optical Triangulation Techniques - Non Contact Sensors For Surface Finish Measurements- non contact non optical inspection technologies- Electrical field- radiation techniques- ultrasonic methods.

Unit - III

Optical projection comparator- Bosch and lomp projector – laser viewer for production profile checks- opto- electronic dimensional gauging, operations and applications- co-ordinate measuring robots- process control robot- digital height gauge with SPC- air gauging with electronic sensors.

Unit – IV

Laser Interferometer, Speckle Measurements, Laser Scanning Systems- - Testing of Machine Tools Using Laser Interferometer- Robotic gauging and inspection systems- expert knowledge based real time inspection system.
Computer Aided Quality Assurance Records- Calibration Control -Automatic Quality Data Acquisition.

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 - 6σ Methods and Tools - 6σ for manufacturing - 6σ for product development.

REFERENCE BOOKS

1. Geoff Vorley and Guilford - Quality management, Principles & Techniques",QMT Ltd., UK, Fred Tickle 2004
2. Mikell P.Groover, - Automation , Production Systems and Computer Integrated Manufacturing, Second Edition, Prentice Hall of India, 2002
3. Douglus C. Montgomery - Statistical Quality Control, John Wiley and sons, 1998
4. Sadhu Singh - CAD/CAM, Khanna Publishers, 2000
5. Khanna, O.P. - Engineering Metrology', Khanna Publishers, 1998

ME 946 ELEMENTS OF FRACTURE MECHANICS

Unit – I

Introduction – kinds of Fracture, Brittle and Ductile Fracture, Modes of Fracture Failure, Damage Tolerance, Energy Release Rate – Surface Energy – Griffith's Analysis, Mathematical Formulation, Energy release rate of DCB Specimen, Crack resistance, Stable and unstable crack growth, R-curve for brittle Cracks on Thin plate and Thick Plate – Critical Energy Release Rate.

Unit – II

Stress Intensity Factor – Stress and Displacement Fields in Isotropic Elastic Materials, Westergaard's Approach – Mode I, Mode II, Mode III, Applications of Westergaard Approach – Wedge leads on cracked surface, Collinear Cracks in an Infinitely Long Strip, Internal Pressure on Cracked Faces, Wedge Load at the Surface of a Crack Face - Crack in a Plate of Finite Dimensions, Edge Cracks, Embedded Cracks – Elliptical Cracks, Semi-elliptical Cracks, Quarter of Corner Cracks – The Relation between G_I and K_I – Critical Stress Intensity Factor.

Unit – III

J-Integral – Definition of the J-Integral – Path independence – Stress-Strain Relation – Experiments to Determine the Critical J-integral, Numerical Evaluation of J-integral, Predicting Safety or Failure, Experimental Determination of the Toughness of Ductile Materials, Simplified Relation for the J-integral, Applications to Engineering Problem Crack Tip Opening Displacement, Equivalence between CTOD and J

Unit – IV

Test Methods- Introduction – K_{Ic}-Test Technique-Test Specimen, Constraints on Specimen, Clip Gauge, Load – Displacement Test, Measuring the Crack Length, Data Analysis,– Test Methods to Determine J_{IC}, Historical Development- Formulation- Test Methods to Determine G_{IC} and $G_{IIC,}$ Determination of Critical CTOD. Finite Element Analysis of Cracks in Solids – Introduction – Direct Methods to Determine Fracture Parameters – Indirect Methods to Determine Fracture Parameters- J- Integral Method, Energy Release Rate Method, Stiffness Derivative Method - Singular Element Method – Barsoum Element.

Unit – V

Crack Detection through Non – Destructive Testing – Introduction – Examination through Human Senses – Visual Inspection, Investigation through Hearing, Detection through Smell, Other simple Methods - Liquid Penetration Inspection – Principle, Procedure, Crack Observation – Ultrasonic Testing – Principle, Equipment, Immersion Inspection – Radiographic Imaging , Limitations – Magnetic Particle Inspection – Principle, Sensitivity, Hardware, Flaw Orientation, Magnetic Ink Powder, Demagnetization, Strength and Limitations.

