ANDHRA UNIVERSITY

REGULATIONS RELATING TO MASTER OF ENGINEERING (M.E)/ MASTER OF TECHNOLOGY (M.TECH)/ MASTER OF PLANNING DEGREE EXAMINATIONS UNDER SEMESTER SYSTEM

(with effect from 2007 – 2008)

1. The Degree of Master of Engineering (2 - year course in 4 semesters) / Master of Technology (2 - year course in 4 semesters)/Master of Planning (2 - year course in 4 semesters) will be conferred on a candidate who satisfies the following conditions.

(i) The candidate must have passed the Bachelor of Engineering/Technology/Architecture Degree in appropriate branch of this University or an examination recognized by this University as equivalent there to secure not less than 55% marks in aggregate.

However, candidates who qualified themselves at the GATE examination shall be given priority in admission to M.E./M.Tech./M.Planning courses. Further, candidates seeking admission in to specified P.G. courses shall be required to appear at a separate entrance test(s) to be conducted by the University. In implementing the above regulation, the following guidelines are stipulated.

(a) Total number of candidates admitted in to a course (specialization) with or without GATE score should not exceed approved sanctioned strength.

(b) Only after all GATE qualified candidates have been considered for admission, non GATE candidates may be considered for admission in to those courses and under those categories (i.e., O.C., S.C., S.T., B.C., etc.) in which vacancies exist.

(ii) After passing B.E./B.Tech./B.Arch. Degree examination in the appropriate branch of this University or an examination recognized by this University as equivalent thereto, the candidate should have undergone a regular courses of study as here in after prescribed, for not less than four semesters (each semester of about 16 weeks duration) and passed the prescribed examination.

(iii) Candidates pursuing the courses on a part-time basis (Evening course) should be employed in any recognized local establishment or Institution or Government service and shall have a minimum of two years experience after graduation. The duration of the course for part-time students shall be six semesters.

(iv) Members of the teaching staff of the University College of Engineering and other local Engineering colleges may be permitted to undergo the course on a part-time basis (Daytime) and complete the whole course and examination in not less than six semesters taking two or three papers only in a semester.

The viva voce examination on the dissertation or project or thesis shall be conducted by a board of minimum four examiners consisting of

1. The Head of the Department as Chairman
2. Chairman, Board of studies of the concerned Department
3. Internal Guide and External Guide (if any)
4. External examiner (other than University)

The valuation of the dissertation, project or thesis shall be as provided in the scheme of examination of each course.

1.1 The normal duration of the course is 2 academic years for M.E / M.Tech/M.Planning Degree.

1.2 Candidates shall have pursued a regular course of study , as detailed below, for not less than two academic years, and shall have fulfilled the academic requirements laid down and shall have passed all the prescribed examinations.

2.1 A regular course of study during an academic year/semester means a minimum attendance of 75% of all the subjects computed by totaling the number of periods conducted over the semester as specified in the schemes of instructions.

However, in special cases and for sufficient causes shown, Chairman of Board of Governors may, on the recommendation of the Principal, Dean (Academic Affairs) and Head of the Department concerned, condone the deficiency in the average attendance to an extent of 10% for reasons such as ill-health, if the application for condonation is submitted at the time of actual illness and is supported by certificate of authorized Medical Officer approved by the Principal.

In the case of students, who participate in co- curricular, extra curricular activities like student seminars, N.S.S, N.C.C, Inter-collegiate tournaments approved by the College and any other activities conducted by Andhra University, Inter-University tournaments conducted by the Inter-University Boards and any such other activities involving the representation of the College/University with the prior approval of the Principal, the candidate may be deemed to have attended the college during the actual period of such activity, solely for the purpose of attendance.

2.2 A candidate who cannot satisfy the attendance requirements as specified in the clause 2.1, because of late admission under special circumstances, reasonable and acceptable to the College of Engineering on the basis of documents, shall attend at least 50% of the total scheduled periods during that semester and shall have attended at least 90% of the total periods of instructions held from the date of admission.

2.3 The criteria for promotion from 1st semester to 2nd semester and to the subsequent semesters is based on the requisite attendance put up by the candidate.

2.4 A candidate who fails to satisfy the regulation under the clause 2.1 or 2.2, shall not be allowed for the University examinations at the end of the semester and shall not be allowed for promotion to the next semester of study. He/ She shall be required to repeat the entire course of study of that semester.

3.1 The period of instruction shall comprise of a minimum of 15 weeks. The semester end examinations shall ordinarily be held after completion of 15 weeks.

3.2 There shall be no supplementary examinations.

4. The examinations for the M.E/M. Tech Degree shall be conducted as per the prescribed Schemes in all the branches of study offered by AU College of Engineering (Autonomous).

5. Assessment for the award of the Degree shall consist of

(i) Internal evaluation of the work done by the students during the semester for 30 marks in each theory subject and for 50 marks or such other marks prescribed in the scheme of examination, in each practical, Industrial Training and project.

(ii) Semester end examination as detailed in the scheme of examination for 70 marks in each theory subject as given in the scheme.

5.1 The marks for the internal evaluation shall be awarded by the concerned teachers based on class work, quiz, viva-voce, two mid-examinations out of which one online examination etc., according to a scheme/schedule to be notified by the Department at the beginning of the semester.

5.2 The semester end examination in each theory subject, for a maximum of 70 marks, shall be conducted by the University/College.

5.3 The semester end examination in practical/Industrial Training/ project for 50 marks or such other marks prescribed in the scheme of examination, shall be conducted by the Department.

5.4 Candidates shall be required to produce complete and certified records of the work done by them in each of the practical subjects at the time of semester end practical examination, failing which they will not be allowed for such examination.

5.5 The candidate is required to obtain a minimum of 28 marks out of 70 in the semester end examination.

5.6 There is no sessional minimum in each subject.

5.7 THE MARKS THUS OBTAINED WILL BE CONVERTED TO GRADES ON A 10.0 POINT SCALE AND THEN TO SEMESTER GRADE POINT AVERAGE (SGPA) AND SUBSEQUENTLY CUMULATIVE GRADE POINT AVERAGE IS AWARDED AT THE END OF THE COURSE

GRADES AND GRADE POINT DETAILS

S. No	Range of Marks	Grade	Grade Points
1.	**≥ 90%**	**O**	**10.0 points**
2.	**80% - 89%**	**A**	**9.0**
3.	**70% - 79%**	**B**	**8.0**
4.	**60% - 69%**	**C**	**7.0**
5.	**55% - 59%**	**D**	**6.0**
6.	**50% - 54%**	**E**	**5.0**
7.	**< 50%**	**F (Fail)**	**0.0**
8.	**The grade W represents failure due to insufficient attendance in a year or semester**	**W**	**0.0**
9.	**Incomplete (subsequently to be changed into pass or E to O or F grade in the same semester)**	**I**	**0.0**

Further these letter grades carry points associated with them in a quantified hierarchy.

