RAJEEV GANDHI MEMORIAL

COLLEGE OF ENGINEERING AND TECHNOLOGY

AUTONOMOUS INSTITUTE

Affiliated to JNTU-Anantapur, Approved by AICTE-New Delhi, Accredited by NBA-New Delhi

NANDYAL-518 501, KURNOOL Dist., A.P.

MACHINE DESIGN

ACADEMIC REGULATIONS,
COURSE STRUCTURE AND SYLLABI

APPLICABLE FOR STUDENTS ADMITTED INTO

M.TECH (REGULAR) FROM 2010-11

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REGULATIONS

For pursuing Two year Master (post graduate) Degree of study in Engineering (M.Tech), offered by Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal-518501 under Autonomous status and herein referred to as RGMCET (Autonomous)

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2010-11 onwards. Any reference to "Institute" or "College" in these rules and regulations stands for Rajeev Gandhi Memorial College of Engineering and Technology (Autonomous).

All the rules and regulations, specified here after shall be read as a whole for the purpose of interpretation as and when a doubt arises , the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, Rajeev Gandhi Memorial College of Engineering and Technology shall be the Chairman, Academic Council.

I. ACADEMIC REGULATIONS 2010 FOR M.TECH (REGULAR)

(Effective for the students admitted into first year from the Academic Year 2010-2011)

THE M.TECH DEGREE OF JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, ANANTAPUR, SHALL BE CONFERRED ON CANDIDATES WHO ARE ADMITTED TO THE M.TECH PROGRAM AT RGMCET, NANDYAL AND THEY SHALL FULFIL ALL THE REQUIREMENTS FOR THE AWARD OF THE DEGREE.

1.0 Eligibility for Admissions:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by Andhra Pradesh State Council of Higher Education (APSCHE) from time to time.

Admissions shall be made on the basis of merit rank obtained in GATE examination or PGCET conducted by any University of Andhra Pradesh designated by Govt. of A.P., or on the basis of any other order of merit prescribed by APSCHE, subject to the reservations prescribed by the Government of A.P. from time to time.

2.0 Award of M.Tech Degree:

2.1) The student shall be declared eligible for the award of the M.Tech degree, if he pursues a course of study and completes it successfully for not less than prescribed course work duration and not more than double the prescribed course work duration.

2.2) The student, who fails to fulfil all the academic requirements for the award of the degree within double the course work duration from the year of his admission, shall forfeit his seat in M.Tech course.

2.2) The minimum clear instruction days for each semester shall be 95.

3.0 Courses of Study:

The following specializations are offered at present for the M.Tech course of study.

1. Computer Science (CSE)
2. Digital Systems and Computer Electronics (ECE)
3. Embedded Systems (ECE)
4. Machine Design (ME)
5. Power Electronics (EEE)
6. Software Engineering (IT)

and any other course as approved by the appropriate authorities from time to time.

4.0 Course pattern:

4.1) The entire course of study is of four semesters. During the first and second semesters the student has to undergo course work and during the third and fourth semesters the student has to carry out project work.

4.2) The student eligible to appear for the End Examination in a subject, but absent at it or has failed in the End Examination may appear for that subject at the supplementary examination.

TABLE 1: CREDITS

	SEMESTER			
	Periods/ Week	Credits	Internal Marks	External Marks
Theory	04	04	40	60
Practical	03	02	40	60
Seminar		02	100	
Comprehensive Viva-voce		04		100
Project		12		

TABLE: 2 COURSE PATTERN

Semester	No.of Subjects	Number of Labs	Total Credits	
First	06	02	6X4=24 2X2=04	28
Second	06	02 Comprehensive Viva	6X4=24 2X2=04 1X4=04	32
Third	Seminar(3rd semester) Project Work			02
Fourth				12
Total credits				74

5.0 Attendance:

5.1) The candidate shall be deemed to have eligibility to write end semester examinations if he has secured a minimum of 75% of attendance in aggregate of all the subjects.

5.2) Condonation of shortage of attendance up to 10% i.e. 65% and above and below 75% may be given by the College academic committee consisting of Principal, Head of the Department and a senior faculty member.

5.3) Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

5.4) **Shortage of attendance below 65% shall in no case be condoned**.

5.5) The candidate shall not be promoted to the next semester unless he fulfils the attendance requirements of the previous semester.