REFERENCE BOOKS

1. Prashant Kumar - Elements of Fracture Mechanics.TataMcGraw-Hill, New Delhi, 2009
2. Ramesh, K - e-book on Engineering Fracture Mechanics, IIT Madras,2007 URL: http// apm.iitm.ac.in/smlab/kramesh/book_4.htm.
3. Gdoutos, E.E - Fracture Mechanics – An introduction, Springer, Netherland,2005
4. Broek, D - Elementary Engineering Fracture Mechanics, Martinus Nijhoff Publishers, Hague1982
5. Hertzberg, R,W - Deformation and Fracture Mechanics of Engineering Materials, New York, John Wiley and sons 1989
6. Cook, R.D., Malkus,D.S - Concepts and Applications of Finite Element Analysis, New York, John Wiley & Sons 1989

ME 947 ERGONOMICS AND MANUFACTURING

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

Work space design - Anthropometry, Work-space design for standing and seated workers, arrangement of components within a physical space, interpersonal aspect of workplace design. Ergonomics: Issues in Work system Design, Measuring Work by Physiological means, Work Posture, Fatigue Measurement and Evaluation, Environmental Factors and Work Systems.

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:

1. Martin Helander - A Guide to Ergonomics of Manufacturing", TMH, 1996.
2. Bridger, R.S. - Introduction to Ergonomics, McGraw Hill, 1995.
3. McCormick, J. - Human Factors in Engineering and Design", McGraw Hill, 1992.

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 co-ordinate systems –Lagrangian Interpolation Polynomials- Serendipity Formulation - Difference between Superparametric, Subparametric and Isoparametric Elements, Isoparamatric Elements Formulation, length coordinates– 1D bar elements, C0 continuous shape function, beam elements, C1 continuous shape function - 2D Triangular elements, Rectangular elements. – Area coordinates- Numerical integration – simple Problems using Gauss quadrature Technique.

UNIT – IV

Basic Boundary Value Problems in 2 Dimensions – Introduction to Theory of Elasticity – Plane Stress – Plain Strain and Axisymmetric Formulation – Principle of virtual work – Weak Formulation – Triangular, Quadrilateral elements - Element matrices using energy approach. - Simple problems using three noded triangular elements only

Unit – V

Finite Element Analysis of 2D Steady State Thermal Problems - Green-Gauss Theorem-Element equation formulation – Variational calculus approach- Galerkin approach – General Two-Dimensional Heat Conduction – Axisymmetric Heat conduction -Triangular, Quadrilateral elements - Simple problems using three noded triangular element only.

REFERENCE BOOKS:

1. Frank L. Stasa - Applied Finite Element Analysis for Engineers, CBS International Edition, 1985
2. Reddy J.N. - An Introduction to Finite Element Method, McGraw Hill, International Edition, 1993
3. Krishnamoorthy C.S - Finite Element Analysis: Theory and Programming, Tata McGraw Hill Publishing Company. Ltd 1998
4. Rao. S.S, - Finite Element Method in Engineering, Pergamon Press, 1989
5. Cook, Robert Devis etal, - Concepts and Application of finite Element Analysis, Wiley John & Sons, 1999

ME 949 FUZZY LOGIC AND NEURAL NETWORKS

Unit – I

Knowledge Representation and processing – knowledge and Intelligence – logic – Frames – production systems. Fundamentals of Fuzzy logic – Fuzzy sets – Fuzzy Relation – composition and Inference.

Unit – II

Membership Function Estimation – Importance – Fuzzy to crisp conversion – methods – Fuzzy extension principle – Fuzzy tautologies – Implication operation Composition operation

Unit – III

Basics of Fuzzy Control – Architecture of Fuzzy Control – examples of Fuzzy Control system Design – Robotic Control system – Industrial applications.

Unit – IV

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

Unit – V

Rule Based Neural Networks – Network Training – Application of Neural Network in Mathematical Modeling – knowledge based approaches – applications in Mechanical Engineering– Fuzzy – Neural, examples, Neuro – Fuzzy examples – Intelligence in Automation.