For example if a student gets the Grades in one semester A, A, B, B, B, D in the subjects having $2(s_1)$, $4(s_2)$, $4(s_3)$, $4(s_4)$, $4(s_5)$, $2(s_6)$ credits respectively,

The SGPA is calculated from the following :

$$SGPA = [9(A) \times 2(s_1) + 9(A) \times 4(s_2) + 8(B) \times 4(s_3) + 8(B) \times 4(s_4) + 8(B) \times 4(s_5) + 6(D) \times 2(s_6)] / [2(s_1) + 4(s_2) + 4(s_3) + 4(s_4) + 4(s_5) + 2(s_6)]$$

$$=162/20 = 8.1$$

If a student gets the grades in another semester D, A, B, C, A, E, A in the subjects having credits $4(s_1)$, $2(s_2)$, $4(s_3)$, $2(s_4)$, $4(s_5)$, $4(s_6)$, $2(s_7)$ respectively,

The SGPA is

$$SGPA = [6(D) \times 4(s_1) + 9(A) \times 2(s_2) + 8(B) \times 4(s_3) + 7(C) \times 2(s_4) + 9(A) \times 4(s_5) + 5(E) \times 4(s_6) + 9(A) \times 2(s_7)] / [4(s_1) + 2(s_2) + 4(s_3) + 2(s_4) + 4(s_5) + 4(s_6) + 2(s_7)]$$

$= 162/22 = 7.36$

The CGPA of the above two semesters is

$$\text{CGPA} = (9 \times 2 + 9 \times 4 + 8 \times 4 + 8 \times 4 + 8 \times 4 + 6 \times 2 + 6 \times 4 + 9 \times 2 + 8 \times 4 + 7 \times 2 + 9 \times 4 + 5 \times 9 + 9 \times 2) /(22 + 20)$$
$$= 7.7$$

6.1 A candidate shall be declared to have passed in any subject (theory) if he /she secures not less than **"E"** Grade in theory and practical/industrial training/project, provided that the result otherwise is withheld.

6.2 A candidate shall be deemed to have satisfied the minimum requirement for the award of the Degree;

(i) If he/she is declared to have passed all the subjects (theory and practical subjects) included in the Scheme of Examination of 4 semesters

and

(ii) If he/she secures 5.0 CGPA by the end of fourth semester.

6.3 A candidate may be permitted to improve his/her performance by reappearing for the whole of the University examinations, only in all the theory subjects of a semester , after completion of the 2 years course of study and during the four consecutive examinations only.

Such an improvement can be availed of only once, for each of the semester examinations of the course of study, provided that all the subjects of the semester shall have been passed as per the clause 6.1. When considered in its totality, better of the two performances (as a whole but not subject wise) shall be taken into consideration for the purpose of awarding First Class. There shall be no subject wise improvement permitted in any semester of study for the above purpose. In any case, no such improvement shall be permitted after completion of four academic years from the year of admission.

6.4 Candidates, who fail to satisfy clause 6.2 (ii) may be permitted to obtain 5.0 CGPA within 2 years after completing the course of study by appearing at the University examinations only of M.E/M.Tech/M.Planning subjects of their choice. Any candidate who fails to attain the minimum CGPA of 5.0 even after such appearances, during a total of four academic years from the year of admission, shall become ineligible for the award of M.E/ M.Tech/M.Planing Degree.

6.5 There shall be no provision for the improvement of internal assessment marks in any theory or practical subject in any semester of study.

7. Whenever there is a change of regulations, scheme and syllabi, a candidate who fails in any subject or who wants to improve his/her performance as per clause 6.4 , will be permitted to appear for the University examinations conducted during the subsequent 2 years only, under the previous regulations, scheme and syllabi.

8. All the candidates who have satisfied the minimum requirement as specified above, shall be arranged in two classes (first class and second class) based on the CGPA obtained in the examinations.

(i) The First Class is awarded for those who have obtained a CGPA of 6.0 and above,

and

(ii) The Second Class is awarded for those who obtained a CGPA of 5.0 and above but less than 6.0.

Candidates who pass in first class without failure in any one of the subjects in the entire course of study and obtained a CGPA of 7.0 and above shall be declared to have passed in First Class with Distinction. However, candidates who have improved their performance as per clause 6.4 shall not be eligible to be awarded First Class with Distinction.

9. The CGPA can be converted to percentage by multiplying CGPA with 10.0, in case of requirement by any other University or any other purpose.

MECHANICAL ENGINEERING-M.E. (**MACHINE DESIGN**)
(Four-Semester Course -Credit System- **w.e.f. 2007-2008**)

FIRST SEMESTER-Scheme of Instruction and Examination

Course No.	Name of the course	Periods per week		Exam (Hrs)	Max. marks		Credits
		Lec.	Lab		Exam	Sess.	
MD 101	Theory of Elasticity and Plasticity	4	—	3	70	30	4
MD 102	Integrated Computer Aided Design	4	—	3	70	30	4
MD 103	Advanced Mechanics of Solids	4	—	3	70	30	4
MD 104	Mechanics of Machinery	4	—	3	70	30	4
MD 105	Advanced Optimization Techniques	4	—	3	70	30	4
MD 106	Mechanical Vibrations	4	—	3	70	30	4
MD 107	CAD Lab	—	3	—	—	50	2
MD 108	Seminar	—	3	—	—	50	2
Total		24	6	—	420	280	28

SECOND SEMESTER-Scheme of Instruction and Examination

Course No.	Name of the course	Periods per week		Exam (Hrs)	Max. marks		Credits
		Lec.	Lab		Exam	Sess.	
MD 201	Design Engineering	4	—	3	70	30	4
MD 202	Instrumentation & Experimental Stress Analysis	4		3	70	30	4
MD 203	Advanced Finite Element Analysis	4	—	3	70	30	4
MD 204	Signal Analysis and Condition Monitoring	4	—	3	70	30	4
MD 205	Elective – I	4	—	3	70	30	4
MD 206	Elective – II	4	—	3	70	30	4
MD 207	Instrumentation & Experimental Stress Analysis Lab	—	3	—	—	50	2
Total		24	3	—	420	230	26

Elective–I: A. Composite Materials; B. Robotics; C. Theory of Plates and Shells; D. Concurrent Engineering

Elective–II : A. Vehicle Dynamics; B. Mechatronics; C. Computational Fluid Dynamics; D. Tribology

THIRD and FOURTH SEMESTER-Scheme of Instruction and Examination

Course No.	Name of the course	Periods per week	Duration of exam (hours)	Max. marks	Credits
				Exam	
MD 301	Project	12	—	Recommended/Not recommended	14

The prerequisite for submission of the ME thesis is that one should communicate his/her work to any referred journal or Publication in a conference.