6.0 Evaluation:

The performance of the candidate in each semester shall be evaluated subject wise, with a maximum of 100 marks for Theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

6.1) For the theory subjects 60 marks shall be for the External End Examination, While 40 marks shall be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately After the completion of instruction (V-VIII) units with four questions to be answered out of six, evaluated for 40 marks. Each question carries 10 marks. Each midterm examination shall be conducted for duration of 120 minutes. The End Examination will have 08 questions and 5 questions are to be answered and each question carries 12 marks.

6.2) For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks shall be for Internal evaluation based on the day-to-day performance. End practical examinations

for M.Tech courses will be conducted with two Examiners, one of them being Laboratory Class Teacher and second Examiner shall be external from other institution.

6.3) Student has to undergo a comprehensive viva pertaining to his specialization which carries 100 marks. He has to secure 50% marks to obtain required credits. Comprehensive viva will be held at the end of II semester with HOD, senior faculty member and external Examiner from outside the institute. For this, HOD of the Department shall submit a panel of 5 Examiners, who are eminent in that field. One from the panel will be selected by the principal of the institute as external Examiner for comprehensive viva.

6.4) For Seminar100 marks shall be for Internal evaluation. The candidate has to secure a minimum of 50 marks to be declared successful. The assessment will be made by a board consisting of HOD and two Internal experts at the end of III semester.

6.5) The candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Examination and Internal evaluation taken together.

6.6) In case the candidate does not secure the minimum academic requirement in any subject(as specified in 6.5.) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

7.0 Re-registration for improvement of Internal marks:

Following are the conditions to avail the benefit of improvement of internal marks.

7.1) The candidate should have completed the course work and obtained examinations results for I & II semesters.

7.2) He should have passed all the subjects for which the internal marks secured are more than 50%.

7.3) Out of the subjects the candidate has failed in the examination due to lack of Internal marks secured being less than 50%, the candidate shall be given one chance for Theory subject and subject to a maximum of three Theory subjects.

7.4) The candidate has to re-register for the chosen subjects and fulfil the academic requirements as and when they are offered.

7.5) For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the Principal, RGMCET payable at RGMCET Nandyal branch along with the requisition through the HOD of the respective Department.

7.6) In case of availing the Improvement of Internal marks, the Internal marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

8.0 Evaluation of Project / Dissertation work :

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Department.

8.1) Registration of Project work: The candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem).

8.2) An Internal Department Committee (I.D.C) consisting of HOD, Supervisor and One Internal senior expert shall monitor the progress of the project work.

8.3) The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

8.4) The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.

8.5) The candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva voce examination may be conducted once in two months for all the candidates submitted during that period.

8.6) Three copies of the Thesis / Dissertation certified in the prescribed form by the supervisor & HOD shall be submitted to the institute.

8.7) The Department shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by the board consists of HOD, concerned supervisor and one external Examiner from other institute nominated by the principal from a panel of Examiners submitted by the Department to the Controller of Examinations.

8.8) If the report of the board is favourable in viva voce examination, the board shall jointly report candidates work as:

1. Satisfactory
2. Not satisfactory

If the report of the viva voce is not satisfactory the candidate will retake the viva voce examination after three months. If he fails to get a satisfactory report at the second viva voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

9.0 Award of Degree and Class:

After the student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following classes:

TABLE 3: AWARD OF DIVISION

Class Awarded	% of marks to be secured	From the aggregate marks secured form the 74 Credits.
First Class with Distinction	70% and above	
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	

(The marks in Internal evaluation and End Examination shall be shown separately in the marks memorandum)

10.0 Supplementary Examinations:

Apart from the regular End Examinations the institute may also schedule and conduct supplementary examinations for all subjects for the benefit of students with backlogs. Such of the students writing supplementary examinations as supplementary candidates may have to write more than one examination per day.

11.0 Transcripts:

After successful completion of prerequisite credits for the award of degree a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

12.0 Minimum Instruction Days:

The minimum instruction days for each semester shall be 95 clear instruction days excluding the days allotted for tests/examinations and preparation holidays declared if any.

13.0 Amendment of Regulations:

The college may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi. However the academic regulations of any student will be same throughout the course of study in which the student has been admitted.

14.0 Transfers

There shall be no branch transfers after the completion of admission process.

15.0 With holding of results:

If the candidate has not paid any dues to the institute or if any case of in-discipline is pending against him, the result of the candidate will be with held and he will not be allowed for the next semester. The issue of the degree is liable to be withheld in such cases.