REFERENCE BOOKS:

1. Clarence W.de Silva - Intelligent Control Fuzzy Logic Applications, CRS Press, 1995.
2. Timothy J.Ross - Fuzzy Logic with Engineering Applications, McGraw Hill Inc., 1995.
3. Limin Fu - Neural Networks in Computer Intelligence, Tata McGraw Hill Publishing Company Ltd., 2003.
4. Stamations and V.Kartalopoulos - Understanding Neural Networks and Fuzzy Logic, Basic Concepts Applications, IEEE Neural Networks Council Prentice Hall of India Pvt.,Ltd., 2001.
5. James A.Freeman and David M.Skapura - Neural Networks Algorithms, Applications & Programming Techniques, Pearson Education Asia, 2001.
6. Yegnarayane.B - Artificial Neural Networks, Prentice Hall – 2001.

ME 950 INDUSTRIAL AUTOMATION

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

Automation in hydraulic systems: Hydraulic systems components – constructional details and characteristics of pumps – actuator – control and regulation elements.

Unit – III

Hydraulic circuits: reciprocation operation of multi cylinder unit – quick return – sequencing, synchronizing circuits – accumulator circuits – safety circuits – circuits for press, drilling, milling and grinding – servo system – selection of components.

Unit – IV

Automation in pneumatic system: Pneumatic principles – elements of pneumatic system – control valves – basic pneumatic and hydro pneumatic circuits – logic circuits – pneumatic sensors – maintenance of pneumatic systems.

Unit – V

Architecture of Microprocessor – interfacing – data transfer schemes – application of microprocessor in hydraulic and pneumatic systems – use of microprocessor for sequencing – PLC – low cost automation.

REFERENCE BOOKS:

1. A.Esposito - Fluid Power with applications, Prentice Hall, 2001.
2. Andrew Par - Hydraulics and Pneumatics for Technicians, Jaico Publishing, 1980.
3. SR Majumdar - Pneumatic System Principles and Maintenance, Tata McGraw Hill, 1995.
4. Goankar - Microprocessor Architecture, Programming and Applications, Wiley Eastern Limited, 1993.

ME 951 INDUSTRIAL ROBOTICS TECHNOLOGY

Unit - I

Robotics and Automation - Robot Definition, Classification of Robots, Robot System components, Functions of Robot System, Specification of Robot System, Robot Drives and Power transmission systems, Remote Centered Compliance devices.

Unit - II

Robotic Sensory Devices, Non optical Position sensors, Optical position sensors, Velocity sensors, Accelerometers, Proximity sensors, Touch and Slip Sensors, Force and Torque sensors – Robot vision system.

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:

1. Richard D.Klafter, Thomas A.Chmielewski and Michael Negin - Robotic Engineering – An Integrated Approach, Prentice Hall of India Pvt Ltd, 2002
2. Mikell P.Groover, Mitchell Nicholas G.Odrey - Industrial Robotics – Technology, Programming and Applications, weiss,Roger N.Nagel and McGraw Hill International Edition, 1996.
3. Shimon Y.Nof - Hand Book of Robotics, John Wiley sons, 1985.

ME 952 INTEGRATED MATERIALS MANAGEMENT

Unit – I

Integrated Materials Management Concept - materials planning and budgeting - Quality specification – source selection - creative purchasing - purchase systems – negotiation –delivery conditions - Make or Buy - Buying seasonal commodities – purchasing under uncertainty – purchasing of capital equipment – international purchasing – import substitution – public buying – legal aspects - contracts – vendor rating – buyer-seller relationship and ethics.

Unit – II

Stores Management – stores systems and procedures – incoming materials control – stores accounting and stock verification – obsolete, surplus and scrap management – codification and standardization - value analysis – material handling – storing and material handling equipments.

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).
Common carriers – Insurance coverage – Transportation documents – railway / lorry receipts – Bill of lading – clearing, forwarding and demurrage - evaluation of materials management performance – computers in materials management.

