ACHARYA NAGARJUNA UNIVERSITY

NAGARJUNA NAGAR, GUNTUR – 522 510

ANDHRAPRADESH, INDIA

CHOICE BASED CREDIT SYSTEM

Regulations,
Scheme of Instruction,
Examination and Syllabi

for

MACHINE DESIGN

2-Year M.Tech. Degree Course
in Mechanical Engineering
(Semester System)

w.e.f.: 2015-2016

ACHARYA NAGARJUNA UNIVERSITY :: NAGARJUNA NAGAR

REVISED REGULATIONS FOR
TWO - YEAR M.TECH. DEGREE COURSE
(CHOICE BASED CREDIT SYSTEM)

(With effect from the batch of students admitted during the academic year 2015-2016)

1.0 ELIGIBILITY FOR ADMISSION

1.1 The candidates, both non-sponsored and sponsored, for Admission into M.Tech programme shall have one of the following qualifications.

S.No.	Programme	Qualifications
1.	Chemical Engineering	Bachelor Degree in Chemical Engineering / Chemical Technology / Biotechnology or its equivalent Degree recognized by Acharya Nagarjuna University
2.	Civil Engineering	Bachelor Degree in Civil Engineering or its equivalent Degree recognized by Acharya Nagarjuna University
3.	Computer Science & Engineering	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
4.	Electrical and Electronics Engineering	Bachelor Degree in Electrical & Electronics Engineering / Electrical Engineering / Electrical Power Engineering / AMIE (Electrical Engineering) or its equivalent Degree recognized by Acharya Nagarjuna University.
5.	Electronics and Communication Engineering	Bachelor Degree in Electronics & Communication / Electronic & Instrumentation Engineering / AMIE or its equivalent Degree recognized by Acharya Nagarjuna University.
6.	Information Technology	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
7.	Mechanical Engineering	Bachelor Degree in Mechanical Engineering or its equivalent Degree recognized by Acharya Nagarjuna University.

1.2 Admission of Non-sponsored category students: Admission of non-sponsored category students is made on the basis of GATE/PGECET rank. When GATE/PGECET qualified candidates are not available, admission will be on the basis of merit in the qualifying examination. Students with or without GATE/PGECET rank should have obtained a minimum of 50% marks in the qualifying examination to become eligible for admission.

Reservation of seats to the candidates belonging to Scheduled Castes and Scheduled Tribes is as prescribed by the State Govt./University from time to time.

If suitable candidates are not available to fill all the seats reserved for S.T category, they shall be filled by students S.C. Category and vice-versa.

If suitable candidates are not available for reserved seats, they shall be filled by the general category candidates.

1.3 Admission of Sponsored Category students: Sponsored category students should have at least 50% marks in the qualifying examination to become eligible for admission to the Post Graduate Programme. Preference will be given to those candidates who are GATE/PGECET qualified.

The candidates must have a minimum of two years of full time work experience in a registered firm / company/ industry / educational and research institutions / any government department or government autonomous organizations in the relevant field in which the admission is being sought.

A letter from the employer must be furnished stating that the candidate is being sponsored to get admission. The employer should also indicate that the candidate will not be withdrawn midway till the completion of course. The rule of reservation shall not apply to the admission of sponsored category students.

1.4 The total number of full time candidates admitted into a course with or without GATE/PGECET rank should not exceed the sanctioned strength.

2.0 MEDIUM OF INSTRUCTION, DURATION AND STRUCTURE

2.1. The medium of instruction shall be in English.

2.2. The minimum and maximum period for completion of the P.G. Programme is 4 Semesters for full time students.

2.3. Each Semester shall normally spread over sixteen weeks.

(a) The Programme may consist of
   i. Core Courses
   ii. Elective Courses
   iii. Seminars
   iv. Internship
   v. Project Work

(b) The structure of the Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects and 3 Lab courses + 1 Mini Project / Seminar (or) 2 Lab courses + 2 Seminars / Mini Project, followed by two semesters of Project work. In summer break, the student should undergo internship for four weeks duration. The student should present a seminar on the project work done at the end of the third semester. At the end of fourth semester the students should submit Project Thesis.

(c) Core subjects are fixed in each semester and a student must opt them without any choice. Whereas electives can be chosen by a student from the list of

electives given (minimum 18 and maximum 24) according to his choice.

2.4. Project work shall be carried out under the Supervision of a Faculty Member in the concerned department.

2.5. A candidate may, however, in certain cases, be permitted to work on his Project/Dissertation at the place of employment, any recognized Institution/R&D Organization/Industry with the approval of the Head of the Department concerned and Head of the Organization. In such cases, the Project Work shall be jointly supervised by a member of the faculty and a person from the Organization holding a minimum of P.G. Degree in the concerned area of specialization.

2.6. Five copies of the Project Report certified by the Supervisor(s) and the Head of the Department concerned shall be submitted within one Calendar Year after completion of the second semester.

2.7. The student is eligible for the submission of M.Tech. Project Report at the end of fourth semester if he/she passed all the course work in the first & second semesters.

2.8. In a special case, if any candidate unable submit his/her Project Report at the end of fourth semester due to ill health or any other reason permitted by the head of the institution, he/she will be allowed submit at a later date and the viva-voce examination will be conducted, if clause 2.7 is satisfied.

3.0. ATTENDANCE

3.1 The candidate shall put up a minimum of 75% attendance in each subject.

3.2. Condonation of shortage in attendance up to 10% in any subject may be condoned by the University on the recommendations of the Principal of the concerned College for reasons of ill health and the application is submitted at the time of actual illness and is supported by a certificate from the authorized Medical Officer approved by the Principal.

3.3. If the candidate does not satisfy the attendance requirement in any subject he or she shall not be permitted to appear for the University examination in that subject and has to repeat that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken into amount.

3.4. Failure in securing minimum prescribed attendance in any subject of previous Semester (s) is no bar for enrollment to the next semester.

4.0. EVALUATION

4.1 The performance of the candidate in each semester shall be evaluated subject wise. The maximum marks for each subject, seminar etc, will be as prescribed in the curriculum. The Internal Evaluation for Theory subjects shall be based on two mid-term examinations and two assignments. In every theory subject, out of 40

sessional marks, 30 marks are allotted to mid-term examination and 10 marks for assignments. The best of the performances in the two midterm examinations, one held in the middle of the semester and another held immediately after the completion of the instruction, will be considered. The internal evaluation for practical subjects is based on the day-to-day performance and semester end internal practical Examination.

4.2 The marks for Seminar will be awarded by internal evaluation made by two staff members of the faculty of the department concerned.

4.3 For taking the University examination in any theory or practical subject, candidates shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he/she shall be required to repeat the course in that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken into amount.

