

RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY

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MACHINE DESIGN

RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING & TECHNOLOGY

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Affiliated to JNTUA -Anantapuramu, Approved by AICTE-New Delhi,
Accredited by NBA- (Tier-I),New Delhi, Accredited by NAAC of UGC with A⁺ Grade

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

DEPARTMENT OF
MECHANICAL ENGINEERING

MACHINE DESIGN



**ACADEMIC REGULATIONS,
COURSE STRUCTURE AND SYLLABI**
APPLICABLE FOR STUDENTS ADMITTED INTO
M.TECH (REGULAR) FROM 2019-20

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MACHINE DESIGN**M.TECH, III-SEMESTER**

S. No.	Subject Code	Subject	L	T	P	Contact hrs. wk	Credits	Scheme of Examination		
								Internal	External	Total
1.	Program Specific Elective-5	1. Advanced Mechanics of Solids 2. Nano Technology 3. Non-Destructive Evaluation	3	0	0	3	3	40	60	100
2.	Open Elective (MOOCs)	1. Mechanics of Composite Materials 2. Industrial Safety 3. Waste to Energy	3	0	0	3	3	40	60	100
3.	CCE	Continuous Comprehensive Evaluation	0	0	4	4	2	40	60	100
4.		Main Project Phase- I	0	0	18	18	09	0	0	0
Total			06	0	22	28	17	120	180	300

I M.TECH, IV-SEMESTER

S. No.	Subject Code	Subject	L	T	P	Contact hrs. wk	Credits	Scheme of Examination		
								Internal	External	Total
1.		Technical Seminar				-	1.5	50	0	50
2.		Main Project Phase-2	0	0	26	26	13	0	0	0
Total			0	0	26	28	14.5	50	0	50

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ADVANCED MECHANICS OF SOLIDS**[Program Specific Elective-5]****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 Non-symmetrical bending; Deflection of straight beams due to non-symmetrical 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

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 - VI

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.

TEXTBOOK:

1. Advanced Mechanics of materials by Boresi& Sidebottom-Wiely International.
2. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia

REFERENCES:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials by Sadhu singh.

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NANO TECHNOLOGY
[Program Specific Elective-5]

UNIT – I

Introduction: Size and shape dependence of material properties at the nano scale, why is small good? limits to smallness, scaling relations, can nano robots walk and nano planes fly? Nano scale elements in conventional technologies.

UNIT – II

Top-down and bottom-up nanofabrication: The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, Electron beam lithography, Soft lithography: nano imprinting and micro contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT – III

Self assembly and self-organization: Functional coatings with self assembled mono layers of molecules and nano particles Langmuir Blodgett films, layer-by-layer growth.

Imaging/characterization of nanostructures - General considerations for imaging, Scanning probe techniques: SEM, STM, AFM, NSOM.

UNIT – IV

Metal and semiconductor nanoparticles: Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nano-particles, bioengineering applications, Catalysis.

UNIT – V

Semiconductor and metal nanowires: Vapor/liquid/solid growth and other synthesis techniques,, Nanowire transistors and sensors.

UNIT – VI

Carbon nanotubes: Structure and synthesis, Electronic, vibrational, and mechanical properties, How can carbon nano tubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement?

Mechanics at nano scale- Enhancement of mechanical properties with decreasing size, Nano electromechanical systems, nano-machines, Nano-fluidics, filtration, sorting, Molecular motors.

TEXT BOOKS:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley .
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

REFERENCES:

1. Introduction to Nanotechnology by Poole and Owens, Wiley.
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing.

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NON - DESTRUCTIVE EVALUATION**[Program Specific Elective-5]****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, Radiographic screens, Scattered radiation, Arithmetic of exposure, Radiographic image quality and detail visibility, Industrial X-Ray films, 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 – III

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 –IV

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. Flaw location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echos and noise. Ultrasonic flaw evaluation.

UNIT – V

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

UNIT – VI

Applications: NDT in flaw analysis of Pressure vessels, piping, 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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MECHANICS OF COMPOSITE MATERIALS

[Open Elective/ MOOCs]

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

UNIT-II

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

UNIT-III

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-IV

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-V

Micro-mechanical 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-VI

Macro-mechanical 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.

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
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Inter science, New York.
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.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Reinhold, New York.

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INDUSTRIAL SAFETY

[Open Elective/ MOOCs]

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering,

Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes

Unit-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

Unit-VI

Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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WASTE TO ENERGY

[Open Elective/ MOOCs]

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Unit-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification –

Unit-VI

Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.