UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
M.TECH. (Machine Design) Course Structure (R19)
With effect from 2019-2020

I Semester

S.No.	Code	Subject		L	T	P	Credits
1	MD101	Advanced Mechanics of Solids		3	0	0	3
2	MD102	Mechanical Vibrations and Acoustics		3	0	0	3
3	Programme Elective – I MD 103	MD1031	Design of Modern Vehicle Systems	3	0	0	3
		MD 1032	Product Design				
		MD 1033	Geometric Modeling				
		MD 1034	Fracture Mechanics				
		MD 1035	Advanced Mechanisms				
4	Programme Elective –II MD 104	MD 1041	Non-Destructive Evaluation	3	0	0	3
		MD 1042	Robotics				
		MD 1043	Design for Manufacturing & Assembly				
		MD 1044	Multi Body Dynamics				
		MD 1045	Vision Systems and Image Processing				
5	MD105	Computational Mathematics Lab		0	0	4	2
6	MD106	Design Practice Lab-I		0	0	4	2
7	MD107	Research Methodology and IPR		2	0	0	2
8	MD108	Soft Skills		2	0	0	0
Total							**18**

II Semester

S.No.	Code	Subject		L	T	P	Credits
1	MD201	Advanced Finite Element Methods		3	0	0	3
2	MD202	Advanced Machine Design		3	0	0	3
3	Programme Elective – III MD 203	MD 2031	Theory of Plasticity	3	0	0	3
		MD 2032	Signal Analysis and Condition Monitoring				
		MD 2033	Computational Fluid Dynamics				
		MD 2034	Composite Materials				
		MD 2035	Soft Computing				
4	Programme Elective – IV MD 204	MD 2041	Experimental Techniques and data analysis	3	0	0	3
		MD 2042	Design with advanced Materials				
		MD 2043	Mechatronics				
		MD 2044	Tribology				
		MD 2045	Experimental Modal Analysis				
5	MD205	Machine Dynamics Lab		0	0	4	2
6	MD206	Design Practice Lab-II		0	0	4	2
7	MD207	Value Education		2	0	0	0
8	MD208	Mini Project		0	0	4	2
Total							**18**

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III Semester

S.No.	Code	Subject		L	T	P	Credits
1	Programme Elective – V* MD 301	MD 3011	Industrial Robotics	3	0	0	3
		MD 3012	Advanced Optimization Techniques				
		MD 3013	Additive Manufacturing				
		MD 3014	Mechanics of Composite Materials				
		MD 3015	Vehicle Dynamics				
2	Open Elective	Should register for courses offered by other departments		3	0	0	3
3	Dissertation	Dissertation Phase -I		0	0	20	10
Total							**16**

* Students going for Industrial Project/ Thesis will complete programme elective and open elective courses through MOOCs

IV Semester

S.No.	Code	Subject	L	T	P	Credits
1	Dissertation	Dissertation Phase -II	0	0	32	16
Total						**16**

Courses offered by Mechanical Engineering Department to other departments as Open electives.

S.No.	Code	Subject	L	T	P	Credits
1	MD 3021	Industrial Robotics	3	0	0	3
2	MD 3022	Operations Research	3	0	0	3

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M.Tech – I Sem.
MD 101 ADVANCED MECHANICS OF SOLIDS

COURSE OBJECTIVES:

- To understand the concept of theory of elasticity equations for solving various engineering problems
- To study the failure modes of different structural members.
- To analyse the internal stresses in curved beams and beams subjected to un-symmetrical bending.
- To understand the deformations and stresses in non circular cross section members with torsional loading.
- To analyse the wertzian contact stresses

UNIT I

Theories of stress and strain, Definition of stress at a point, stress notation, principal stresses, other properties, differential equations of motion of a deformable body, deformation of a deformable body, strain theory, principal strains, strain of a volume element, small displacement theory.

Stress –strain temperature relations: Elastic and non elastic response of a solid, first law of thermodynamics, Hooke's Law, Anisotropic elasticity, Hooke's Law, Isotropic elasticity, initiation of Yield, Yield criteria.

UNIT II

Failure criteria: Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for number of cycles $N > 10^6$, buckling.

Application of energy methods: Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castiglione's theorem on deflections, Castiglione's theorem on deflections for linear load deflection relations, deflections of statically determinate structures.

UNIT III

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

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 : Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.

UNIT V

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.