4.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he or she secures a minimum of 50% marks in internal evaluation.

4.5 In case the candidate does not secure the minimum academic requirement in any subject he/she has to reappear in the University examination in that subject or any equivalent subject prescribed.

4.6 Failure to attain the minimum academic requirement in any subject of previous semester (s) is no bar for enrollment to the next semester.

4.7 The performance of the students in each semester shall be evaluated subject wise The distribution of marks between sessional work (based on internal assessment) and University Examination will be as follows:

Nature of the subject	Sessional Marks	University Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Project Seminar	100	--
Project work	50	150iva voce)

5.0 AWARD OF CREDITS

Credits are awarded for each Theory/Practical/Seminar/Project Subjects. Each theory subject is awarded 4 credits and each practical/Seminar subjects is awarded 2 credits. Project seminar in III Semester is awarded 6 credits and 2 credits will be awarded for internship and Project Viva-voce at the end of IV Semester is awarded 16 credits.

6.0 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1	≥85%	S	10.0
2	75%-84%	A	9.0
3	65%-74%	B	8.0
4	60%-64%	C	7.0
5	55%-59%	D	6.0
6	50%-54%	E	5.0
7	≤49%	F(Fail)	0.0
8	The grade 'W' represents withdrawal/absent (subsequently changed into pass or E toS or F grade in the same semester)	W	0.0

A Student securing 'F' grade in any subject there by securing 0 grade points has to reappear and secure at least 'E' grade at the subsequent examinations in that subject

'W' denotes withdrawal/absent for a subject:

- After results are declared and Grade sheets will be issued to each student which will contain the following details:
- The list of subjects in the semester and corresponding credits and Grade obtained

- The Grade point average(GPA) for the semester and

- The Cumulative Grade Point Average(CGPA) of all subjects put together up to that semester from first semester onwards

GPA is calculated based on the fallowing formula:

$$\frac{\text{Sum of [No.Credits X Grade Point]}}{\text{Sum of Credits}}$$

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester onwards.

7.0 AWARD OF DEGREE AND CLASS

A candidate who becomes eligible for the award of the degree shall be placed in the following three divisions based on the CGPA secured by him/her for the entire Programme

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.0 or more but less than 6.5

8.0 WITH-HOLDING OF RESULTS

The result of a candidate may be withheld in the following cases

i. The candidate has not paid dues to the institution
ii. A case of indiscipline is pending against the candidate
iii. A case of malpractice in examination is pending against the candidate The issue of degree is liable to be withheld in such cases

9.0 GENERAL

9.1. The University reserves the right of altering the regulations as and when necessary.

9.2 The regulations altered will be applicable to all the candidates on the rolls Irrespective of the fact that the regulations at the time of admission of the student to the programme are different.

9.3 The Academic Regulations should be read as a whole for purpose of any Interpretation Whenever there is a dispute regarding interpretation of regulations, the decision of the Vice-Chancellor is final.

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ACHARYA NAGARJUNA UNIVERSITY: NAGARJUNA NAGAR

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (MACHINE DESIGN) :: FIRST SEMESTER

Si No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks			
		Lecture	Practical		Internal	External		Total
						Theory	Practical	
1	MT/ME/CC/MD-511: Computer Aided Design	4	--	4	40	60	--	100
2	MT/ME/CC -612 / MT/ME/MD -512: Design of Mechanisms & Manipulators	4	--	4	40	60	--	100
3	MT/ME/MD -513: Theory of Elasticity and Plasticity	4	--	4	40	60	--	100
4	Elective Subject-1	4	--	4	40	60	--	100
5	Elective Subject-2	4	--	4	40	60	--	100
6	Elective Subject-3	4	--	4	40	60	--	100
7	MT/ME/MD-551– Computer Aided Design Lab	--	3	2	40	--	60	100
8	MT/ME/MD-552– Analysis Lab	--	3	2	40	--	60	100
TOTAL		24	6	28				800

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (MACHINE DESIGN) :: SECOND SEMESTER

Si No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks			
		Lecture	Practical		Internal	External		Total
						Theory	Practical	
1	MT/ME/CC -613 / MT/ME/MD -514 Advanced Mechanisms Design	4	--	4	40	60	--	100
2	MT/ME/MD -515: Mechanics of Fracture and Fatigue	4	--	4	40	60	--	100
3	MT/ME/CC/MD -516: Optimization Techniques	4	--	4	40	60	--	100
4	Elective Subject-4	4	--	4	40	60	--	100
5	Elective Subject-5	4	--	4	40	60	--	100
6	Elective Subject-6	4	--	4	40	60	--	100
7	MT/ME/MD-553– Machine Dynamics & Simulation Lab	--	3	2	40	--	60	100
8	MT/ME/MD -554 Mini Project/ Seminar	--	3	2	100	--	--	100
TOTAL		24	6	28				800

ACHARYA NAGARJUNA UNIVERSITY: NAGARJUNA NAGAR

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (MACHINE DESIGN) :: THIRD SEMESTER

Si No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks		
		Lecture	Practical		Internal	External	Total
1	MT/ME/MD -711 Internship	---	---	2	100	--	100
2	MT/ME/MD -712 Project Seminar	--	---	6	100	--	100

SCHEME OF EXAMINATION AND INSTRUCTION FOR

M.TECH (MACHINE DESIGN) :: FOURTH SEMESTER

Si No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks		
		Lecture	Practical		Internal	External	Total
1	MT/ME/MD -713 Project Viva	--	---	16	50	150	200

LIST OF SUBJECTS

ELECTIVE SUBJECTS:

Subject Code	Subject Title
MT/ME/CC/MD -611	Computational Methods
MT/ME/CC -512/ MT/ME/MD -612	Finite Element Analysis
MT/ME/MD -613	Robotic Engineering
MT/ME/CC/MD -614	Design for Manufacturing
MT/ME/CC/MD -615	Mechanical Vibrations
MT/ME/MD -616	Tool Design
MT/ME/MD -617	Design of Pressure Vessels
MT/ME/MD -618	Tribology
MT/ME/MD -619	Gear Engineering
MT/ME/MD -620	Experimental Stress Analysis
MT/ME/CC/MD -621	Mechanics of Composite Materials
MT/ME/CC/MD -622	Computational Fluid Dynamics
MT/ME/MD -623	Product Life Cycle Management
MT/ME/MD -624	Design of Experiments
MT/ME/CC/MD -625	Reliability Engineering
MT/ME/CC/MD -626	Quality Engineering
MT/ME/CC/MD -627	Fluidics and Control Systems
MT/ME/CC/MD -628	Nanotechnology

LAB COURSES:

MT/ME/MD -551	:	Computer Aided Design Lab
MT/ME/MD -552	:	Analysis Lab
MT/ME/MD -553	:	Machine Dynamics & Simulation Lab
MT/ME/MD -554	:	Mini Project / Seminar

- 24 credits have to be achieved from Core Subjects.
- 24 credits have to be achieved from Elective Subjects.
- 8 credits have to be achieved from Labs.
- 2 credits have to be achieved from internship.
- 22 credits have to be achieved from Project.
- Total 80 credits required for Awarding the M.Tech Degree.