Unit – V

Creating the logistics vision – problems with conventional organizations – developing logistics organizations - need for integration – managing supply chain as a network – process integration and ECR – comakership and logistics partnerships – supplier development.
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:

1. Panneerselvam, R. - Operations Research, Prentice Hall of India, New Delhi, 2002.
2. Gopalakrishnan, P. and Sundaresan, M. - Materials Management – An integrated approach, Prentice Hall of India Pvt. Ltd., 2000.
3. Donald M Dobler, Lamar Lee Jr and David N. Burt - Purchasing and Materials Management – Texts and Cases, Tata McGraw Hill Publishing Co. Ltd., 1985.
4. Martin Christopher - Logistics & Supply Chain Management, Pitman Publishing, 2000.
5. Tony Arnold, J.R. and Stephen N Chapman - Introduction to Materials Management, IV Edition, Pearson Education Asia Ltd.,2001.
6. Dutta, A.K. - Materials Management – Procedures, Text and Cases, II Edition, Prentice Hall of India Pvt. Ltd., 2001.

ME 953 LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Unit – I

Logistics and Competitive Strategy: Competitive advantage – gaining competitive advantage through logistics – mission of logistics management – supply chain and competitive performance – changing logistics environment. Customer Service Dimension: marketing and logistics interface – customer service and customer retention – service driven logistics systems – setting customer service priorities – setting service standards.

Unit - II

Measuring Logistics Cost and Performance: concept of total cost analysis – principles of logistics costing – logistics and the bottom line – logistics and shareholder value – customer profitability analysis – direct product profitability – cost drivers and activity-based costing.
Benchmarking the Supply Chain: benchmarking the logistics process – mapping supply chain processes – supplier and distribution benchmarking – setting benchmarking priorities – identifying logistics performance indicators. Managing the global pipeline: trend towards globalization in the supply chain – challenge of global logistics - organizing for global logistics.

Unit - III

Strategic Lead-Time Management: time based competition – concept of lead-time – logistics pipeline management – logistics value engineering – lead-time gap.
Just-in-time and Quick Response Logistics – Japanese philosophy – implications for logistics – quick response logistics – vendor managed inventory – logistics information systems – logistics systems dynamics – production strategies for quick response.

Unit - IV

Managing the Supply Chain: creating logistics vision – problems with conventional organizations – developing logistics organizations - logistics as a vehicle for change – need for integration – managing supply chain as a network – process integration and ECR – co-makership and logistics partnerships – supplier development.
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

Developing and Maintaining Supply Chain Relationships : conceptual model of alliance development – developing a trusting relationship with partners in supply chain – resolving conflicts in supply chain relationship.
Cases in SCM. - Future Challenges in SCM : greening of supply chain – design for SCM – intelligent information systems.

REFERENCE BOOKS:

1. Martin Christopher - Logistics and Supply Chain Management – Strategies for Reducing cost and improving service, Pitman Publishing, II Edition, 1998.
2. Robert B Handfield and Ernest L Nicholas Jr. - Introduction to Supply Chain Management, Prentice Hall,NJ,1999.

3. Donald J Bowersox and David J Closs - Logistical Management, Tata McGraw Hill, New Delhi, 2000.
4. David Taylor and Thomson VikaDavid - Manufacturing Operations and Supply Chain Management, Learning, 2001.
5. David Simchi and Levi - Designing and Managing the Supply Chain, Mc Graw Hill, 2000.
6. Ayers, J B - Handbook of Supply Chain Management, St. Lencie Press, 2000.
7. Sahay, B S - Supply Chain Management for Global Competitiveness, Macmillan India Ltd., New Delhi, 2000.
8. Scharj, P B and Lansen, TS- Managing the Global Supply Chain, Viva Books, New Delhi, 2000.

ME 954 MAINTENANCE AND SAFETY ENGINEERING

Unit - I

Objectives of maintenance - types of maintenance – Breakdown, preventive and predictive maintenance - Repair cycle - Repair Complexity, Lubrication and Lubricants. Maintenance of Mechanical transmission systems and process plants-Energy conservation and auditing-Case studies.

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

Safety and productivity - causes of accidents in industries – accident reporting and investigation - measuring safety performance - Safety organizations and functions - Factories act and rules-ISo 18000 and standards.

Unit - V

Safety Codes and Standards - General Safety considerations in Material Handling equipments - Machine Shop machineries-pressure vessels and pressurized pipelines – welding equipments – operation and inspection of extinguishers – prevention and spread of fire – emergency exit facilities.