16.0 Transitory Regulations:

Candidates who have discontinued or have been detained for want of attendance are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 6.5 and 2.0

17.0 Rules of Discipline:

17.1) Any attempt by any student to influence the teachers, Examiners, faculty and staff of controller of Examination for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.

17.2) When The student absents himself, he is treated as to have appeared and obtained zero marks in that subject(s) and grading is done accordingly.

17.3) When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject(s).

17.4) When the student's answer book is confiscated for any kind of attempted or suspected malpractice the decision of the Examiner is final.

18.0 General:

18.1) The Academic Regulation should be read as a whole for the purpose of any interpretation.

18.2) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Council is final.

18.3) The Institute may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institute.

18.4) Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

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SCHOOL OF MECHANICAL ENGINEERING

M.Tech - I Semester (Machine Design) **Regulation: 2010**

S. NO	COURSE CODE	SUBJECT	ABBREVIATION	CREDITS	SCHEME OF INSTRUCTION PERIODS/WEEK			DURATION OF END EXAM IN HOURS	SCHEME OF EXAMINATION MARKS		
					Th	D*/T	P		END	INTERNAL	TOTAL
THEORY:											
1	D1501101	Advanced Mechanisms	AM	4	4	0	-	3	60	40	100
2	D1502101	Finite Element Analysis	FEA	4	4	0	-	3	60	40	100
3	D1503101	Computational Methods in Engineering	CME	4	4	0	-	3	60	40	100
4	D1504101	Advanced Mechanics of Solids	AMS	4	4	0	-	3	60	40	100
5	D1505101	Creep, Fatigue & Fracture Mechanics	CF&FM	4	4	0	-	3	60	40	100
6	D1506101 D1507101 D1508101	**Elective –I** Tribology Pressure Vessel Design Theory of Plasticity	E-I	4	4	0	-	3	60	40	100
PRACTICALS:											
7	D1591101	Simulation Lab	Sim.L	2	-	-	3	3	60	40	100
8	D1592101	Computer Aided Design Lab	CAD.L	2	-	-	3	3	60	40	100
TOTAL				**28**	**24**	**0**	**6**		**480**	**320**	**800**
					30						

M.Tech -II Semester (Machine Design) **Regulation: 2010**

S. NO	COURSE CODE	SUBJECT	ABBREVIATION	CREDITS	SCHEME OF INSTRUCTION PERIODS/WEEK			DURATION OF END EXAM IN HOURS	SCHEME OF EXAMINATION MARKS		
					Th	D*/T	P		END	INTERNAL	TOTAL
THEORY:											
1	D1509102	Advanced Mechanical Engineering Design	AMED	4	4	-	-	3	60	40	100
2	D1510102	Mechanical Vibrations	MV	4	4	-	-	3	60	40	100
3	D1511102	Experimental Stress Analysis	ESA	4	4	-	-	3	60	40	100
4	D1512102	Robotics	ROBO	4	4	-	-	3	60	40	100
5	D1513102	Advanced Optimization Techniques		4	4	-	-	3	60	40	100
6	D1514102 D1515102 D1516102	**Elective –II** Design for Manufacturing Mechanics of Composite Materials Non-Destructive Evaluation	E-II	4	4	-	-	3	60	40	100
PRACTICALS:											
7	D1593102	Machine Dynamics Lab	MDL	2	-	-	3	3	60	40	100
8	D1594102	CAD/CAM Lab	C/C.L	2	-	-	3	3	60	40	100
9	D1595102	Core Comprehensive Via Voce	C.V.V	4	-	-	-	-	100	00	100
TOTAL				**32**	**24**	**0**	**6**		**580**	**320**	**900**
					30						

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M.Tech -III & IV Semester (Machine Design) **Regulation: 2010**

S. NO	COURSE CODE	SUBJECT	ABBREVIATION	CREDITS	SCHEME OF INSTRUCTION PERIODS/WEEK			DURATION OF END EXAM IN HOURS	SCHEME OF EXAMINATION MARKS		
					Th	D*/T	P		END	INTERNAL	TOTAL
		SEMINAR	SEM	2	-	-	-	-	-	-	-
		PROJECT WORK	PW	12	-	-	-	-	-	-	-
TOTAL				**22**							

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M.TECH, I SEM (Machine Design)	**Th**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(D1501101) ADVANCED MECHANISMS

Unit - I

Introduction: Elements of Mechanisms; Mobility Criterion for Planar mechanisms and manipulators; Mobility Criterion for spatial mechanisms and manipulators. Spherical mechanisms-spherical trigonometry.