CORE SUBJECT

MT/ME/CC/MD 511 :: COMPUTER AIDED DESIGN

M.Tech. (CAD/CAM / Machine Design): First Semester

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT – I

Typical Product Cycle, Implementation of a typical CAD process, Application of CAD and their Advantages
3D modeling and viewing: Introduction, Modeling Approaches, Types of Geometric Models, Coordinate System, sketching and Sketch Planes, Parameters and Dimensions, Basic Features, Datum Features, Geometric Constraints, Modeling Operations and Strategies
Modeling Aids and Tools: Introduction, Geometric Modifiers, Layers, Colors, Grids, Groups, Dragging and Rubbering, Clipping, Entity Selection methods, Geometric Arrays, Transformat**ions**, Editing.

UNIT – II

Geometric Modeling: Types of Curves and Curve Manipulations, Types of Surfaces and Surface Manipulations, *Solids:* Introduction, Geometry and Topology, Solid Entities, Fundamentals of Solid Modeling, Boundary Representation (B-rep), Constructive Solid Geometry (CSG) – examples, Sweeps and Solid Manipulations

Feature based Modeling: Introduction, Feature Entities, Parametrics, Feature Manipulations
Rapid Proto Typing: Introduction, RP activities, RP applications, RP techniques: Stereo-lithography, Selective Laser Sintering, 3 – D Printing, Fused Deposition Modeling and Laminated Object Manufacturing.

UNIT – III

Visualization: Introduction, Model clean up, Hidden-Line Removal, Hidden Surface Removal, Hidden Solid Removal, Shading, Colors. **Computer Animation:** Introduction, Animation Types, Key Frame Technique **Product Data Exchange:** Introduction, Types of Translators, IGES, Processors

UNIT – IV

Assembly Modeling: Introduction, Assembly Modeling, Assembly Tree, Assembly Planning, Mating Conditions, Bottom – Up and Top – Down Assembly Approaches with examples
Tolerance Analysis and Mass Property calculations

Collaborative Design: Traditional design, Collaborative Design, Principles and Approaches
Product Lifecycle Management: Introduction, Product Information, PLM Frame Work, Benefits

TEXT BOOK:

1. "Mastering CAD/CAM" by Ibrahim Zeid, Tata McGraw-Hill Edition, New Delhi

REFERENCES:

a. CAD/CAM by PN Rao, PHI
b. CAD/CAM – Theory and Practice by Ibrahim Zeid, MGH International
c. CAD/CAM – Computer Aided Design and Manufacturing by Mikell P Groover and Emory W Zimmers Jr., Prentice Hill, International

CORE SUBJECT

MT/ME/CC 612/ MT/ME/MD 512 :: DESIGN OF MECHANISMS & MANIPULATORS

M.Tech. (CAD/CAM/Machine Design) Second Semester

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT - I

Mobility analysis – Degree of freedom (DOF), mixed mobility, total, partial and fractional DOF. Closed and open chain systems, structural analysis and synthesis of mechanisms.

UNIT - II

Alternative design solutions, coding, evaluation and selection of optimum mechanism, type synthesis, number synthesis and design of mechanisms.

UNIT - III

Indexes of merit, graphical, algebraic and optimization techniques, matrix methods of design and analysis, design of function, path and motion generators, structural and mechanical error

UNIT - IV

Manipulators – Classification, actuation and transmission systems, coordinate transformation – DH notations, inverse and forward kinematics, manipulator dynamics from Lagrangian and Newtonian point of view.

REFERENCES:

1. George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 1, PHI, 1988
2. George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 2, PHI, 1988
3. Mechanisms & Mechines (Analysis & Syntheis)by Arthur Erdman
4 . Klafter R.D., Cmielewski T.A. and Negin M ., "Robot Engineering An Intergrated approach", Prentice Hall of India,New Delhi,1994
5. Deb S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Co., Ltd.,1994

CORE SUBJECT

MT/ME/MD 513 :: THEORY OF ELASTICITY & PLASTICITY

M.Tech. (Machine Design) First Semester

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.

Problem in rectangular coordinates - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.

UNIT II

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

Analysis of stress and strain in three dimensions - Principle stresses – Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.

UNIT III

General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

Bending of prismatic bars - Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

UNIT IV

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

Methods of solving practical problems - The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

REFERENCES:

1. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N.
2. An Engineering Theory of Plasticity by E.P. Unksov.
3. Applied Elasticity by W.T. Wang.
4. Theory of Plasticity by Hoffman and Sacks.

CORE SUBJECT

MT/ME/CC 613/ MT/ME/MD 514 :: ADVANCED MECHANISMS DESIGN

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

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 solutions for velocity and acceleration analysis – human tolerance for acceleration. Plane complex mechanisms – auxiliary point method

UNIT - II

Path Curvature Theory: Fixed and moving centroids, inflection points and inflection circle, Euler savary equation.

Synthesis of Mechanisms: Type synthesis – case study of casement window mechanisms Number synthesis – Associated linkage concept Dimensional synthesis – function generation, path generation, motion generation - Graphical methods – two, three positions, circle point and centre point circles – order synthesis of four bar function generation – four positions, special cases of four position synthesis – Finite Ball's point – five positions – cognate linkages

UNIT - III

Coupler curve synthesis, design of six bar mechanisms for different applications including dwell. Algebraic methods – using vector loop equations and complex algebra, synthesis of multi loop linkage mechanisms, geared linkages, application of instant centre in linkage design. Practical considerations in mechanism design, mechanism defects.

UNIT - IV

Dynamics of Mechanisms: Static force analysis with friction – inertia force analysis – slider crank mechanism, four bar mechanism, crank – shaper mechanism – combined static and inertia force analysis, shaking force, kinetostatic analysis of a card bunch – time response of a four bar linkage, modification of the time response of a mechanism – virtual work. Introduction to force and moment balancing of linkages

Spatial Mechanisms and Robotics: Kinematic analysis of spatial RSSR mechanism – Denavit - Hartenberg parameters - Forward and inverse kinematics of robotic manipulators

REFERENCE BOOKS:

1. Sandor G.N, and Erdman A.G. Advanced Mechanism Design : Analysis and Syntheis, PHI, 1984.
2. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, EWLP, Delhi, 1994
3. Shigley, J.e., and Vicker, J.J. Theory of Mechanisms, McGrawHill, 1995.
4. Norton R.L. Design of machinery, McGrawHill, 1992.