FIRST SEMESTER

MD 101 THEORY OF ELASTICITY AND PLASTICITY

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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.
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.
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.
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.

MD 102 INTEGRATED COMPUTER AIDED DESIGN

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Fundamentals of CAD: Introduction, Design process, Application of computer for design, Creating the manufacturing database, Benefits of CAD, Design work station, CAD hardware.
Geometric modeling: Geometric modeling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces, Solid modelers, Feature recognition.
Computer aided drafting: AutoCAD tools, 3D model building using solid primitives and boolean operations, 3D model building using extrusion, Editing tools, Multiple views: Orthogonal, Isometric.
Visual realism: Shading solids, Coloring, Color models, Using interface for shading and coloring.
Graphic aids: Geometric modifiers, Naming scheme, Layers, Grids, Groups, Dragging and rubber banding.

Computer animation: Conventional animation, Computer animation - Entertainment animation, Engineering animation, Animation types, Animation techniques.
Mechanical assembly: Assembly modeling, Part modeling, Mating conditions, Generation of assembling sequences, Precedence diagram, Liaison-sequence analysis.
Mechanical tolerancing: Tolerance concepts, Geometric tolerancing, Types of geometric tolerances, Location tolerances, Drafting practices in dimensioning and tolerancing, Tolerance analysis.
Mass property calculations: Geometrical property formulation - Curve length, Cross-sectional area, Surface area, Mass property formulation - Mass, Centroid, Moments of inertia, Property mapping. Properties of composite objects.

References:

1. CAD/CAM Theory and Practice by Ibrahim Zeid.
2. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.
3. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
4. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

MD 103 ADVANCED MECHANICS OF SOLIDS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Flat plates: Introduction - Stress resultants in a flat plate - Kinematics: Strain - Displacement relations for plates - Equilibrium equations for small displacement theory of flat plates - Stress-strain-temperature relations for isotropic elastic plates - Strain energy of a plate - Boundary conditions for plates - Solutions of rectangular and circular plate problems.
Torsion: Torsion of cylindrical bar of circular cross-section Saint-Venant's semi-inverse method - Linear elastic solution - The Prandtl elastic - Membrane (soap-film) analogy - Narrow rectangular cross-section - Hollow thin-wall torsion members: Multiply connected cross-section - Thin-wall torsion members with restrained ends - Fully plastic torsion.
Beams on elastic foundation: General theory - Infinite beam subjected to concentrated load: Boundary conditions - Infinite beam subjected to a distributed load segment - Semi-infinite beam subjected to loads of its end - Semi-infinite beam with concentrated load near its end - Short beams - Thin-wall circular cylinders.
Stress concentrations: Basic concepts - Nature of a stress concentration problem. Stress concentration factor - Stress concentration factor. Theory of elasticity - Stress concentration factors. Experimental techniques - Stress gradients due to concentrated load - The stationary crack - Crack propagation. Stress intensity factor. Effective stress concentration factor: Applications - Stress concentration factor. Combined loads - Effective stress concentration factors - Effective stress concentration factors. Repeated loads - Effective stress concentration factors - Other influences - Effective stress concentration factors - In-elastic strains.
Contact stresses: Introduction - The problem of determining contact stresses - Assumptions on which a solution for contact stresses is based - Notation and meaning of terms - Expressions for principal stresses - Method of computing contact stresses - Deflection of bodies in point contact - Stress for two bodies in contact over narrow rectangular area (line

contact). Loads normal to area - Stresses for two bodies in line contact. Loads normal and tangent to contact area.

References:

1. Advanced Mechanics of Materials by Boresi, A.P. and Sidebottm, O.M.
2. Advanced Mechanics of Materials by Seely and Smith.
3. Advanced Strength of Materials by Den Hartog.
4. Advanced Strength of Materials by Timoshenko S.P.

MD 104 MECHANICS OF MACHINERY

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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

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

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

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

Forces in mechanisms - Free body diagrams - Friction in link connections - Forces in linkages.

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

References:

1. Kinematics and Dynamics of Plane Mechanisms by J. Hirschhorn, McGraw Hill Book Co., 1962.
2. Theory of Mechanics by J.E. Shigley, McGraw Hill Book Co., 1961 (for Cam Dynamics topic).

MD 105 ADVANCED OPTIMIZATION TECHNIQUES

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P), Complementary Geometric Programming (C.G.P)
Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimization and Principal of optimality, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. and continuous D.P.
Integer programming(I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Branch-and-bound method, Sequential linear discrete Programming, Generalized penalty function method.
Stochastic Programming (S.P.): Basic Concepts of Probability Theory, Stochastic Linear programming.
Non-traditional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated annealing, Neural Networks based Optimization.

References:

1. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research by Hiller and Lieberman, Mc Graw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Engineering Optimization By Kalyanmanai Deb, Prentice Hall of India, New Delhi.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

MD 106 MECHANICAL VIBRATIONS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)
Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Single degree freedom systems -Introduction - Single degree freedom systems - free and forced vibrations - Damping classification and damped systems .
Ttwo degree freedom systems - Free, forced damped and undamped motions - Use of influence coefficients, Matrix methods and Lagrange's equations - Phenomenon of beat - Dynamic absorbers – Applications.
Transient (Shock) vibrations as applied to single and two degree freedom systems - Use of mathematics and graphical techniques in the analysis (superposition integral, Laplace transformations, phase plane techniques).
Multi degree freedom systems - Free and forced motions in longitudinal, torsional and lateral modes - damped and undamped, critical speeds of rotors. Continuous systems - free and forced vibrations of string, bars and beams - Principle of orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.

References:

1. Mechanical Vibrations by A.H. Church.
2. Vibration Problems in Engineering by Timoshenko and Young.
3. Mechanical Vibrations by Den Hartog.

MD 107 CAD LAB

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 3Pr. Ses. : 50

Credits : 2

2D and 3D modeling and assembly modeling using modeling packages like AutoCAD, Auto Desk Mechanical desktop, ProEngineer, IDEAS.
Linear and non-linear static and dynamic analysis using any FEA package ANSYS / CAEFEM / NASTRAN.

MD 108 SEMINAR

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 3 Pr. Ses. : 50

Credits: 2

The student has to give at least three seminars on topics related to Machine design.