TEXTBOOKS:

1.Advanced Mechanics of materials by Boresi& Sidebottom-Wiely International.
2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition
3. Advanced Mechanics of Solids, L.S Srinath

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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

COURSE OUTCOMES:

- Able to identify the failure modes of different structural members and apply various energy methods for statically determinant and in determinant structures.
- Gets aquainted with solving problems of curved beams and beams with un-symmetrical loading
- Able to apply the Soap-film analogy concept for torsional problems with non-circular cross section
- Exposed to solve the contact stress problems like rail wheels contact with rail track, hip joint
- Explain the stresses under two bodies in contact

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M.Tech – I Sem.
MD 102 MECHANICAL VIBRATIONS AND ACOUSTICS

UNIT-I: INTRODUCTION
Relevance of and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and undamped systems.

UNIT-II: MULTI DEGREE FREEDOM SYSTEMS
Free and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes - Orthogonality principle-Energy methods, Eigen values and Eigen vectors

UNIT-III: CONTINUOUS SYSTEMS

Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non linear and random vibrations.

UNIT-IV: BASICS OF ACOUSTICS

Speed of Sound, Wavelength, Frequency, and Wave Number, Acoustic Pressure and Particle Velocity, Acoustic Intensity and Acoustic Energy Density, Spherical Wave propagation, Directivity Factor and Directivity Index, Levels and the Decibel, Addition and subtraction of Sound levels, Octave Bands, Weighted Sound Levels.

UNIT-V: NOISE MEASUREMENT AND CONTROL

Sound Level Meters, Intensity Level Meters, Octave Band Filters Acoustic Analyzers, Dosimeter, Measurement of Sound Power, Impact of noise on humans, A-Weighting, Noise control strategy, sound absorption and insulation.

TEXT BOOKS:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. L.Meirovitch, “Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.

REFERENCES:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition,Pearson Education, 2008.
2 M.L.Munjal, “Noise and Vibration Control”, World Scientific, 2013.
3. Beranek and Ver, “Noise and Vibration Control Engineering: Principles and Applications”, John Wiley and Sons, 2006.

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4. Randall F. Barron, "IndustrialNoise Controland Acoustics",Marcel Dekker, Inc., 2003.

Web Resources:
http://www.nptel.ac.in/courses/112103111
http://www.nptel.ac.in/courses/112103112

M.Tech – I Sem.
MD 1031 DESIGN OF MODERN VEHICLE SYSTEMS
(PROGRAMME ELECTIVE – I)

UNIT I

Conceptual design of automobiles: body shape definition based on aerodynamic structure safety, sub - systems integration considerations, road load analysis, transmission of road loadsto structure. Detail design of structural elements, load analysis for different vehicles, safety consideration, design for bending, torsion conditions, criteria for toppling, based on cornering loads.

UNIT II

Basics of Electric vehicles (EV) , Review of existing design of EV, EV design, Performance, Operation and charging.
Hybrid Vehicles Principles-serial, parallel, electrical, hydraulic

UNIT III

Definition of hybridness , Hybrid design philosophy , Hybridness: parallel hybrid, series, mixed and range extender (plug-in) hybrids , Range extender , Optimization and hybridness , Battery power and electric motor power

UNIT IV

Introduction to UAVs/Drones, Drone Applications, Working Principle and Design, Inertial Measurement Unit, Sensors and Calibration, PID - Implementation and Tuning, Flight controller, Remote Controller, Quadcopter dynamics

UNIT V

Safety aspects of automobiles, devices, energy absorbing systems, crash worthiness, legislation relating to safety, vehicle performance requirements, sub systems packaging and verification of vehicle performance through testing(lab, field testing).

TEXT BOOKS:

1 Donald E.Males, Fundamentals of automobile body structure design(R-394), SAE2011
2 W.F.Milliker,D.L.Milliker,Maurice Olly, Chassis design: principles an analysis (R-206)SAE2002
3. J.H Smith, Introduction to Modern Vehicle Design, Butterworth-Heinemann

REFERENCES:
(https://nptel.ac.in/downloads/108103009/)
(https://www.iith.ac.in/~raji/courses.html)

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MD1032 **PRODUCT DESIGN**
(PROGRAMME ELECTIVE - I)

Course objectives

1. Understanding of materials, processes, ergonomics, human behaviour and systems with reference to product design.
2. To develop conceptual thinking, and workshop and computer skills for modelling and simulation of a variety of individual and group projects ranging from basic to the complex.
3. To understand various risks involved through various techniques and perform reliability analysis.
4. To acquaint with different product testing procedures under thermal, vibration, electrical and combined environments.