CORE SUBJECT

MT/ME/MD-515 :: MECHANICS OF FRACTURE & FATIGUE

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Introduction: Introduction to historical review, Source of micro and macro cracks, An atomic view of fracture stress concentration flaws. NDT and various NDT methods used in fracture mechanics. **Fatigue:** Introduction to High and low cycle fatigue, process of fatigue fracture, effect of mean stress, cyclic stress/strain response of materials, establishment of cyclic stress/strain curve, transition fatigue life, Coffin-Manson relationship. Empirical Fatigue crack growth equation.

UNIT II

Linear elastic Fracture Mechanics: The Griffith's Energy balanced approach. Stress analysis of cracks, Stress Intensity Factor, Relationship between K and Global behavior, Effect of Finite Size, Principle of superposition, Relation between K and G. Crack Tip plasticity, Irwin Approach, Strip Yield model, comparison plastic zone corrections, K-Controlled Facture, Plain Strain Facture, Mixed Mode Fracture, Mathematical foundation for linear elastic fracture mechanics, crack growth instability analysis, Crack Tip stress Analysis.

UNIT III

Elastic-Plastic fracture mechanics: Crack tip opening displacement, The J Contour Integral, Relationships between J and CTOD, Crack growth with resistance curves crack strip constant under large scale yielding .Mathematical Modeling for Elastic – Plastic Fracture mechanics.

UNIT IV

Dynamic and Time Dependent Fracture: Dynamic Fracture And Crack Arrest, Rapid Crack Propagation And Arrest, Elasto-dynamic Crack-Tip Parameters, Dynamic Toughness, Dynamic Contour Integrals, Creep Crack Growth Viscoelastic Fracture Mechanics, The Viscoelastic *J* Integral, Transition From Linear To Nonlinear Behavior, Dynamic Fracture Analysis.

TEXT BOOKS:

1. Fracture Mechanics-Fundamental and Application - Anderson, T.L CRC press1998.
2. Elementary Engineering Fracture Mechanics - David Brock, Noordhoff.

REFERENCE BOOKS:

1. Engineering fracture mechanics - S.A. Meguid Elsevier.
2. Fracture of Engineering Brittle Materials, Applied Science - Jayatilake, London.
3. Fracture and Fatigue Control in Structures - Rolfe and Barsom, , Prentice Hall.
4. Introduction to fracture mechanics - Karen Hellan, McGraw Hill.
5. Fundamentals of fracture mechanisms - Knott, Butterworths.

CORE SUBJECT

MT/ME/CC/MD 516 :: OPTIMIZATION TECHNIQUES

M.Tech. (CAD/CAM / Machine Design): *Second Semester*

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints -Classification of optimization problems and applications.
Single variable and multivariable optimization, Techniques of unconstrained minimization Golden Section, Fibonocci and gradient search methods – Quadratic Interpolation method.

UNIT II

Optimization with equality and inequality constraints - Direct methods - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming, Linear programming using simplex approach.

UNIT III

Introduction to Genetic Algorithms, Simulated Annealing , Neural networks and fuzzy logic techniques..

UNIT IV

Integer programming: Introduction – formulation – Gomory cutting plane algorithm – Zero - One algorithm, branch and bound method.
Design application - Structural applications - Design of simple truss members. Design of simple axial, transverse loaded members for minimum cost and /or weight, - Design of shafts and torsionally loaded members for minimum weight.

TEXT BOOKS:

1. A.Ravindran, K.M.Ragsdell & G.V.Reklaitis “Engineering Optimization Methods and Applications”, 2nd edition, Wiley publications
2. Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd., Publishers, 2000.

REFERENCES:

1. Johnson Ray, C., "Optimum design of mechanical elements”, Wiley, John & Sons, 1981..
2. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India, 1995.
3. R. Pannerselvam , “Operations Research “, Prentice Hall of India , 2nd Edition, 2006

LAB COURSE

MT/ME/MD-551 :: Computer Aided Design Lab

M.Tech. (Machine Design): First Semester

Practicals	*: 3 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

Exercises will be given on Modeling of mechanical Components using packages like PRO/ENGINEER, Uni-Graphics, CATIA, Autodesk INVENTOR, Solid works etc.

1. Creation of working drawings of components and preparation of assembly models of screw jack, leaf jig, plumber block, lathe chuck, machine-vice, box type drilling jig assembly etc. by using the following techniques:

-Generation of surfaces of revolution

-Generation of surfaces of extrusion

-Generation of surfaces by skinning operation

-Generation of solid models using constructive solid geometry, method shading and rendering.

2. Generation of Ferguson's cubic surface patches, Generation of Bezier UNISURF surface patches, Generation of Coon's patches.

LAB COURSE

MT/ME/MD 552 :: Analysis Lab

M.Tech. (Machine Design) First Semester

Practicals	*: 3 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

Exercises will be given on Analysis of mechanical Components using packages like ANSYS/HYPERMESH/NASTRAN, etc..

I. Structural Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Buckling Analysis
6. Analysis of Composites

II. Thermal Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Steady state thermal analysis
2. Transient thermal analysis

III. Transient analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Linear
2. Non-Linear (Geometrical Non-linearity)

IV Contact Analysis

V Crushing Analysis

LAB COURSE

MT/ME/MD-553:: Machine Dynamics & Simulation Lab

M.Tech. (Machine Design) Second Semester

Practicals	*: 3 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

Any Ten Experiments should be performed:

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils
2. Determination of steady state amplitude of a forced vibratory system
3. Static balancing using steel balls
4. Determine the MI of connecting rod by bi-filar suspension pendulum method
5. Determination of natural frequency of given structure using FFT analyzer
6. Diagnosis of machine using FFT analyzer.
7. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.
8. Direct kinematic analysis of a robot
9. Inverse kinematic analysis of a robot
10. Palletizing operation using Robot programming.

SIMULATION:

11. Solving problems involving numerical differentiation and integrations
12. Solving problems related to optimization
13. Obtaining Natural frequencies and mode shapes for vibration systems.
14. Position Analysis of Slider-Crank (R-RRT) Mechanism and determination of point on a link.
15. Simulation of spring mass damper System using MATLAB
16. Frequency Response Analysis (Draw the Phase Margin and Gain Margin, Bode Plots) of given system using MATLAB.