MODEL QUESTION PAPER-Mechanical Engineering
M.E. (MACHINE DESIGN)-I SEMESTER

MD 101 THEORY OF ELASTICITY AND PLASTICITY
(Four Semester-Credit System-w.e.f. 2007--2008)

Time : 3 Hrs. Max. Marks : 70

Answer any FIVE questions.
All questions carry equal marks.

1. a) Starting from the principal stress tensor, determine the magnitudes of the three maximum shear stresses that occur at a point and their direction cosines.
   b) Explain the significance of Saint Venant's principle in solution of problems of elasticity.
   c) Discuss about octahedral normal stress and octahedral shear stress at the point.
2. a) Explain about plane stress and plane strain problems in elasticity with two examples.
   b) Determine the principal stresses and the direction cosines of the plane containing maximum principal stress at a point in a material, where the stress tensor is given by
   $$\begin{bmatrix} 50 & 15 & -20 \\ 15 & -30 & 25 \\ -20 & 25 & 40 \end{bmatrix} \text{ MPa. Check the invariant properties.}$$
3. A cantilever beam of narrow rectangular cross section carries a point load at the free end. Derive the expressions for the stress components at any point in the cross section of the beam. Compare the results with those obtained from elementary strength of materials. Evaluate the vertical deflection at the free end and explain the shear effect.
4. a) Explain stress function and what is the meaning of pure bending of a cantilever.
   b) Derive the stresses in the case of circular cross-section for bending.
5. a) Derive the equations of equilibrium in polar coordinates.
   b) Obtain an expression for the hoop stress induced in a thick cylinder subjected to internal fluid pressure, using general solution satisfying
   $$\nabla^4\phi = 0,\ \phi = A \log r + Br^2 \log r + Cr + D$$
6. a) What is creep and what is stress relaxation rate of deformation? Explain with new sketches.
   b) Explain in detail the engineering method for solving practical problems encountered in plasticity.
7. a) Explain what do you understand by true stress and true strain. Derive the relationships between these and nominal stress and engineering strain.
   b) Derive the expression for specific drawing pressure in flat dies.
8. Write short notes of the following
   a) State and prove uniqueness theorem.
   b) Obtain the strain displacement relations and stress-strain relationship for plane stress condition in polar coordinates.
   c) Explain about characteristic method

MODEL QUESTION PAPER-Mechanical Engineering
M.E. (MACHINE DESIGN)-I SEMESTER

MD 102 INTEGRATED COMPUTER AIDED DESIGN
(Four Semester-Credit System-w.e.f. 2007--2008)

Time : 3 Hrs. Max. Marks : 70

Answer any FIVE questions.
All questions carry equal marks.

1. a) What is CAD and what are its applications and benefits?
   b) What are the hardware requirements of a Design workstation? Explain.
2. a) What is geometric modeling? Compare and contrast the various modeling techniques.
   b) How are solid modelers categorized? Explain the generic architecture of any solid modeler. Name some popular solid modelers.
   c) Create the CSG model of the solid shown in the figure 1.

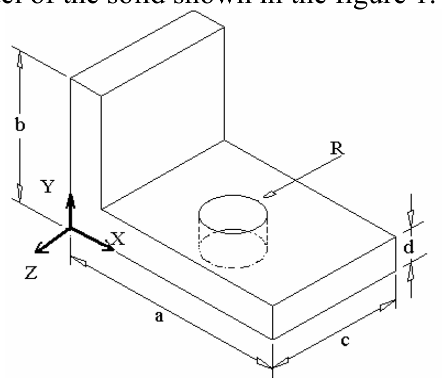


Fig.1.

3. a) What is shading? How is the shading of CSG model achieved? Explain any one shading algorithm for solids.
   b) What do you understand by the term geometric modifier? Explain. Give some examples where layering concepts are useful.
4. a) What is animation? Compare and contrast the conventional animation and computer animation. Write a brief note on animation techniques.
   b) Explain the procedure involved in animating a four bar linkage.
5. a) Generate the assembly tree and the precedence diagram for the assembly shown in the figure 2. Count the number of all possible assembly sequences to create the assembly.

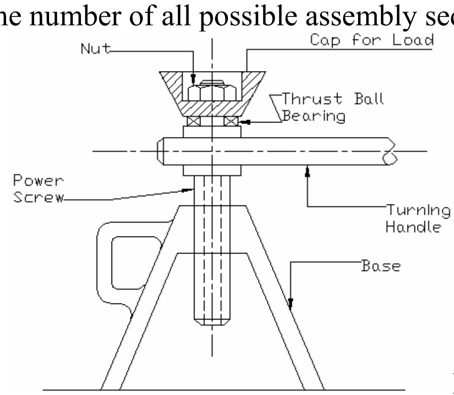


Fig. 2.

   b) What are the various techniques to generate all assembly sequences for a mechanical component? Explain Liaison sequence analysis.
6. a) What is geometric tolerancing? What are the types of geometric tolerances? How is it different from conventional tolerancing? Give a list of ANSI symbols for geometric tolerances?

b) Fig.3 shows a part design with assigned tolerances. Use the arithmetic method to calculate the tolerance information for the axial dimension F of the outside surface shown.

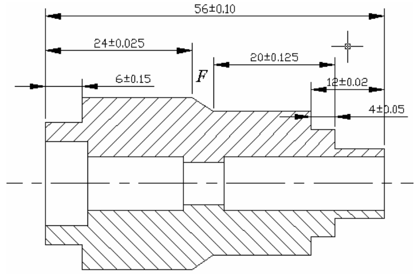


Fig. 3

7. a) Derive the principal moments of inertia of an object given its moments about a co-ordinate system.

   b) The geometry of an object is given in the following figure. Calculate the mass properties of the object assuming a density of 801.2 N/m^3.

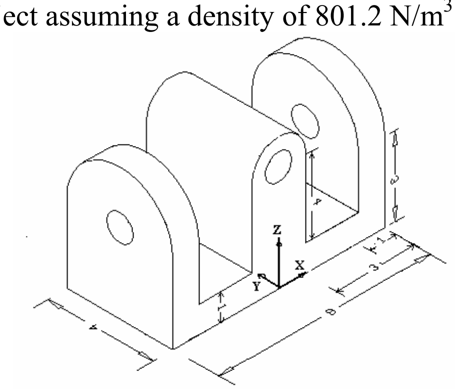


Fig. 4

8. Write short notes on any FOUR of the following:

   a) Rubber banding and dragging
   b) Rendering a 3-D solid model
   c) Boolean operations, extrusion with AutoCAD
   d) Tolerance analysis
   e) Properties of composite objects

MODEL QUESTION PAPER-Mechanical Engineering

M.E. (MACHINE DESIGN)-I SEMESTER

MD 103 ADVANCED MECHANICS OF SOLIDS

(Four Semester-Credit System-w.e.f. 2007--2008)

Time : 3 Hrs. Max. Marks : 70

Answer any FIVE questions.