REFERENCE BOOKS:

1. Garg, H.P. - Industrial Maintenance, S.Chand & Co Ltd., New Delhi, 1990.
2. Gopalakrishnan, P. - Maintenance and Spare parts Management, Prentice Hall of India Pvt. Ltd., New Delhi, 1990.
3. Panneerselvam. R - Production and Operations Management, Prentice Hall of India, New Delhi, 2006
4. Mishra, R.C. and Pathak, K.- Maintenance Engineering and Management, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
5. Alexandrov - Material Handling Equipment, Mir Publications, 1981.

ME 955 MATERIALS SCIENCES

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

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel – Smart materials, shape memory alloys – Quasi crystal and nano crystalline materials. Polymeric materials – Formation of polymer structure – Production techniques of fibres, foams, adhesives and coatings – structure, properties and applications of engineering polymers.

Unit – V

Composites – polymer matrix – metal matrix – Lamina stress strain relationship – Analysis of Laminates – Mechanical Testing of composites and their constituent materials – strength, fracture, fatigue and creep – Applications.

REFERENCE BOOKS:

1. Anderson, T.L. - Fracture Mechanics, Fundamentals and Applications, II Edition CRC Press, Boca Raton, 1995.
2. Ronald F.Gibson, - Principles of composite material mechanics McGraw Hill 1994.
3. Thomas H.Courtney - Mechanical Behaviour of Materials, II Edition, McGraw Hill, 2000
4. Charles J.A. Crane.F.A.A. - Selection and use of Engineering materials and Furness. J.A.G III Edition, Butterworth Heinemann, 1997.
5. Flinnn R.A. and Trojun P.K.- Engineering materials and their Applications, IV Edition, Jaico, 1999.

ME 956 MICRO- ELECTRO- MECHANICAL SYSTEMS

Unit - I

Mechatronics in Products – Semi conductor Sensors and micro electro mechanical Devices - Actuators – Hydraulics Actuators – pneumatic Actuators. Programmable Logic Controllers (PLC) – basic structure – input / output processing-programming – Mnemonics Timers – relays and counters – data handling – selection of PLC. Control architecture – Analog – Digital – Examples of Mechatronic systems from Robotics. Manufacturing, Machine Diagnosis.

Unit - II

Miniaturization and application- Micro electro mechanical devices and trends in developing them- Miniactuators, Microsensors, and Micromotors-Principles of Operations. Introduction, Absolute and Relative Tolerance in Manufacturing, Human Manufacturing, Top-Down Manufacturing Methods, Bottom-Up Approaches.
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 - Introduction of Mechatronics and Measurement Systems, McGraw Hill International Edition, 1999.
2. HMT - Mechatronics, Tata McGraw Hill Publishing Company Ltd., 1998.
3. Lawrence J.Kamm - Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics, Prentice Hall, 2000.
4. Marc Madou - Fundamentals of Micro fabrication, CRC Press, 1997,
5. Trimmer, W. (Ed.) - Micromechanics and MEMS, IEEE Press, 1997.
6. Elwenspoek , M. - Silicon Micromachining, Cambridge Press, 1998.

ME 957 NANOTECHNOLOGY

Unit – I

Elements of Nanoscience and Nanotechnology - Fundamentals and overview of nanoscience - Nanorevolution of the 20th century, Properties at nanoscale (optical, electronic and magnetic). Theory, definitions and scaling.

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

Applications of Nanotechnology - Nano Devices and Sensors-Nano fabrication and machining-Nanocoatings-Nanotechnology for Energy Systems-Nanotechnology in Health Care, Solar cells - Thin film Si solar cells, Fuel Cells.

REFERENCE BOOKS:

1. Guozhong Cao , - Nanostructures and Nanomaterials , synthesis , properties and applications, Imperial College Press ,2004.
2. Pradeep, T. , - NANO The Essential , understanding Nanoscience and Nanotechnology. Tata McGraw-Hill Publishing Company Limited 2007.
3. Charles Poole, P. Jr. - Introduction to Nanotechnology, John Willey & Sons , 2003.
4. Nabok, A. - Organic and Inorganic Nanostructures, Artech House, 2005
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

Design of Guideways and power screws – design of Slideways- design of spindles and spindle supports – materials for spindles – anti-friction bearings – sliding bearing- dynamics of machine tools – dynamic characteristic of the cutting process.