MT/ME/MD- 554:: MINI PROJECT/SEMINAR

M.Tech. (Machine Design) :: Second Semester

Practicals	*: 3 Periods / week*	*Sessional Marks*	*: 100*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: --*

- Report has to be submitted and a presentation has to be given at the end of semester for mini project.
- Six presentations have to be given on research topics for evaluation of Seminars.
- ***Internal assessment is done based on the seminar presentations.***

ELECTIVE SUBJECT

MT/ME/CC/MD 611 :: COMPUTATIONAL METHODS

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT – I

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations, Matrix notation, Determinants and inversion, Iterative methods, Relaxation methods , System of non-linear equations , computer programs
Numerical integration: Newton-Cotes integration formulas, Simpson's rules, Gaussian quadrature. Adaptive integration

UNIT – II

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrained optimization
Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – III

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples, Derivative boundary conditions , Irregular and non , rectangular grids , Matrix patterns, sparseness , ADI method , Finite element method.
Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

UNIT – IV

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method , method of characteristics-wave equation in two space dimensions-computer programs.
Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares, regression analysis, multiple linear regression, non linear regression - computer programs.

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw hill
2.Curtis F.Gerald, partick.O.Wheatly, "Applied numerical analysis" Addison-wesley,1989
3.Douglas J..Faires,Riched Burden "Numerical methods" Brooks/cole publishing company,1998.

REFERENCES:

1.Ward cheney &David Kincaid "Numerical mathematics and computing" Brooks/cole publishing company1999,fourth edition.
2.Riley K.F.M.P.Hobson&Bence S.J, "mathematical methods for physics and engineering" Cambridge university press,1999.

ELECTIVE SUBJECT

MT/ME/CC 512/ MT/ME/MD 612 :: FINITE ELEMENT ANALYSIS

M.Tech. (CAD/CAM / Machine Design: *First Semester*

Lectures / Tutorials : 4 Periods / week *Sessional Marks : 40*

University Exam. : 3 hrs. *University Exam. Marks : 60*

UNIT – I

Formulation Techniques: Methodology, Engineering problems and governing differential equations , finite elements , Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin,

UNIT – II

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.**Beams and Frames:** Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT – III

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration. Higher order Elements

UNIT – IV

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems.**Convergence:** Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

TEXT BOOK:

1. Finite element methods by Chandrubptla & Belagondu.

REFERENCES:

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press,1994
2. Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill,1983.
3. J. N. Oden, Finite Element of Nonlinear continua, McGraw-Hill, New York, 1971
4. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996

ELECTIVE SUBJECT

MT/ME/MD 613:: ROBOTIC ENGINEERING

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT-I

Fundamentals of Robots: Introduction to Robotics, classification of robots – Classification by coordinate system and by control method, Basic components of robot system, functions and specifications of robot, overview of robot application.
Robot end Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices.

UNIT-II

Actuators: Types, Characteristics of actuating system: weight, Power-to-weight ratio, Operating pressure, Stiffness vs. compliance, Comparison of hydraulic, Electric, pneumatic, actuators, Hydraulic actuators, Electric Motors: Brushless DC motors, Stepper motors-structure and principle of operation.
Sensors: Sensor characteristics, Position sensors- potentiometers, synchros, Resolvers, inducto-syn, Encoders, LVDT, Force sensors – strain gauge force sensors, Touch and slip sensor, Proximity sensors-Reflected light sensors, fibre optics scanning sensors, scanning laser sensors, ultrasonic sensors, Eddy -current proximity sensors.

UNIT-III

Transformation and Kinematics: Homogeneous coordinates, properties of transformation matrices, homogeneous transformations, Representation of transformations – pure translation, pure rotation, combined transformations. Forward solution – Denavit-Hartenberg procedure. Problems on simple 2R and 3R manipulator, Puma manipulator, SCARA manipulator, Inverse or backward solution – techniques, problems involved of 2R, 3R manipulator.

UNIT-IV

Velocity and Statics of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocities of links in serial 2R manipulators, Singularities. **Motion Generation:** Introduction to trajectory planning, basics of trajectory planning,

TEXT BOOKS:

1. Robotic Engineering- an integrated approach - Richard D.Klafter, PHI
2. Introduction to Robotics Analysis - Niku, S. B., Systems, Applications, Pearson Education.

REFERENCE BOOKS:

1. Robotics and Control – R K Mittal and I J Nagrath
2. Introduction to Robotics: Mechanics and Control - 2nd Edition - Craig, J.J.
3. Fundamentals of Robotics, Analysis and Control - Schilling R. J., PHI, 2006.

ELECTIVE SUBJECT

MT/ME/CC/MD-614 :: DESIGN FOR MANUFACTURING

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT- I

Introduction: General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits – Datum features - Tolerance stacks

UNIT- II

Factors Influencing Form Design: Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on from design - from design of welded members, forgings and castings.

UNIT –III

Component Design-Machining Consideration: 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 .

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

UNIT -IV

Design for Manufacture and Case Studies: Identification of uneconomical design, Design for economy , Design for clampability - Design for accessibility - Modifying the design , Design for assembly , Group technology - Computer Applications for DFMA

TEXT BOOK:

Harry Peck, "Design for Manufacture", Pittman Publication, 1983.

REFERENCES:

1. Robert Matousek, "Engineering Design - A systematic approach", Blackie & sons Ltd.
2. James G. Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Co.
3. Swift K.G., "Knowledge based design for manufacture, Kogan Page Ltd., 1987.

ELECTIVE SUBJECT

ELECTIVE SUBJECT

MT/ME/CC/MD 615 : MECHANICAL VIBRATIONS

M.Tech. (CAD/CAM)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Fundamentals of vibration Review of Single degree system - Response to arbitrary periodic excitations - Duhamel's Integral – Impulse Response function - Virtual work - Lagrange's equation - Single degree freedom forced vibration with elastically coupled viscous dampers - System Identification from frequency response - Transient Vibration - Laplace transformation formulation.
Two degree of freedom systems Free vibration of spring - coupled system - mass coupled system - Bending vibration of two degree of freedom system - forced vibration - Vibration Absorber - Vibration isolation

UNIT II

Multi- degree of freedom system Normal mode of vibration - Flexibility Matrix and Stiffness matrix - Eigen values and eigen vectors - orthogonal properties - Modal matrix- Modal Analysis - Forced Vibration by matrix inversion – Modal damping in forced vibration - Numerical methods for fundamental frequencies.