UNIT I
Product Design Process: Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioral Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees.
Modeling and Simulation: Triz, Role of Models in Engineering Design, MathematicalModeling, Similitude and Scale Models, Computer Simulation, Geometric Modeling on Computer, Finite-Element Analysis.

UNIT II
Product management:
The operation of product management: Customer focus of product management , product planning process, Levels of strategic planning, Wedge analysis, Opportunity search, Product life cycle Life cycle theory and practice.
Product development: Managing new products, Generating ideas, Sources of product innovation, Selecting the best ideas, The political dimension of product design, Managing the product launch and customer feedback.
Product managers and manufacturing: The need for effective relationships, The impact of manufacturing processes on product decisions, Prototype planning,, Productivity potentials, Management of product quality, Customer service levels.

UNIT III
Risk and Reliability: Risk and Society, Hazard Analysis, Fault Tree Analysis. Failure Analysis and Quality: Causes of Failures, Failure Modes, Failure Mode and Effect Analysis, FMEA Procedure, Classification of Severity, Computation of Criticality Index, Determination of Corrective Action, Sources of Information, Copyright and Copying. Patent Literature.

UNIT IV
Product Testing; thermal, vibration, electrical, and combined environments, temperature testing, vibration testing, test effectiveness. Accelerated testing and data analysis, accelerated factors. Weibull probability plotting, testing with censored data.

UNIT V
Design For Maintainability: Maintenance Concepts and Procedures, Component Reliability, Maintainability and Availability, Fault Isolation in design and Self-Diagnostics.

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Product Design for Safety, Product Safety and User Safety Concepts, Examples of Safe Designs.
Design Standardization and Cost Reduction: Standardization Methodology, Benefits of Product Standardization; International, National, Association and Company Level Standards; Parts Modularization

TEXT BOOKS:
1. Engineering Design , George E. Dieter, McGRAW-HILL
2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans, Springer Verlag

REFERENCES:
1. The Product Management Handbook, Richard S. Handscombe, McGRAW-HILL
2. New Product Design, Ulrich Eppinger
3. Product Design, Kevin Otto.

COURSE OUT COMES:

- Apply creative thinking skills for idea generation
- Translate conceptual ideas into clear sketches
- Present ideas using IT application software and physical model
- Able to identify causes of failure through fault free analysis and perform failure analysis

To carryout perform product testing under thermal, vibration, electrical and combined environments.

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M.Tech – I Sem.

MD 1033 **GEOMETRIC MODELING**
(PROGRAMME ELECTIVE - I)

COURSE OBJECTIVES:

- Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings,
- Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program,
- Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring, Model complex shapes including freeform curves and surfaces,
- Understand the possible applications of the CAD systems in motion analysis, structure analysis, optimization, rapid prototyping, reverse engineering and virtual engineerin
- Use full-scale CAD software systems designed for geometric modeling of machine components and automatic generation of manufacturing information.

UNIT - I
Introduction: Definition, Explicit and implicit equations, parametric equations.
UNIT - II
Cubic Splines-1: Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves.
UNIT - III
Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.
B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.
UNIT – IV
Surfaces: Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.
UNIT – V
Solids: Tricubic solid, Algebraic and geometric form.
Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

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TEXT BOOKS:

1. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
2. Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.

REFERENCES:

1. Geometric Modeling by Micheal E. Mortenson, McGraw Hill Publishers
2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.MallikarjunaRao, MMM Sarcar, PHI Publishers

COURSE OUTCOMES:

- The students will get a thorough view on modern techniques in geometric modeling, emphasizing practical methods and the mathematical theory.

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M.Tech – I Sem.
MD 1034 FRACTURE MECHANICS
(PROGRAMME ELECTIVE - I)

COURSE OBJECTIVES:

- To provide an understanding of fundamental principles and assumptions, and to give a basis for analysis and evaluation of structures from a fracture mechanics point of view.
- Also students will be explored to fatigue, creep deformation, creep-fatigue interactions

UNIT-I

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. 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

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

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, crack tip plasticity, effect of thickness on fracture toughness.

UNIT-III

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-IV

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. Goodmans 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-V

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.

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REFERENCES:

1. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
2. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
3. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
4. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
5. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).

COURSE OUTCOMES:

- After completion of this course students will acquire the knowledge for applying fracture mechanics theory
- To calculate stress areas and the "energy release rate" around crack tips and crack growth due to fatigue.
- To develop the theory of fracture by different postulator- Griffith's theory and fracture toughness etc.
- Understand the concepts of elastic-plastic functional machines (EPFM) theorems

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M.Tech – I Sem.
MD 1035 ADVANCED MECHANISMS
(PROGRAMME ELECTIVE - I)

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 ;Collineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

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 – III

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.