UNIT V

Numerical control of machine tools – fundamental concepts, classification and structure of numerical control systems- manual part programming- computer aided part programming- control systems in machine tools – control systems for changing speeds and feeds. Manual, automatic and adaptive control system – Extension of Numerical control – CNC, DNC, Machining centres.

REFERENCE BOOKS:

1. Mehta NK - Machine Tool Design & Numerical Control, Tata McGraw Hill publisher New Delhi 2009
2. CMTI - Machine Tool Design Handbook, Tata McGraw Hill publisher New Delhi 2009
3. Basu SK & Pal DK - Design of Machine Tools, India Book House Pvt Ltd, New Delhi 2009
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:

1. Johnson Ray,C. - Optimum Design of mechanical elements, Wiley, John & Sons, 1990.
2. Goldberg,D.E. - Genetic algorithms ion search, Optimization and Machine, Barnen, Addison-Wesley, New York,1989
3. Kalyanamoy Deb - Optimization for Engineering Design algorithms and Examples, Prentice Hall of India Pvt., 1995

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 chiteria. Decision tree.

Unit - III

Scope, Review of Markov chains-Markov processes and Chains – Classification. Finite and infinite – Stage dynamic programming models, exhaustive enumeration and policy iteration methods, linear programming solution.

Unit - IV

Monte Carlo Simulation – Types of simulation – Examples - Discrete event simulation – General principles – Generation of Random numbers – Manual simulation and Spreadsheet-Based simulation of single-server model – Statistical observation methods – Introduction to Simulation Languages.

UNIT - V

Genetic Algorithms- principle of working – Similarities and differences between GA and traditional methods- Simulated Annealing approach – Applications.

REFERENCE BOOKS:

1. Handy A Taha - Operations Research – An Introduction, Pearson Education India, Seventh Edition, 2002.
2. Panneerselvam, R. - Operation Research, Prentice – Hall of India, Pvt., Ltd., 2002.
3. Harvey M.Wagner - Principles of Operation Research with applications to managerial decision, Prentice Hall of India, 2001.
4. Daniel P. Heyman - Stochastic Models in Operations Research, Vol. I: Dover Publications, 2004
5. Matthew J. Sobel - Processes and Operating Characteristic, Dover Publications, 2003
6. Frederick S Hillier - Introduction to Operations Research, Mc GrawHill, NY, 1990
7. Paul A Jensen - Operations Research Models and Methods, John Wiley & Sons, 2003

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

Wear and wear types-Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., -Wear of metals and non-metals- Wear models – wear maps-wear damage.

UNIT-IV

Introduction to lubrication-Lubrication regimes-Thick Film, Mixed, Boundary - Hydrodynamic Journal and Thrust Bearings- General Reynolds equation- Various mechanisms of pressure development in oil film-Performance parameters. Design of hydrodynamically lubricated bearings using Raimondi-Boyd charts.
Composition and properties of lubricant, Evaluation and testing of lubricants.

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:

1. Halling, J., - Principles of Lubrication, Macmillan Press Ltd., 1975.
2. Hamrock, B.J. Schmid S.R.,- Fundamentals of fluid film lubrication, 2nd Ed., Marcel Jacobson B.O Dekkar,2004.

3. Cameron, A. - Basic lubrication theory, EllisHarwood Limites, 1976.
4. Bharat Bhushan, - Introduction to Tribology, John Wiley & sons., 2002.
5. Majumdar, B.C. - Introduction to Tribology of Bearings," Allied Publishers, 1992.
6. Athre, K Biswas,S - Bearings selection and Maintenace", Galcotia Publishers, 2004.

ME 962 PRODUCT RELIABILITY ENGINEERING

Unit – I

Definition – Importance of Reliability – Introduction to Probability Distributions – exponential, Weibull, normal, lognormal – Gamma – bath tub Curve – reliability and hazard functions – Determination methods.

Unit – II

Factor of Safety and Reliability – Reliability when S and L follow normal distribution, log normal distribution – Fatigue Design: deterministic design procedure, Probabilistic design procedure –Reliability analysis of Mechanical Systems.