UNIT III

Vibration of continuous systems Systems governed by wave equations - Vibration of strings - vibration of rods - Euler Equation for Beams - Effect of Rotary inertia and shear deformation - Vibration of plates

UNIT IV

Experimental methods in vibration analysis Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of Vibration tests - Industrial case studies

REFERENCES:

4. Thomson, W.T. - "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990
5. Rao, J.S., & Gupta, K. - "Introductory Course on Theory and Practice of Mechanical Vibrations", New Age International Ltd., 1984
6. Den Hartog, J.P. "Mechanical Vibrations", Dover Publication, 1990
7. Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995

ELECTIVE SUBJECT

MT/ME/MD 616 :: TOOL DESIGN

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Tool design methods Introduction, Design procedure, Statement of the problem, Needs Analysis – Tentative design solutions, finished design, Drafting and design techniques in tooling drawings, Punch and die Manufacturing Techniques.

UNIT II

Tooling materials Introduction, Properties of tool materials, Metal cutting tools, Single-point cutting tools, Milling cutters, Drills and Drilling, Reamer classification, Taps, Tap classification, The selection of carbide cutting tools, Determining the insert thickness for carbide tools, Various heat treatments.

Gages and gage design Introduction, Fixed Gauges, Gauge Tolerances, The selection of material for Gages, Indicating Gages, and Automatic gages.

UNIT III

Design of Drill Jigs : Principles of location, Locating methods and devices, Principles of clamping, Drill jigs, Chip formation in drilling, General considerations in the design of drill jigs, Drill bushings, Methods of construction, Drill jigs and modern manufacturing, Computer aided Jig design.

Design of Fixtures : Introduction, Fixtures and economics, Types of Fixtures, Vise Fixtures, Milling Fixtures, Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding Fixtures, Types of Die construction, Computer aided Fixture Design,

Design of Dies : Die-design fundamentals, Blanking and Piercing die construction, Pilots, Strippers and pressure pads, Presswork materials, Strip layout, Short -run tooling for Piercing, Bending dies ,Forming dies, Drawing operations.

UNIT IV

Tool design for numerically controlled machines Introduction, The need for numerical control, A basic explanation of numeric control, Numerical control systems in use today, Fixture design for numerically controlled machine tools, Cutting tools for numerical control, Tool holding methods for numerical control, Automatic tool changers and tool positioners, Tool presetting, Introduction, General explanation of the Brown and Sharpe machine, tooling for Automatic screw machines.

Text Books

1. Donaldson, Cyrll, George H. LeCain, Goold, V.C., "Tool Design", Tata McGraw Hill Publishing Company Ltd., 36th Reprint 2006.
2. Joshi, Prakash Hiralal, "Tooling data", Wheeler Publishing, 2000
3. Sharma, P.C., "Machine Tool and Tool Design ", S Chand Company. 2004.
4. Mehta N.K., "Machine Tool Design", Tata McGraw Hill, 1989.
5. Paquin, J. R. and Crowley, R. E., Die design fundamentals, Ind. Press Inc., New York,1987

ELECTIVE SUBJECT

MT/ME/MD-617 :: DESIGN OF PRESSURE VESSELS

M.Tech. (Machine Design)

Lectures / Tutorials : 4 Periods / week *Sessional Marks : 40*

University Exam. : 3 hrs. *University Exam. Marks : 60*

UNIT – I

Introduction: Materials-shapes of Vessels-stresses in cylindrical, spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load, bending and torque-ilation of pressure vessels-conical and tetrahedral vessels.

Theory of thick cylinders: Shrink fit stresses in built up cylinders-auto frettage of thick cylinders. Thermal stresses in Pressure Vessels.

UNIT – II

Theory of rectangular plates: Pure bending-different edge conditions.

Theory circular plates: Simple supported and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.

Discontinuity stresses in pressure vessels: Introduction, beam on an elastic foundation, infinitely long beam, semi infinite beam, cylindrical vessel under axially symmetrical loading, extent and significance of load deformations on pressure vessels, discontinuity stresses in vessels, stresses in a bimetallic joints, deformation and stresses in flanges.

UNIT – III

Pressure vessel materials and their environment: Introduction, ductile material tensile tests, structure and strength of steel, Leuder's lines, determination of stress patterns from plastic flow observations, behaviour of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels, fracture types in tension, toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth, fatigue life prediction, cumulative fatigue damage, stress theory of failure of vessels subject to steady state and fatigue conditions.

UNIT – IV

Stress concentrations: Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life, thermal stress fatigue, creep and rupture of metals at elevated temperatures, hydrogen embrittlement of pressure vessel steels, brittle fracture, effect of environment on fracture toughness, fracture toughness relationships, criteria for design with defects, significance of fracture mechanics evaluations, effect of warm pre stressing on the ambient temperature toughness of pressure vessel steels.

Design features: Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subjected to tension, elliptical openings, stress concentration, stress concentration factors for superposition, dynamic and thermal transient conditions, theory of reinforced openings, nozzle reinforcement, placement and shape, fatigue and stress concentration.

TEXT BOOKS:

1. Theory and design of modern Pressure Vessels by John F.Harvey, Van nostrand reihold company, New York.
2. Pressure Vessel Design and Analysis by Bickell, M.B.Ruizcs.

REFERENCES:

1.Process Equipment design- Beowll & Yound Ett.
2.Indian standard code for unfired Pressure vessels IS:2825.
3.Pressure Vessel Design Hand Book, Henry H.Bednar, P.E., C.B.S.Publishers, New Delhi.
4.Theory of plates and shells- Timoshenko & Noinosky.

ELECTIVE SUBJECT

MT/ME/MD-618 :: TRIBOLOGY

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Introduction to Tribology: Introduction, Tribological problems in machine design, Friction, Wear, Wear Characterization.

Lubrication: Purpose of lubrication, Basic modes of lubrication-Stribeck curve. Properties of lubricant, Additives, Newton's Law of viscous forces, Effect of pressure and temperature on viscosity. **Hydrodynamic lubrication:** Flow through stationary parallel plates. Hagen's poiseuille's theory-Numerical Problems.

UNIT II

Hydrodynamic Bearings: Fundamentals of fluid film formation, Mechanisms of pressure development in oil film. Reynolds 2D equation with assumptions.

Hydrodynamic journal bearing- Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings. Concept of lightly loaded bearings-Petroff's equation-Numerical Problems. Comparison between heavily loaded and lightly loaded bearings. Sommerfeld number its significance. Design Procedure of Journal bearings-Numerical Problems.

UNIT III

Hydrostatic Bearings: Types of hydrostatic Lubrication systems Expression for discharge, load carrying capacity, Flow rate, Condition for minimum power loss. Torque calculations-Numerical problems.

EHL Contacts: Introduction to Elasto hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution. Introduction to gas lubricated bearings. Governing differential equation for gas lubricated bearings.

UNIT IV

Seals: Different types - mechanical seals, lip seals, packed glands, soft piston seals, mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves - selection of mechanical seals.