Unit – II

Advanced Kinematics of plane motion- I: The Inflection circle ; Euler – Savary Equation; Analytical and graphical determination of d_i ; Bobillier's Construction; ollineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

Unit - III

Advanced Kinematics of plane motion - II: Polode curvature; Hall's Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; Determination of the output angular acceleration and its Rate of change; Freudenstein's collineation –axis theorem; Carter –Hall circle; The circling – point curve for the Coupler of of a four bar mechanism.

Unit – IV

Introduction to Synthesis-Graphical Methods - I: The Four bar linkage ;Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Rotocenter triangle ; Guiding a body through Four distinct positions; Burmester's curve.

Unit - V

Introduction to Synthesis-Graphical Methods - II: Function generation- General discussion; Function generation: Relative –rotocenter method, Overlay's method, Function generation- Velocity – pole method; Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

Unit – VI

Introduction to Synthesis - Analytical Methods: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components.

Unit – VII

Manipulator kinematics – I: D-H notation, D-H convention of assignment of co-ordinate frames and link parameters table;D-H transformation matrix ; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.

Unit – VIII

Manipulator kinematics – II: Differential kinematics Formulation of Jacobian for planar serial manipulators and spherical manipulator; Singularity analysis.

Text Books:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms, McGraw-Hill, 1962.
2. L.Sciavicco and B.Siciliano, Modeling and control of Robot manipulators, Second edition, Springer – Verlag, London, 2000.
3. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines. E.W.P.Publishers.

Reference Books:

1. Allen S.Hall Jr., Kinematics and Linkage Design, PHI, 1964.
2. J.E Shigley and J.J. Uicker Jr., Theory of Machines and Mechanisms, McGraw-Hill, 1995.
3. Mohsen Shahinpoor, A Robot Engineering Text book, Harper & Row Publishers, New York, 1987.
4. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold, 1980

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	4	**0**	**0**	**4**

(D1502101) FINITE ELEMENT ANALYSIS

UNIT -I:
Introduction to FEM: Basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods, variational approach, Galerkin Methods

UNIT -II:
Co-ordinates, basic element shapes, interpolation function. Virtual energy principle, Rayleigh- Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain displacement relations

UNIT -III:
1-D structural problems – axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape function. Analysis of Trusses – Plane Truss and Space Truss elements.

UNIT -IV:
Analysis of beams – Hermite shape functions – stiffness matrix – Load vector – Problems, 2-D problems – CST, LST, force terms, Stiffness matrix and load vector, boundary conditions.

UNIT – V:
Isoparametric element – quadrilateral element, Shape functions – Numerical Integration – sub parametric and super parametric elements. 3-D problems – Tetrahedron element – Jacobian matrix – Stiffness matrix.

UNIT -VI:
Scalar field problems - 1-D Heat conduction – 1-D fin element – 2-D heat conduction problems – Introduction to Torsional problems.

UNIT -VII:
Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen Vector, natural frequencies – mode shapes – modal analysis.

UNIT – VIII:
Non linearity, Introduction, Non linear problems, geometric non linearity, non linear dynamic problems, analytical problems.

TEXT BOOKS:
1. Introduction to Finite Elements in Engineering – Tirupathi K. Chandrupatla and Ashok D. Belagundu.
2. Concepts and applications of finite element analysis – Robert Cook
3. The Finite Element Methods in Engineering – S.S. Rao - Pergamon, New York

REFERENCE BOOKS
1. An Introduction to Finite Element Methods – J. N. Reddy – Mc Graw Hill.
2. The Finite Element Methods in Engineering science – O.C. Zienkowitz, Mc Graw Hill.
3. Finite Element Procedures in Engineering analysis – K.J Bathe.

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	4	**0**	**0**	**4**

(D1503101) COMPUTATIONAL METHODS IN ENGINEERING

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

Unit – II

Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration

Unit – III

Optimization:

One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrained optimization

Unit – IV

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 – V

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.

Unit – VI

Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

Unit – VII

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.

Unit – VIII

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.Second edition.

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.

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	4	**0**	**0**	**4**

(D1505101) ADVANCED MECHANICS OF SOLIDS

Unit – I

Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

Unit - II

Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

Unit - III

Curved beam theory: Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

Unit - IV

Torsion : Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse method; Linear elastic solution; 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.