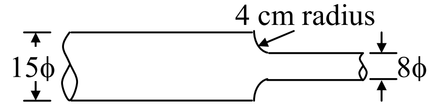
All questions carry equal marks. Data tables are allowed.

1. Analyse a circular plate freely supported around the edge and having a central hole carrying distributed load. Obtain maximum deflection and moment.

2. a) How is torsion of a non circular shaft different from that of circular shaft?

   b) Obtain expression for the shear stress developed in an rectangular cross-section subjected to a twisting moment. Also the expression for angle of twist.

3. Derive the expression for stress concentration factor at the fillet of stepped circular shaft as shown in figure. The shaft is under the influence of torsional and bending loading.

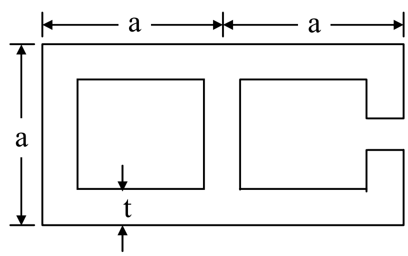


4. A beam fixed on elastic foundation carries an uniformly distributed transverse load throughout its length. Derive the expressions for shear force, bending moment, slope and deflection at any point on the beam.

5. Derive the expression for contact pressure on a single row ball bearing. If the ball diameter is 4 cm, the radius of the groove is 2.5 cm. The diameter of the outer race is 20 cm and the greatest compressive force on one ball is 5 kN. Calculate the contact pressure.

6. a) Define "Stress concentration" and explain the phenomenon with two examples.
   b) Explain how a crack which is orthogonal to the direction of tensile stress propagates? How do you prevent its further propagation?
   c) Contact pressure when a roller resting on a flat surface.

7. A thin walled box section has two components as shown in figure. It has a constant wall thickness 't', what is the shear stress for a given torque and what is the stiffness, i.e., the torque per unit radian? Derive all the necessary relations for solving the above problem starting from fundamentals.



8. a) A cylindrical surface is in contact with a flat plane. Determine the expression for contact stress.
   b) Discuss about the stress concentration at reentrant corners.
   c) Explain the principle of membrane analogy and establish the analogous quantities.

MODEL QUESTION PAPER-Mechanical Engineering
M.E. (MACHINE DESIGN)-I SEMESTER

MD 104 MECHANICS OF MACHINERY
(Four Semester-Credit System-w.e.f. 2007--2008)

Time : 3 Hrs. Max. Marks : 70

Answer any FIVE questions.
All questions carry equal marks.

1. a) Write on velocity image and acceleration image of a rigid body in plane motion. (7)
   b) What are polodes? Explain construction of fixed and moving polode. (7)
2. a) Briefly explain any two methods for the analysis of complex mechanisms. (4)
   b) The mechanism shown in Fig.1 is driven by link 6 with ω_6 = 0.5 rad/sec. and α_6 = 2 rad/sec^2. both counterclockwise. Determine ω_2 and α_2. (10)

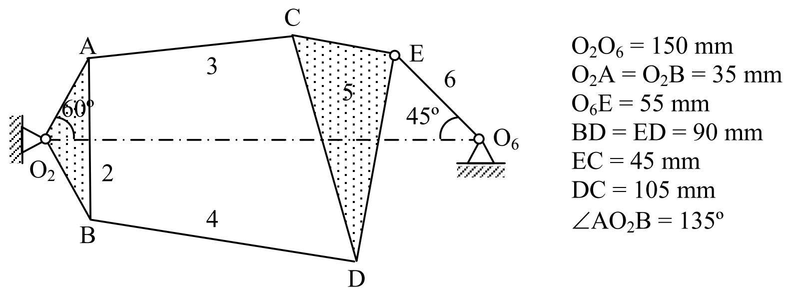


Fig. 1

3. a) Derive the Euler-Savery equation. (4)
   b) Draw the circling point curve for the coupler of the four-bar mechanism shown in Fig.2. (10)

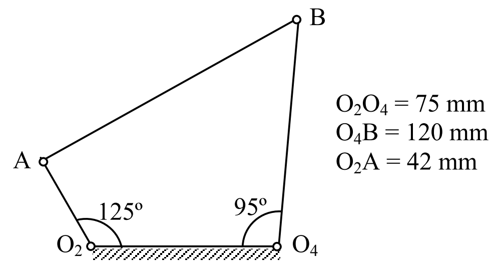


Fig. 2

4. a) Explain overlay method used for function generation. (6)
   b) State and prove Robert's theorem. (8)
5. a) Derive Freudensten's equation and explain it's importance in synthesis. (6)
   b) Synthesize the four-bar mechanism for the following specifications by the method of components. (8)
   Fixed line p = 85 mm; Driving link ω_q = 10 rad/sec; α_q = 0; Driven link s_x = 100 mm; s_4 = 120 mm; ω_s = 5 rad/sec; α_s = 10 rad/sec^2.
6. a) Write about friction in link connections. (6)
   b) The mechanism shown in Fig.3, starts from rest with an angular acceleration α_2 = 1000 rad/sec, CCW. A clockwise couple of torque T_4 = 30 Nm is applied to link 4. The links of the mechanism have the following properties.
      Link 2: W_2 = 135 N $I_{g2} = I_{o2}$ = 0.07 kg m^2
      Link 3: W_3 = 25 N I_{g3} = 0.02 kg m^2
      Link 4: W_4 = 30 N I_{o4} = 0.04 kg m^2
   Determine the torque T_2 required to overcome T_4, neglecting friction. (8)

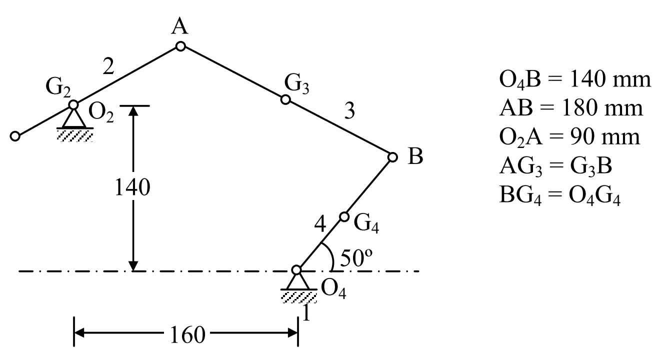


Fig. 3

7. A dwel-rise-dwel cam has 30 mm rise with uniform velocity for 120º of cam rotation. The follower is assembled with a retaining spring with sufficient pre-compression, the stiffness of the spring being 40 N/mm. The equivalent weight and stiffness of the follower train are 3 N and 700 N/mm respectively. Determine the follower response by Johnson's numerical method when the cam rotates at 3500 rpm. (14)

8. Write notes on:
i) Hartmann's construction. (5) ii) Burmerster's curve (5)
iii) Block synthesis (4)

MODEL QUESTION PAPER-Mechanical Engineering
M.E. (MACHINE DESIGN)-I SEMESTER

MD 105 ADVANCED OPTIMIZATION TECHNIQUES (Model paper)
(Four Semester-Credit System-w.e.f. 2007--2008)

Time : 3 Hrs. Max. Marks : 70

Answer any FIVE questions.
All questions carry equal marks.