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

Reliability techniques – Reliability allocation - Derating Components – reliability prediction in industries- Cut set / tie set – FTA – Markov models – Monte Carlo Simulation.

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:

1. Rao, S.S. - Reliability Based Design, McGraw Hill Inc, New York, 1992.
2. Balagurusamy, E. - Reliability Engineering, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2003.
3. Carter, A.D.S. - Mechanical Reliability, Macmillan, 1986.
4. Srinath, L.S. - Concepts in Reliability Engineering, Affiliated East West Press Private Limited, New Delhi, 2003.

ME 963 PROJECT MANAGEMENT

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

Appraisal process, Concepts and Techniques, Cost and Benefit from Financial angle - Basic principles for measuring costs and benefits, components of cash flow. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice.

Unit - IV

Cost of capital - Cost of different sources of finance, Cost of debt, preference capital, and Equity capital, Weighted average Cost of capital, Marginal cost of capital. Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Social cost benefits analysis (SCBA) - Rationale for SCBA, UNIDO approach.
Cost of Capital. Means of financing, Term Loans, Financial Institutions. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections.

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:

1. Gopalakrishnan, P. and Rama Moorthy , V.E. - Project Management, Macmillan India Ltd., New Delhi, 1993.
2. Prasanna Chandra - Projects - Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.
3. Goel, B.B. - Project Management - Principles and Techniques, Deep & Deep Publications, New Delhi, 1986.
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

Factorial experiments: Two way analysis of variance, Fixed, Random and Mixed models, Expected mean square rules, Nested and nested factorial designs, Effect of confounding, Fractional factorial design – response surface methodology: The method of steepest ascent, response, Surface designs.

Unit – IV

Steps in designing performance in to a product – Taguchi's definition of quality – Loss functions and manufacturing tolerances – Additivity – orthogonal arrays vs. classical statistical experiments – Graphic evaluations of main effects – Selecting factors for Taguchi Experiments.

Unit – V

Concept of S/N Ratios – Its significance in robust design – Case studies of S/N ratios in optimization – Identifying control and noise factors- Ishikawa Diagram- Constrained Robust Design Approach – Applications.

REFERENCE BOOKS:

1. Douglus C.Montgomery - Design and Analysis of Experiments, John Wiley & Sons, 1984.
2. Charles R.Hicks, - Fundamental Concepts in design of experiments,1984. Holt, Rinehort and Winston
3. Tapan P.Bagchi, - Methods Explained: Practical steps to Robust Design, Prentice Hal of India Private Limited, New Delhi,1993.

ME 965 RAPID PROTOTYPING

Unit - I

Basic concept of design, Practical Issues in Design, Information in Design, Tools for Design, Recent developments in theories of design.

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:

1. Richard Bizmingham, Graham Cleland, Robert Driver and Dwid Maffin - Understanding Engineering design, Prentice Hall of India, 1998.
2. Amitabha Ghosh, - Rapid Prototyping – A Brief Introduction, Affiliated East West Press Pvt. Ltd., 1997.
3. Radhakrishnan, P. and Subramanian, S. - CAD/CAM/CIM, New Age International (P) Ltd, Publishers, 1995.

ME 966 SIMULATION AND ITS APPLCIATIONS IN MANUFACTURING

Unit - I

Introduction to Simulation - areas of applications - systems – Components – discrete and continuous systems – types of models - simulation study steps – simulation examples – simulation of queuing systems, inventory systems and reliability problem.

Unit – II

General Principles – concepts in discrete event simulation - buildings blocks - world view – manual simulation using event scheduling and operations - List processing – basic properties**.**
Introduction to programming languages – simulation in FORTRAN, GPSS, SIMAN, SLAM and MODSIM – Comparison.

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

Mathematical and statistical models in Simulation – review of terminology and concepts – useful statistical models – discrete distributions – continuous – empirical distribution - Poisson process.
Basic concepts of queuing models and estimation of performance measures.