Unit - V

Axi-Symmetric Problems: Rotating Discs**-** Flat discs, Discs of uniform thickness, Discs of uniform strength; Rotating Cylinders

Unit - VI

Theory of 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 relation for Isotropic elastic plates; Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem ; Solution of circular plate problem.

Unit - VII

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 a distributed load at its end; Semi-infinite beam with concentrated load near its end; Short Beams.

Unit - VIII

Contact stresses: Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

Textbook:

1. Advanced Mechanics of materials by Boresi & Sidebottom-Wiely International.

References:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia.
4. Strength of materials by Sadhu singh.

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	4	**0**	**0**	**4**

(D1505101) CREEP, FATIGUE AND FRACTURE MECHANICS

UNIT-I

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behavior. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter-granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, the ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.

UNIT-II

Griffith's analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

UNIT-III

Linear Elastic Fracture Mechanics, (LEFM). Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor.

UNIT-IV

The effect of Constraint, definition of plane stress and plane strain and the effect of component thickness. The plasticity at the crack tip and the principles behind the approximate derivation of plastic zone shape and size. Limits on the applicability of LEFM.

UNIT-V

Elastic-Plastic Fracture Mechanics; (EPFM). The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use.

UNIT-VI

The effect of Microstructure on fracture mechanism and path, cleavage and ductile failure, factors improving toughness,

UNIT-VII

Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Goodman's rule and Miners rule. Micromechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

UNIT-VIII

Creep deformation: the evolution of creep damage, primary, secondary and tertiary creep. Micro-mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigue interactions. Examples.

Text Books

1. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press, (1995)
2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.
3. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
4. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
5. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
6. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
7. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).
8. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
9. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley (1996)
10. F.R.N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

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(D1506101) TRIBOLOGY

(Elective-I)

(NOTE: PSG Design data book is permitted in Examination**)**

Unit – I

Introduction: Nature of surfaces and contact-Surface topography-friction and wear mechanisms and effect of lubricants- methods of fluid film formation.

Unit – II

Selection of rolling element bearings: Nominal life, static and dynamic capacity-Equivalent load, probabilities of survival- cubic mean load- bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

Unit – III

Hydrodynamic bearings: Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number- performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings- fixed tilting pads, single and multiple pad bearings- optimum condition with largest minimum film thickness.

Unit – IV

Hydrostatic Bearings: Thrust bearings – pad coefficients- restriction- optimum film thickness-journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

Unit – V

Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.

Unit – VI

Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants- additives- lubrication systems and their selection – selection of pump, filters, piping design- oil changing and oil conservation.

Unit – VII

Seals: different type-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.

Unit – VIII

Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography.

Text Books:

1. Rowe WW& O' Dionoghue,"Hydrostatic and Hybrid bearing design "Butter worths &Co. Publishers Ltd, 1983.
2. Collacott R.A," Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London 1977.
3. Bernard J.Hamrock, "Fundamentals of fluid film lubricant", Mc Graw-Hill Co., 1994.

References:

1. PSG Design Data Hand book.
2. Connor and Boyd JJO (Editors) "Standard hand book of lubrication engineers "ASLE, Mc Graw Hill Book & Co., 1968.
3. Shigley J, E Charles," Mechanical Engineering Design", McGraw Hill Co., 1989.

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(D1507101) PRESSURE VESSEL DESIGN
(Elective-I)

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.

Unit – II

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

Unit – III

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

Unit – IV

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.

Unit – V

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 – VI

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 – VII

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 prestressing on the ambient temperature toughness of pressure vessel steels.

Unit – VIII

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.

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	4	**0**	**0**	**4**

(D1508101) THEORY OF PLASTICITY
(Elective-I)

Unit – I

Introduction: Modeling Uniaxial behavior in plasticity. Index notation, Cartesian tensors. Yield and failure criteria Stress, stress deviator tensors. Invariants, principal, mean stresses. Elastic strain energy. Mohr's representation of stress in 2 & 3 dimensions. Haigh-Westergaard stress space. Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria.

Unit – II

Strain at point: Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations

Unit – III

Principle of virtual work and its rate forms: Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations.

Unit – IV

Criteria for loading and unloading: Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic–plastic materials. Expansion of a thick walled cylinder.

Unit – V

Incremental stress strain relationships: Prandtl-Reuss material model. J_2 deformation theory, Drucker-Prager material, General Isotropic materials.