1. a) What is arithmetic – geometric inequality?
b) Minimize the following function:
$$f(X)=\frac{1}{2}x_1^2+x_2+\frac{2}{3}x_1^{-1}x_2^{-1}$$
2. a) Explain the problem of Dimensionality in Dynamic programming.
b) Maximize $f(x_1,x_2)=50x_1+100x_2$
Subjected to
$$10x_1+5x_2\le 2500$$
$$4x_1+10x_2\le 2000$$
$$x_1+1.5x_2\le 450$$
$$x_1\ge 0,\quad x_2\ge 0$$
3. Solve the following problem using Bala's method.
Minimize $f=3x_1+2x_2+x_3+x_4$
Subjected to
$$x_2x_3+x_4\le 1$$
$$2x_1+x_2x_3+x_4\ge 3$$
$$x_i=0\,or 1,\ i=1,2,3,4.$$
4. A contractor plans to use four tractors to work on a project in a remote area. The probability of a tractor functioning for a year without a breakdown is known to be 82%. If X denotes the number of tractors operating at the end of a year, determine the probability mass and distribution function of X and also find the expected value and the standard deviation of the number of tractors operating at the end of one year.
5. Find the minimum of
$$f_1=x_1^2+x_2^2$$
$$f_2=(x_1-2)^2+x_2^2$$
Subject to
$$x_1-x_2-1\le 0$$

6. a) Construct the objective function to be used in GAs for a minimization problem with mixed equality and inequality constraints.
   b) Consider the following two strings denoting the vector X_1 and X_2
   X_1: {1 0 0 0 1 0 1 1 0 1}
   X_2: { 0 1 1 1 1 1 0 1 1 0}
   Find the result of crossover at location 2. Also, determine the decimal value of the variable before and after crossover if each string denotes a vector of two variables.
7. a) What is a sigmoid function? How it is affected by weighted sum of inputs, explain.
   b) How is a neuron modeled in neural network-based model, explain with one example.
8. Explain any four of the following.
   a) Goal programming method
   b) Simulated Annealing Algorithm
   c) Continuous Dynamic programming
   d) Branch & Bound method
   e) Complementary Geometric programming

MODEL QUESTION PAPER-Mechanical Engineering
M.E. (MACHINE DESIGN)-I SEMESTER

MD 106 MECHANICAL VIBRATIONS
(Four Semester-Credit System-w.e.f. 2007--2008)

Time : 3 Hrs. Max. Marks : 70

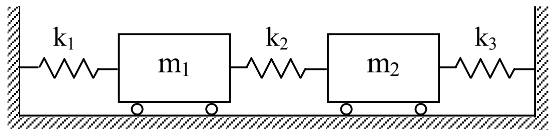
Answer any FIVE questions.
All questions carry equal marks.
Assume suitable data wherever necessary and state clearly.

1. a) A steel wire ($E = 1.96 \times 10^{11}$ N/m^2) is of 2 mm dia and is 30 m long. It is fixed at the upper end and carries a mass M kg at its lower end. Find M so that the frequency of longitudinal vibrations is 4 cycles per sec.
   b) Find the period of oscillation of a homogeneous right semicircular cylinder of radius 30 cm for small amplitudes of rolling a horizontal plane.
2. a) Discuss in detail the undamped vibration absorber.
   b) A reciprocating engine has a mass of 40 kg and runs at a constant speed of 3000 rpm. After it was installed it vibrated with a large amplitude at the operating speed. What dynamic vibration absorber should be coupled to the system if the nearest resonant frequency of the combined system has to be at least 25 percent away from the operating speed?
3. a) Determine the normal functions for free longitudinal vibration of a bar of length L and uniform cross-section. One end of the bar is fixed and the other free.
   b) Determine the normal functions in transverse vibration for a simply supported beam of length L and uniform cross-section.
4. a) A single degree of freedom viscously damped system has a stiffness of 5000 N/m, critical damping constant of 0.2 N-s/mm and a logarithmic decrement of 2.0. If the system is given an initial velocity of 1 m/sec, determine the maximum displacement of the system.
   b) The maximum permissible recoil distance of a gun is specified as 0.5 m. If the initial recoil velocity is to be between 8 m/sec and 10 m/sec, find the mass of the gun and

the spring stiffness of recoil mechanism. Assume that a critically damped dash pot is used in the recoil mechanism and the mass of the gun has to be at least 500 kg.

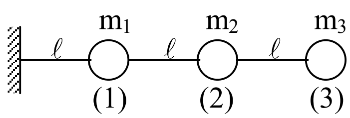
5. A spring mass system is subjected to a harmonic force whose frequency is close to the natural frequency of the system. If the forcing frequency is 39.8 Hz and the natural frequency is 40.0 Hz, determine the total response of the system. The deflection of the mass when the excitation force is applied with zero driving frequency is 0.05 m. Initial displacement of the mass is 0.02 m and initial velocity is zero. Also determine the period of beating. Give a rough sketch of response as a function of time.

6. a) Determine the natural frequencies and mode shapes for the system shown in figure. For K_1 = 300 N/m, K_2 = 500 N/m, K_3 = 200 N/m, m_1 = 2 kg and m_2 = 1 kg.



7. a) What are flexible and stiffness matrices in relation to dynamical systems of several degrees of freedom? Explain with suitable examples.

   b) Determine the influence coefficients for the points shown in figure below. Also write the flexibility matrix of the system. Given beam stiffness = EI.



8. Write short notes on any FOUR of the following:
   a) Lagranges equation of motion.
   b) Beat phenomena.
   c) Rayleigh, Ritz and Gelarkin methods.
   d) Model analysis.
   e) Critical speeds of rotors.