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:

1. Jerry Barks et al - Discrete Event System Simulation, Prentice Hall, NJ, 1996.
2. Law, A.M. and Kelton, W.D.- Simulation Modeling and Analysis, II Edition, McGraw Hill, NY, 1991.
3. Shannon and E.Robert - Systems Simulations -The Art and Science, Prentice Hall, Englewood Cliffs, NJ, 1975.
4. Irwin R.Miller et al - Probability & Statistics for Engineers, PHI Pvt. Ltd, New Delhi, 1992.
5. Barry L.Nelson, - Stochastic Modeling - Analysis & Simulation, McGraw Hill, NY, 1995.

ME 967 SURFACE ENGINEERING IN TRIBOLOGY

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-carbo-nitriding-surface coating-PVD-CVD- Nanocoatings

REFERENCE BOOKS:

1. Halling, J. - Principles of Tribology, Macmillan Press, 1976
2. Williams, J.A. - Engineering Tribology, Oxford University Press, 1994
3. Srivatsava, S.K. - Tribology in Industries, S. Chand & Co., 2001
4. Hutchings, I.M. - Tribology: Friction and wear of engineering materials, Edward Arnold, 1992.

ME 968 TOTAL QUALITY MANAGEMENT

Unit - I

Introduction to TQM – Strategies concepts and objectives – Total quality model – TQM as applied to Indian Industries – Quality circle concepts – concepts, objectives and functions of quality circles – Benefits of the organization – Training of quality Circle members – Implementation.

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

Quality based product and process Design – Design for reliability – Design for maintainability – Quality Function Deployment (QFD) – QFD and Quality Assurance – QFD Principles, Concepts and applications – case studies.

Unit – V

Introduction to SQC concepts- KAIZEN Concepts – Kaizen by TQC – POKA YOKE - IS 9000-QS9000,14000 concepts- certification system – 9001 to 9004 systems – procedures, audits and reviews – Lean manufacturing systems- Toyota production concepts-case studies.

REFERENCE BOOKS:

1. Sundara Raja, S.M. - Total Quality Management Tata Mc Graw Hill, 1998.
2. Patrick.J.Sweeney(Editor)- TQM for Engineering, Quality Resources, Newyork, 1993.
3. John Bank - The Essence of Total Quality Management, Prentice Hall of India, 1998.
4. James I Bossert - Quality Function Deployment, ASQC Quality Press, Wisconsin, 1994.

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:

1. Benjamin W.Niebel, - Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 1982.
2. Barnes, R.M. - Motion and Time Study, John Wiley, 1980.
3. Stephen Konz., - Work Design, Publishing Horizon Inc., Second Edition, 1979.
4. Bridger R.S. - Introduction to Ergonomics, McGraw-Hill, 1995.

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

1. INFRASTRUCTURE:

(i) Building Infrastructure

Sl.No.	Building Details	Area (Sq.m)
1.	Class/Tutorial Room	34
2.	Laboratory	75
3.	Project Lab	50

(ii) Equipment Infrastructure

Sl.No.	Facilities/Equipment/Accessories	Qty.
2.	Surface Roughness Measuring Instrument	1
3.	CNC Trainer Lathe	1
4.	CNC Trainer Milling Machine	1
5.	CNC Bench Trainer lathe	1
6.	Wind Tunnel	1
7.	Gear Hobbing Machine	1
8.	Mould Strength Testing Machine	1
9.	FFT Analyser	1
10.	Gas Analyser	1
11.	Computer Systems connected with LAN	25
12.	CATTIA 12 version	15 Licence
13.	ANSYS 12 version	15 Licence
14.	AUTO CAD 2002	15 Licence
15.	UTM Machine	1
16.	Plotter 450	1
17.	HP Laser Printer 1000	1
18.	HP Laser Printer 1023	1

19. LIBRARY:

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

20. FACULTY REQUIREMENT:

S.No.	Cadre	No.	Qualification	Specialization
1.	Professor	**1**	As per AICTE norms	Production/Manufacturing/Machine Design/Tribology
2.	Associate Professor	**1**	As per AICTE norms	Production/Manufacturing/Machine Design/Tribology
3.	Assistant Professor	**1**	As per AICTE norms	Production/Manufacturing/Machine Design

4. TEACHER TO STUDENT RATION : 1:15

5. STUDENT TO COMPUTER RATIO : 1:1