Unit – VI

Deformation theory of plasticity: Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.

Unit – VII

Finite element formulation for an elastic plastic matrix: Numerical algorithms for solving non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations

Unit – VIII

Bounding surface theory: Uniaxial and multiaxial loading anisotropic material behavior Theroms of limit analysis: Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorms, examples and problems.

Text books/References:

1. Plasticity for structural Engineering W.F.Chen s and D.J.Han, Springer verlag-1987.
2. Mechanics of Materials –II, Victor E. Saouma

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(D1591101) SIMULATION LABORATORY

I. Modeling

1. Surface modeling.
2. Solid modeling
3. Drafting
4. Assembling

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

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Bucking Analysis
6. Analysis of Composites
7. Fracture Mechanics

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

1. Steady state thermal analysis
2. Transient thermal analysis

References:

1. User manuals of ANSYS package Version 10.0
2. I-DEAS Package Version 9.0

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	0	**0**	**3**	**2**

(D1592101) COMPUTER AIDED DESIGN LAB

1. 2D Modeling using Pro-E.
2. Use of various types of surfaces in 3D modeling, animation features and other editing entities in machine tool assemblies in Pro-E.
3. Kinematic and dynamic simulation of various mechanisms in Pro-E
4. Process simulation like Pro-Cast, Pro-Mould and other machining features.
5. Using Pro-E/ Uni-grahics Physical interpretation of machining features and tool geometries.

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(D1509102) ADVANCED MECHANICAL ENGINEERING DESIGN

(PSG Design data book is permitted in Examination)

Unit – I

Introduction: Introduction to design, the engineering model, computer aided design and Engineering, materials, load analysis, stresses, strains, deflection and stability, stress element representation for different types of loads. Locating critical sections, force flow concept, methodology for solving machine component problems.

Unit – II

Failure Theories: Static failure theories-failure of ductile materials, failure of brittle materials, fracture mechanics, fatigue-failure theories, surface failures.

Unit – III

Design synthesis: Introduction to product design, product design practice and industry, designing with plastics, rubber, ceramics & woods: economic factors influencing design, human engineering considerations in product design; Modern approach to product design.

Unit – IV

Design of power transmission elements: Design of flat belts, v-belts, toothed belts, roller chains, hydrodynamic drives.

Unit – V

Design of Gears-I: Spur, Helical, Gear materials, forces, stresses, lubrication, design procedure considering Lewis beam strength, Buckingham dynamic load and wear load.

Unit – VI

Design of Gears-II

Design of Spiral , worm and wheel, Bevel gears, Algorithms for the design procedure of different types of gears.

Unit – VII

Journal bearings: Lubricants, hydrodynamic lubrication theory, design of hydrodynamic bearings, multi lobe bearings

Unit – VIII

Rolling Element Bearings

Rolling element bearings, selection of rolling element bearings, bearing mountings and special bearings. Algorithms for the design procedure of bearings

Text Books:

1. Machine Design –An Integrated approach, Robert L. Norton, Prentice-Hall, 1998.
2. Mechanical Design: Theory methodology, Manjula B Waldron and Kenneth J.Waldron, Springer Verlag, New York, 1996.
3. Product design & Manufacturing by A.K Chitale & R.C Gupta, PHI, 3rd Edition.

Reference Books:

1. Engineering Design: A materials and processing approach, George Dieter, McGraw-Hill, 1983.
2. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M. Marshek, John Wiley & Sons, 2nd edition, 1991.
3. Product Design by Chitale, P.H.I.

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(D1510102) MECHANICAL VIBRATIONS

Unit - I

Single degree of Freedom systems I: Undamped and damped free vibrations: forced vibrations; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation; Vibration isolation and transmissibility; Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

Unit - II

Single degree of Freedom systems II: Response to NonPeriodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum ;system response by the Laplace Transformation Method, The Transfer Function; General system response; response by the state transition matrix ; Discrete-Time systems, the Convolution Sum; Discrete-Time Response using the Transition Matrix

Unit - III

Two degree freedom systems: Principal modes – undamped and damped free and forced vibrations; undamped vibration absorbers; Response to Nonperiodic excitations by the Convolution sum.

Unit - IV

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

Unit - V

Numerical Methods: Rayliegh's, stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

Unit - VI

Continuous systems: Free vibration of strings – longitudinal oscillations of bars-traverse vibrations of beams- Torsional vibrations of shafts.