Surface Engineering: Surface modifications - transformation hardening, surface fusion - thermo chemical processes – surface coatings - plating and anodizing - fusion processes - vapour phase processes.

TEXT BOOKS:

1. Mujamdar.B.C "Introduction to Tribology of Bearing", Wheeler Publishing, New Delhi2001.
2. Susheel Kumar Srivasthava "Tribology in industry" S.Chand and Co.

REFERENCE BOOKS:

1. Dudley D.Fulier " Theory and practice of Lubrication for Engineers", New York CO.1998 Moore "Principles and applications of Tribology" Pergamon press.
2. Gerhard Schweitzer, Hannes Bleuler & Alfons Traxler, "Active Magnetic bearings", Authors Working group, www.mcgs.ch. 2003.
3. Radixmovsky, "Lubrication of Bearings - Theoretical principles and design" The Oxford press Company, 2000.
4. Gwidon Stachowiak, Andrew W Batchelor, "Engineering Tribology", Elsevier Butterworth-Heinemann, 2005.

ELECTIVE SUBJECT

MT/ME/MD 619 :: GEAR ENGINEERING

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.

Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT II

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT III

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.

Gear failures : Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures

UNIT IV

Gear trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

Note: *PSG DATA BOOK ALLOWED*

TEXT BOOKS:

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Merrit,Gear engineering ,Wheeler publishing,Allahabad,1992.
3. Practical Gear design by Darle W. Dudley, McGraw-Hill book company

REFERENCES:

1. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
2. G.M.Maitha, Hand book of gear design, TaTa Mc.Graw Hill publishing company Ltd.,New Delhi,1994.

ELECTIVE SUBJECT

MT/ME/MD 620 :: EXPERIMENTAL STRESS ANALYSIS

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT – I

Introduction: Theory of Elasticity, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, Three-dimensional stress strain relations.

Strain Measurement Methods: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits

Unit – II

Recording Instruments

Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

Brittle coatings : Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

Unit – III Bi-

Refringent Coatings

Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

Unit – IV

Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics

Three dimensional Photo elasticity : Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear difference method in three dimensions, applications of the Frozen-stress method, the scattered light method.

Text books :

1. Theory of Elasticity by Timoshenke and Goodier Jr
2. Experimental stress analysis by Dally and Riley,Mc Graw-Hill

References:

1. A treatise on Mathematical theory of Elasticity by LOVE .A.H
2. Photo Elasticity by Frocht

ELECTIVE SUBJECT

MT/ME/CC/MD 621 :: MECHANICS OF COMPOSITE MATERIALS

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Introduction to Composite Materials: Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction.
Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants

UNIT II

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems.
Strength Failure Theories of an Angle Lamina: Maximum stress theory, Maximum strain theory, Tsa-Hill theory, Tsai-Wu tensor theory.

UNIT III

Macro Mechanical Analysis of Laminate: Introduction, Lamination code, Stress-strain relations for a laminate, In-plane and Flexural modulus of a laminate.
Manufacturing: Lay-up and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Blow moulding.

UNIT IV

Application Developments: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites.
Metal Matrix Composites: Re-inforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications.

Text Books:

1. Composite Materials handbook, Mein Schwartz Mc Graw Hill Book Company, 1984.
2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.

Reference Books:

1. Mechanics of Composite Materials, Rober M. Joness Mc-Graw Hill Kogakusha Ltd.
2. Stress analysis of fiber Reinforced Composite Materials, Michael W, Hyer MGH International.
3. Composite Material Science and Engineering, Krishan K. Chawla Springer.

ELECTIVE SUBJECT

MT/ME/CC/MD 622 :: COMPUTATIONAL FLUID DYNAMICS

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations. **Solution methods**: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with ridiagonal matrix algorithm.

UNIT II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.
Formulations of incompressible viscous flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

UNIT III

Treatment of compressible flows: potential equation, Eluer equations, Navier-stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.
Finite volume method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – IV

Standard variational methods: Linear fluid flow problems, steady state problems, Transient problems.

TEXT BOOK:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press,2002.

REFERENCE:

1. Text book of fluid dynamics, Frank Chorlton, CBS Publishers & distributors, 1985.

ELECTIVE SUBJECT

MT/ME/MD 623 :: PRODUCT LIFE CYCLE MANAGEMENT

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT-I

Fundamentals of PLM: Product data or Product information, Product lifecycle management concept, Information models and product structures-Information model, the product information (data) model, the product model, Reasons for the deployment of PLM systems.
Enterprise solution with PLM: Use of product lifecycle management systems in different organization verticals, Product development and engineering, Impact of Manufacturing with PLM-Challenges of product management in the engineering and manufacturing industry, Life cycle thinking, value added services and after sales, Case 1: Electronics manufacturer, Case 2: An engineering product.

UNIT-II

Product Structures: Standardized product data and materials data model, Product structure of a ship, Product structure of a customizable product, Product structure of a configurable service product.
PLM service information model: Categorizing services , Rational for building service products, How to make a service more like a tangible product?, Making items out of product functions, PLM challenges in service business, An IT-service provider and a customer-specifically variable product.

UNIT-III

PLM for e-manufacturing: electronic business and PLM, Preconditions for electric business from the viewpoint of the individual company, Significance of product management, collaboration and electronic business for the manufacturing industry.
Integration of the PLM system with other applications: Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD.

UNIT-IV
Implementing end to end business process management: Product lifecycle management as a business strategy tool, Product lifecycle management as an enabler of cooperation between companies, Contents of collaboration, Successful cooperation, Tools of collaboration, from changes in the business environment to product strategy, Business Benefits of PLM.
PLM applications in process and product industries examples: Case 1: Electronics manufacturer, Case 2: An engineering product, Case 3: Capital goods manufacturer and customer-specifically variable product.

REFERENCE:

1. Jaya Krishna S, Product Lifecycle Management Concepts and cases, ICFAI Publications 2011.
2. SOA approach to Enterprise Integration for Product Lifecycle, IBM Red books, 2011.

ELECTIVE SUBJECT

MT/ME/MD 624 :: DESIGN OF EXPERIMENTS

M.Tech. (Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT-I

Introduction : Strategy of experimentation, some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation.

Simple comparative experiments : Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Inferences about the Differences in means, Paired comparison Designs, Inferences about the Variances of Normal Distributions.

UNIT-II

Randomized Block Designs : Randomized complete block design, Latin square design, Balanced incomplete block design.

Introduction To Factorial Design : Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and surfaces, Blocking in a factorial design.

UNIT-III

Fitting Regression Models : Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, testing for lack of fit

Analysis Of Variance (Anova) : Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test.

UNIT-IV

Taguchi Method Of Design Of Experiments : Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean(ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study.