SECOND SEMESTER

MD 201 DESIGN ENGINEERING

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Design philosophy: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability
Product Design: Product strategies, Product value, Product planning, product specifications, concept generation, concept selection, concept testing.
Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood, Glass parts. Material selection in machine design
Failure theories: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory., Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation
Surface failures: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength,
Economic factors influencing design: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

References:

1. Machine Design An Integrated Approach by Robert L. Norton, Prentice-Hall New Jersey, USA.
2. Mechanical Engineering Design by J.E. Shigley and L.D. Mitchell published by McGraw- Hill International Book Company, New Delhi.
3. Fundamentals of machine elements by Hamrock, Schmid and Jacobian, 2nd edition, McGraw- Hill International edition.
4. Product design and development by Karl T. Ulrich and Steven D. Eppinger. 3rd edition, Tata McGraw Hill.
5. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall

MD 202 INSTRUMENTATION AND EXPERIMENTAL STRESS ANALYSIS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70

Examination (Theory): 3hrs. Credits: 4

PART - A (Instrumentation)

Basic concepts - Calibration - Standards - Basic concepts in dynamic measurements - System response - Distortion.

Sensing devices - Bridge circuits - Amplifiers - Filter circuits - Oscilloscope - Oscillograph - Transducers - variable resistance transducers, LVDT - Capacitive and piezoelectric transducers.

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

Flow measurement: Positive displacement methods - Flow obstruction methods - Flow measurement by drag effect - Hot wire anemometer.

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

PART - B (Stress Analysis)

Brittle lacquer method of stress analysis - Application of lacquer - Stress determination - Dynamic stresses.

Strain gauges - Mechanical resistance wire gauges - Types of resistance gauges - Cements and cementing of gauges - Wheatstone bridge - Balanced and unbalanced gauge factor - Calibration of gauges - Strain gauge rosette - Evaluation and principal stresses static and dynamic instrumentation **Photo elasticity** - Polariscope plane and circularly polarized light - Photo elastic materials - Calibration - Isochromatic fringes - Isoclines stress determination

Grid methods.

Note: Equal numbers of questions are to be answered from each section.

References:

1. Experimental Stress Analysis and Motion Measurement by Dove and Adams.
2. Experimental Methods for Engineers by Holman, J.P., McGraw Hill Book Company.

D 203 ADVANCED FINITE ELEMENT ANALYSIS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70

Examination (Theory): 3hrs. Credits: 4

Introduction, Finite elements of an elastic continuum - displacement approach, generalization of the finite element concept - weighted residuals and variational approaches. Plane stress and plane strain, Axisymmetric stress analysis, 3-D stress analysis.

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

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

Shells as an assembly of elements, axisymmetric shells, semi-analytical finite element processes - Use of orthogonal functions, shells as a special case of 3-D analysis.
Steady-state field problems - Heat conduction, electric and magnetic potentials, field flow. The time domain, semi-descritization of field and dynamic problems and analytical solution procedures.
Finite element approximation to initial value - Transient problems.

References:

1. The Finite Element Method by Zienkiewicz, O.C.
2. The Finite Element Methods in Engineering by Rao, S.S.
3. Concepts and Applications of Finite Element Analysis by Cook, R.D.
4. Applied Finite Element Analysis by Segerland, L.J.

MD 204 SIGNAL ANALYSIS AND CONDITION MONITORING

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.
Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.
Practical analysis of stationary signals: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.
Practical analysis of continuous non-stationary signals: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.
Practical analysis of transients: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).
Condition monitoring in real systems: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

References:

1. Condition Monitoring of Mechanical Systems by Kolacat.
2. Frequency Analysis by R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory by V. Ramamurti, Narosa Publishing House.

(Elective - I)-(A) MD 205 COMPOSITE MATERIALS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Historical background; definitions, classification of composites: fibrous composites, particulate composites, potential features of composites, idealization of composites, mechanics of composites, basic steps in FRP molding. Applications.
Raw materials: Resins: polyester, epoxy, phenolics, melamine and urea formaldehydes, polyimide and silicone, high temperature matrices, metal matrices.
Reinforcement: glass fibers, boron fibers, silicone carbide, carbon and graphite fibers, Kevlar, sisil and other vegetable fibers, whiskers, fillers and parting agents.

Fabrication methods: Hand lay-up: materials, molding, bag molding, mating molds, spray-up molding, matched - die molding, preform molding, premix and sheet molding, pre impregnation, filament winding, winding patterns and winding machines, pultrusion, centrifugal molding.
Micro mechanics: Introduction, weight and volume fractions, properties of lamina, representative volume element, micro mechanics, analysis of continuous and discontinuous fibers, reinforced composites, failure modes of unidirectional composites. Stress-strain relations of anisotropic medium and plane stress orthotropic medium
Experimental characterization and testing methods of composites: Properties of constituents: Single filament tensile properties, matrix tensile properties, density, volume fractions, coefficient of thermal and moisture expansions, properties of composites: tensile test method, compression test method, in-plane shear test method, interlaminar shear strength, various testing techniques ultrasonic, radiography and acoustic emission methods.

References:

1. Analysis and performance of Fiber composites, B.D. Aggrawal and L.J. Broutman, Willey Interscience Publications, New York.
2. Mechanics of composite Materials, R.M. Jones, Scripta Book company, Washington DC
3. Design and manufacture of composite structures by Geoff Eckold, Jaiko Publishing House, Bombay.
4. The analysis of laminated composite structures by L.R. Calcote, Van Nostrand Reinhold Company, New York.
5. Principles of Composite Material Mechanics by Ronald Gibson, Tata McGraw Hill Company Ltd.

(Elective - I)-(B) MD 205 ROBOTICS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction, Transformations and kinematics: Historical development, A sense of mechanisms, Robotic systems, Classification of robots, Position, orientation and location of a rigid body, Mechanics of robot manipulators. Objectives, Homogeneous coordinates, Homogeneous transformations, Coordinate reference frames, Some properties of transformation matrices, Homogeneous transformations and the manipulator: The position of the manipulator in space, Moving the base of the manipulator via transformations, Moving the tool position and orientation.
Position analysis of serial manipulators: Link parameters and link coordinate systems, Denavit-Hartenberg homogeneous transformation matrices, Loop-closure equations, Other coordinate systems, Denavit-Hartenberg method: Position analysis of a planar 3-DOF manipulator: Direct kinematics, Inverse kinematics, Method of successive screw displacements, Wrist centre position.
Position analysis of parallel manipulators: Structure classification of parallel manipulators, Denavit-Hartenberg method versus geometric method, Position analysis of a planar 3RRR parallel manipulator, Geometry, Inverse kinematics and Direct kinematics, Position analysis of a spatial orientation mechanism.
Jacobian analysis of serial manipulators: Differential kinematics of a rigid body, Differential kinematics of serial manipulators, Screw coordinates and screw systems, Manipulator Jacobian matrix.