Unit - VII

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Unit - VIII

Nonlinear Vibrations: Undamped free vibration with non-linear spring forces; Forced undamped vibration with nonlinear spring forces; Self-excitated vibrations; Stability.

Text books:

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by G.K. Groover.

References:

1. Vibrations by W.T. Thomson
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.

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(D1511102) EXPERIMENTAL STRESS ANALYSIS

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.

Unit – II

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

Unit – III

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.

Unit – IV

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 – V

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 – VI

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

Unit – VII

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.

Unit – VIII

Birefringent 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.

Text Books:

1. Theory of Elasticity by Timoshenko 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

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(D1512102) ROBOTICS

Unit – I

Fundamentals of Robots: Introduction, definition of robot, classification of robots, History of robotics, robot components, degree of freedom, robot joints, robot coordinates, reference frames, programming modes, robot characteristics, robot work space, robot languages, advantages, disadvantages and applications of robots.

Unit – II

Matrix transformations: Introduction, robots as a mechanisms, matrix representation-representation of a point in a space, representation of a vector in space, representation of a frame at the origin of a reference frame, representation of a frame in a reference frame, representation of a rigid body. Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis, representation of combined transformations, transformations relative to the rotating, inverse of transformation matrices.

Unit – III

Robot kinematics: Forward and inverse kinematics of robots-forward and inverse kinematic equations for position, forward and inverse kinematic equations for orientation, forward and inverse kinematic equations for position and orientation,Denavit-Hartenberg(D-H) representation of forward kinematic equations of robots, The inverse kinematic solution and programming of robots, Degeneracy and Dexterity, simple problems with D-H representation.

Unit – IV

Differential motions and Velocities:

Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

Unit – V

Dynamic analysis and forces: Introduction, Lagrangian mechanics, Effective moments of inertia, dynamic equations for multi-degree of freedom robots-kinetic enrgy,potential energy, the Lagrangian,robot's equations of motion, static force analysis of robots.

Unit – VI

Trajectory planning: Introduction, path Vs trajectory, basics of trajectory planning, joint space trajectory planning-third order polynomial trajectory planning, fifth order polynomial trajectory planning, Cartesian-space trajectories.

Unit – VII

Robot Actuators: Introduction,charecterics of Actuating systems-weight, power to weight ratio, operating pressure, stiffness Vs compliance,comparision of actuating systems, hydraulic devices, pneumatic devices,
Electric motors-DC motorcar motors, Brushless DC motors, direct Drive electric motors, servomotors, stepped motors.

Unit – VIII

Robot sensors: Introduction, sensor characteristics, Position sensors-potentiometers, encoders, LVDT, Resolvers, time of travel displacement sensor, Velocity sensors-Encoders, Tachometers, differentiation of position signal, Accelerating sensors, force and pressure sensors-piezoelectric, force sensing resistor, strain gauges, Torque sensors, light and infrared sensors, touch and tactile sensors, proximity sensors-magnetic proximity sensors, optical proximity sensors, Ultrasonic proximity sensors, inductive proximity sensors, capacitive proximity sensors, eddy current proximity sensors, sniff sensors.

Text Books:

1. Introduction to Robotics – Analysis, System, Applications by Saeed B. Niku, PHI Publications
2. Industrial Robotics – Mikell P. Groover & Mitchell Weiss, Roger N. Nagel,Nicholas G.Odrey – Mc Graw Hill, 1986

References:

1. Robot Modeling and Kinematics – Rachid Manseur, Firewall Media Publishers (An imprint of Laxmi Publications Pvt. Ltd., New Delhi).
2. Robot Analysis and Control - H. Asada and J.J.E. Slotine John Willey & Sons.
3. Fundamentals of Robotics: Analysis and control, Robert J. Schilling, Prentice Hall, 1990.
4. A robot Engineering text book – Mohsen shahinpoor, Harper & Row Publishers, 1987.
5. Introduction to Robotics: Mechanics and Control, John.J.Craig, Addison- Wesley, 1999.
6. Robotics: Control, sensing, vision, and intelligence – K.S. FU, R.C. Gonzalez and C.S.G Lee. Mc Graw Hill, 1987.
7. Modeling and control of Robot manipulators, L. sciavicco and b. Siciliano, Springer (second edition) 2000.
8. ROBOTICS (Fundamental concepts and analysis) ASHITAVA GHOSAL.Oxford university press, Y.M.C.A.Library Building.jai singh Road.NEWDELHI-110001.