REFERENCES:

1. Douglas C Montgomery, “Design and Analysis of Experiments”, John Wiley.
2. John P.W.M., “Statistical Design and Analysis of Experiments”, Macmillan.
3. Montgomery D.C., Runger G. C., “Introduction to Linear Regression Analysis”, John Wiley
4. Myres R.H., Montgomery D. C., “Response Surface Methodology: Process And Product Optimisation Using Designed Experiments”, Wiley, New York
5. Taguchi, “Introduction to Quality Engineering”, Asian Productivity Organisation, G. UNIPUB, White Plains, New York.

ELECTIVE SUBJECT

MT/ME/CC/MD 625 :: RELIABILTY ENGINEERING

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT I

Reliability concepts : Reliability function - failure rate - Mean time between failures (MTBF) - Mean time to failure (MTTF) - a priori and a posteriori concept - mortality curve - useful life availability - maintainability

UNIT II

Reliability data analysis : Time to failure distributions - Exponential, normal, Gamma, Weibull, ranking of data - probability plotting techniques - Hazard plotting.

UNIT III

Reliability prediction models

Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT IV

Reliability testing and monitoring:

Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards, Reliability growth monitoring-Non parametric methods Reliability and life cycle costs -Reliability allocation - Replacement model.

Risk assessment

Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

TEXT BOOKS:

1. L.S. Srinath “Reliability Engineering”, Fourth Edition, East-West Press
2. E. Balagurusamy “Reliability Engineering”,Tata McGraw-Hill

REFERENCES:

1. Modarres, " Reliability and Risk analysis ", Mara Dekker Inc., 1993.
2. Smith C.O." Introduction to Reliability in Design ", McGraw Hill, London, 1976.

ELECTIVE SUBJECT

MT/ME/CC/MD 626 :: QUALITY ENGINEERING

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT-I

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.
Loss function and quality level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT-II

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S type characteristics, tolerance allocation for multiple components.
Parameter and tolerance design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT-III

Design of Experiments: Introduction, Task aids and Responsibilites for DOE process steps, DOE process steps description.
Analysis of variance (ANOVA): No-way ANOVA, One -way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.
Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

UNIT-IV

Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean
ISO-9000 Quality system, BDRE,6-sigma, bench marking, quality circles-brain storming-fishbone diagram-problem analysis.

TEXT BOOKS:

1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition,1995.

REFERENCES:

1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl.Edition, 1989.
2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.

ELECTIVE SUBJECT

MT/ME/CC/MD 627 :: FLUIDICS & CONTROL SYSTEMS

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials : 4 Periods / week *Sessional Marks : 40*
University Exam. : 3 hrs. *University Exam. Marks : 60*

UNIT I

Hydraulic Pumps & Pressure Regulation:
Pressure regulation, pump types: Gear Pump, Vane Pump, Piston Pump, Combination Pumps. Selection and specification of pumps pump characteristics

UNIT II

Hydraulic & Pneumatic Actuators:
Linear and Rotary Actuators-Selection, Specification and Characteristics, Hydraulic and pneumatic accessories

UNIT III

Control and Regulation elements:
Pressure-direction and flow control valves, relief valves, non return valves and safety valves, actuation systems
Hydraulic Circuits
Reciprocation, quick return, sequencing synchronizing circuits-accumulator circuits-industrial circuits-press circuits.

UNIT IV

Pneumatic Systems and Circuits
Pneumatic fundamentals, Control elements, Sequential circuits, Cascade methods, Mapping Methods, Step counter method, Compound circuit design, Combination circuit design

TEXT BOOK:
1. Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999

REFERENCES:
1. Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980
2. Dudleyt A.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall, 1987

ELECTIVE SUBJECT

MT/ME/CC/MD 628 :: NANOTECHNOLOGY

M.Tech. (CAD/CAM / Machine Design)

Lectures / Tutorials	*: 4 Periods / week*	*Sessional Marks*	*: 40*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 60*

UNIT – I

Nanotechnology: Introduction, History of Nano Technology, Biomimetics, Definition of Nanotechnology, Nanoscience and NanoTechnology, Feynman predictions on NanoTechnology, Moore's law. NanoTechnology applications in various fields.
Classification of Nano Structures: Introduction to Zero dimensional-Nanoparticles,One Dimensional-Nanowires,Two dimensional Nano structures-Thin films.
Introduction to Nano materials and Nano composites

UNIT-II
Top-Down Nanofabrication: Definiton:Top-Down fabrication methology- **Deposition** (or) Growing-Physical Vapour deposition methods, Chemical Vapour deposition methods. **Lithography**-PhotoLithography, Electron Beam Lithography, Soft lithography-Nano imprinting, Microcontact printing. **Etching**-Dry, Wet-Physical and Chemical Etching. **Material modification: Bottom-up Fabrication Methodology**-Definition. Building block Fabrication-Colloidal chemistry, Physical fabrication approaches-Nanoparticles. Chemical Vapour growth (VLS Mechanism). Nano wires-preparation, control of size and applications.
Characterization of Nano Structures: Electron microscopy- SEM, TEM Scanning Probe Microscopy- STM, AFM, NSOM.

UNIT – III
Self Assembly and Self Organization-Chemical Self assembly (SAMs), Physical self assembly, Biological Self assembly-examples, Quantum dots applications**.** Longmuir-Blodgett films, layer-by-layer growth.
Carbon Nanotubes: Structure and synthesis of CNTs, Electronic, Adsorption, Optical and Mechanical properties, Fullerenes.

UNIT – IV
Micro electromechanical systems-MEMs and Nanoelectromechanical systems-NEMs-Preparation and applications. **Mechanics at nanoscale:** Enhancement of mechanical properties with decreasing size, Nanomachines, Nanofluidics.

Text Books:
1.Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
2.Nanostructures&Nanomaterials,Synthesis Properties and applications by Guozhong Cao. IPC London
3. Hand Book of NanoTechnology Bharat Bhushan,Springer
References:
1.Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing
3. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

MT/ME/MD-711 :: INTERNSHIP

M.Tech. (Machine Design) :: Third Semester

Practicals : --- *Sessional Marks : 100*

Internal assessment is done based on Internship certificate for a period of minimum 4 weeks and presentation.

MT/ME/MD-712 :: Project Seminar

M.Tech. (Machine Design) :: Third Semester

Practicals : --- *Sessional Marks : 100*

Internal assessment is done based on the minimum six seminar presentations of their project.

MT/ME/MD 713 :: Project Viva

M.Tech. (Machine Design) :: Fourth Semester

Practicals : --- *Sessional Marks : 50*

University Exam. : 3 hrs. *University Exam. Marks : 150*

Assessment is done based on the seminar presentations and Project viva-voce examination.