Trajectory generation: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Geometric problems with Cartesian paths, Path generation at run time, Description of paths, Planning paths using the dynamic model, Collision-free path planning.
Robot Programming: Robot languages: AL, AML, RAIL, RPL, VAL, Demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).

References:

1. Robot Analysis - The Mechanics of Serial and Parallel Manipulators by Lung-Wen Tsai, John Wiley & Sons, Inc.
2. Introduction to Robotics - Mechanics and Control by John J. Craig, Addison-Wesley Longman Inc., 1999.
3. Robotic Engineering - An Integrated Approach by Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall of India Private Limited, 1994.

(Elective - I)- (C) MD 205 THEORY OF PLATES AND SHELLS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Bending of long rectangular plates to a cylindrical surface: Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported edges - Cylindrical bending of uniformly loaded rectangular plates with built-in edges
Pure bending of plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending - Strain energy in pure bending of plates.
Symmetrical bending of circular plates: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate concentrically loaded - Circular plate loaded at the center.
Small deflections of laterally loaded plates: The differential equation of the deflection surface - Boundary conditions - Alternate method of derivation of the boundary condition - Reduction of the problem of bending of a plate to that of deflection of a membrane
Simply supported rectangular plates: Simply supported rectangular plates under sinusoidal load - Navier solution for simply supported rectangular plates.
Rectangular plates with various edge conditions: Bending of rectangular plates by moments distributed along the edges - Rectangular plates with two opposite edges simply supported and the other two edges clamped.
Continuous rectangular plates: Simply supported continuous plates - Approximate design of continuous plates with equal spans - Bending symmetrical with respect to a center.
Deformation of shells without bending: Definition and notation - Shells in the form of a surface of revolution and loaded symmetrically with respect to their axis - Particular cases of shells in the form of surfaces of revolution - Shells of constant strength.
General theory of cylindrical shells: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels.

Reference:

1. Theory of Plates and Shells by Timoshenko, S. and Woinowsky-Krieger, S.

(Elective - I)-(D) MD 205 CONCURRENT ENGINEERING

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.
Strategic approach and technical aspects of product design: Steps in the strategic approach to product design - Comparison to other product design methods - Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.
Basic issues in manufacturing system design: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.
Assembly workstation design: Strategic issues - Technical issues analysis.
Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.
Case studies: Automobile air conditioning module - Robot assembly of automobile rear axles.

Reference:

1. Concurrent Design of Product and Processes by James L. Nevins and Daniel E. Whitney, McGraw-Hill Publishing Company, 1989.

(Elective - II)-(A) MD 206 VEHICLE DYNAMICS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction to Vehicle Dynamics: Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.
Mechanics of pneumatic tyres: Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.
Performance characteristics of road vehicle: Equation of motion and maximum tractive effort, Aerodynamic forces and moments, Vehicle power plant and transmission characteristics, Prediction of vehicle performance, Operating fuel economy, Braking performance.
Handling and stability characteristics of road vehicles: Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling

characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.

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

References:

1. Theory of Ground Vehicles by Wong, J.Y., John Wiley and Sons, NY, 1993.
2. Fundamentals of Vehicle Dynamics by Gillespie, T.D., SAE Publication, Warrendal, USA, 1992.
3. Tyres, Suspension and Handling by Dixon, J.C., SAE Publication, Warrendal, USA and Arnold Publication, London, 1997.

(Elective - II)- (B) MD 206 MECHATRONICS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70

Examination (Theory): 3hrs. Credits: 4

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

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

Sensors and transducers: An introduction to sensors and transducers, Sensors for motion and position measurement, Force, torque and tactile sensors, Flow sensors, Temperature-sensing devices. Actuating devices: Direct current motor, Permanent magnet stepper motor, Fluid power actuation.

Signals, systems and controls: Introduction to signals, systems and controls, System representation, Linearization of nonlinear systems, Time delays.

Real time interfacing: Introduction, Elements of a data acquisition and control system, Overview of the I/O process, Installation of the I/O card and software.

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

References:

1. Mechatronics System Design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishing Company, 2001.
2. Mechatronics by W. Bolton, Pearson Education, Asia, II-Edition, 2001.

Elective – II-(C) MD 206 COMPUTATIONAL FLUID DYNAMICS

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70

Examination (Theory): 3hrs. Credits: 4

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 tridiagonal matrix algorithm.

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.

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.

Standard variational methods - 1: Linear fluid flow problems, steady state problems,

Standard variational methods - 2: 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 – II-(D) MD 206 TRIBOLOGY

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Periods/week: 4 Th. Ses. : 30 Exam: 70

Examination (Theory): 3hrs. Credits: 4

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

Circumferential flow - Oil flow through a bearing having a circumferential oil groove - Heat generation and lubricant temperature - Heat balance and effective temperature - Bearing design: Practical considerations - Design of journal bearings - Parallel surface bearing - Step bearing - Some situations under squeeze film lubrication - The mechanism of hydrodynamic instability - Stiffness and damping coefficients - Stability.

Elastohydrodynamic lubrication: Theoretical consideration - Grubin type solution - Accurate solution - Point contact - Dimensionless parameters - Film thickness equations -

Different regimes in EHL contact - Deep-groove radial bearings - Angular contact bearings - Thrust ball bearings - Geometry - Kinematics - Stress and deformations - Load capacity.
Surface topography - Surface characterization - Apparent and real area of contact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings - Laws of friction - Friction theories - Surface contaminants - Frictional heating - Effect of sliding speed on friction - Classification of wear - Mechanisms of wear - Quantitative laws of wear - Wear resistance materials.

Reference:
1. Introduction to Tribology of Bearings by Majumdar, B.C.

MD 207 INSTRUMENTATION AND EXPERIMENTAL STRESS ANALYSIS LAB

(Four-Semester Course -Credit System- w.e.f. 2007-2008)
Periods/week: 3Pr
Ses: 50

Credits : 2

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

THIRD SEMESTER

MD 301 PROJECT

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Project (to be continued in Fourth semester)

Periods per week: 12 Credits: 14

Semester end appraisal of Project through seminar by a committee consisting of Head of the Department, Chairman, Board of Studies & Guide

FOURTH SEMESTER

(Four-Semester Course -Credit System- w.e.f. 2007-2008)

Project (continued from Third semester)

Periods per week: 12

Presentation followed by Viva-Voce Examination with the following members.

1. Chairman, Board of Studies.
2. Head of the Department.
3. External Examiner.
4. Internal Guide and External Guide (if any).

No marks are allotted for the Project work.
Viva-voce - Examination: Recommended/Not recommended.
For final result the dissertation credits are not added for CGPA..