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(D1513102) ADVANCED OPTIMIZATION TECHNIQUES

UNIT - I

Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications.

UNIT - II

Assignment problem: Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.

UNIT - III

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT - IV

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT - V

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

UNIT - VI

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT – VII

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems .

UNIT VIII

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Text Books:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

References:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

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(D1514102) DESIGN FOR MANUFACTURING
(Elective-II)

UNIT - I
Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

UNIT - II
Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

UNIT - III
Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT - IV
Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

UNIT - V
Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

UNIT – VI
Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – VII
Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT VII
Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection molding – design guidelines for machining and joining of plastics.

Text Books:
1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

References:
1. ASM Hand book Vol.20

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(D1515102) MECHANICS OF COMPOSITE MATERIALS
(Elective-II)

UNIT-I

Introduction to Composite Materials: Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications.

UNIT-II

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT-III

Manufacturing methods: Autoclave, tape production, molding methods, filament winding, man layup, pultrusion, RTM.

UNIT-IV

Micromechanical Analysis of a Lamina: Introduction, Definitions: Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT-V

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina.

UNIT-VI

Micromechanical Analysis of a Lamina :Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi-Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion.

UNIT-VII

Micromechanical Analysis of Laminates: Introduction, Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates.

UNIT-VIII

Failure, Analysis, and Design of Laminates: Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues.

Text Books:

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw, Publisher: CRC

References:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

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(D1516102) NON - DESTRUCTIVE EVALUATION
(Elective-II)

Unit – I

Ultra Sonic Hardness Testing: Flaw Detection Using Dye Penetrants. Magnetic Particle Inspection introduction to electrical impedance, Principles of Eddy Current testing, Flaw detection using eddy currents.

Unit – II

Introduction to X-Ray Radiography: The Radiographic process, X-Ray and Gamma-ray sources, Geometric Principles, Factors Governing Exposure, Radio graphic screens, Scattered radiation, Arithmetic of exposure, Radiographic image quality and detail visibility, Industrial X-Ray films,

Unit – III

X-Ray Radiography processes: Fundamentals of processing techniques, Process control, The processing Room, Special Processing techniques, Paper Radiography, Sensitometric characteristics of x-ray films, Film graininess signal to noise ratio in radiographs, The photographic latent image, Radiation Protection,

Unit – IV

Introduction to Ultrasonic Testing: Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes- straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media,

Unit – V

Ultrasonic tests: Transmission and pulse echo methods, A-scan, B-scan, C-scan, F-scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, Zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echos and noise. Ultrasonic flaw evaluation.

Unit – VI

Holography: Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.

Unit – VII

Applications - I: NDT in flaw analysis of Pressure vessels, piping

Unit – VIII

Applications - II: NDT in Castings, Welded constructions, etc., Case studies.

Text books:

1. Ultrasonic testing by Krautkramer and Krautkramer
2. Ultrasonic inspection 2 Training for NDT: E. A. Gingel, Prometheus Press,
3. ASTM Standards, Vol 3.01, Metals and alloys

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AUTONOMOUS
SCHOOL OF MECHANICAL ENGINEERING

M.TECH, II SEM(Machine Design)	**Th**	**T**	**P**	**C**
	0	**0**	**3**	**2**

(D1593102) MACHINE DYNAMICS LAB

LIST OF EXPERIMENTS:

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. Determination of the magnitude and orientation of the balancing mass in dynamic balancing
4. Field balancing of the thin rotors using vibration pickups.
5. CAM Analysis-Study of Jump Phenomina-determination critical speed.
6. Turn Table apparatus for determination of Moment of Inertia.
7. Diagnosis of a machine using FFT analyzer.

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	0	**0**	**3**	**2**

(D1594102) CAD/CAM LAB

I. CNC PART PROGRAMMING

PART-A

1. Generation of part programs on CNC Lathe machine to perform the following operations

i. Step turning

ii. Taper turning

iii. Thread cutting using canned cycles

PART- B

1. Generation of part program on CNC milling machine to perform

i. Profile milling

ii. Circular/ Rectangular Pocketing operation.

2. Cutting tool path generation using any one simulation package for different machining operations.

Suggested Software packages: Pro/E, I-DEAS, Unigraphics, Iron CAD, Edge-CAM.

II. Robot simulation / Programming

i. Robot programming for pick and place operations

ii. Robot simulation using software (Workspace5.0).