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 – IV

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 – V

Manipulator Kinematics: D-H transformation matrix ; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.

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TEXT BOOKS:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms,McGraw-Hill,1962.
2. L.Sciavicco and B.Siciliano, Modelling 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.

REFERENCES:

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. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold,1980

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M.Tech – I Sem.
MD 1041 NON - DESTRUCTIVE EVALUATION
(PROGRAMME ELECTIVE - II)

COURSE OBJECTIVES:

- To understand the concepts, principles, and methods employed for nondestructive evaluation (NDE) of structures and materials, while emphasis is on inspection methods employed to ensure structural integrity of aerospace vehicles.
- To acquaint with different Major NDE techniques such as X-rays, ultrasonics, eddy currents, penetrants, magnetic flux, and visual/optical methods.
- Further to learn the topics topics such as damage-tolerant design, retirement-for-cause, factors affecting NDE reliability, and structural "aging" are discussed in the context of NDE engineering.
- To study various principles, techniques, equipment, applications and limitations of basic NDT methods.

UNIT – I

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

UNIT – II

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,

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

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, 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 – IV

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

UNIT – V

Applications: NDT in flaw analysis of Pressure vessels, piping, NDT in Castings, Welded constructions, etc., Case studies.

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Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
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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

Course outcomes

- Define different non-destructive testing (NDT) methods and to be able to demonstrate various NDT techniques to evaluate materials during processing and finished products and structures.
- Explain the principles of conventional NDT methods (visual inspection,magnetic methods, thermal methods, radiography, Eddy current testing, ultrasonic inspection).
- Analyze the different NDT methods to select the appropriate techniques for inspections

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M.Tech – I Sem.
MD 1042 **ROBOTICS**
(PROGRAMME ELECTIVE - II)

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.

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 – III

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 – IV

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.

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.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

UNIT – V

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.

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.
8.ROBOTICS (Fundamental concepts and analysis)ASHITAVA GHOSAL.Oxford university press

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
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Sri P.Sukumar Dr.R.R Das

M.Tech – I Sem.
MD 1043 DESIGN FOR MANUFACTURING & ASSEMBLY
(PROGRAMME ELECTIVE - II)

UNIT - I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

UNIT - II

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 - III

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.

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 - IV

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

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

UNIT – V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

TEXT BOOKS:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
1. Design for Manufacture by Boothroyd,
2. Design for manufacture, James Bralla

REFERENCE:

ASM Hand book Vol.20

M.Tech – I Sem.

MD 1044 **MULTI BODY DYNAMICS**
(PROGRAMME ELECTIVE – II)

UNIT-I

Review of kinematics and dynamics of point mass and rigid body - types of constraints - constraints for revolute joints, translational joints, composite joints

UNIT-II

Formulation of planar multi-body systems, kinematics and dynamics in point coordinates, body coordinates, and joint coordinates

UNIT-III

Numerical methods for solution - analysis of planar multi-body systems, kinematic analysis in various formulations.

UNIT-IV

Inverse dynamic analysis, forward dynamic analysis, constraint stabilization - case studies, McPherson strut suspension, Double A-arm suspension, planar robot manipulator

UNIT-V

Spatial multi-body systems-formulation- joints: - revolute, prismatic, cylindrical, spherical, universal-case studies.

TEXT BOOKS:

1. Planar Multibody Dynamics Formulation, Programming and Applications by Parviz E. Nikravesh, CRC Press
2. Dynamics of Multibody Systems by Ahmed A. Shabana, Cambridge University Press.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

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M.Tech – I Sem.
MD 1045

VISION SYSTEMS AND IMAGE PROCESSING
(PROGRAMME ELECTIVE – II)

UNIT - I

Machine vision: Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.

UNIT - II

Image representation: Application of image processing - Image sampling, Digitization and quantization - Image transforms.

UNIT - III

Spatial domain techniques: Convolution, Correlation. Frequency domain operations - Fast Fourier transforms, FFT, DFT, Investigation of spectra. Hough transform

UNIT - IV

Image enhancement: Filtering, Restoration, Histogram equalisation, Segmentation, Region growing.

UNIT - V

Image compression: Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification.

TEXT BOOKS:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
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2 Robot Vision by Prof. Alan Pugh (Editor), IFS Ltd., U.K. 3. Digital Image Processing by A.Rosenfled and A. Kak, Academic Press.

REFERENCES:

1. The Psychology of Computer Vision by P. Winstan, McGraw-Hill.

2. Algorithms for Graphics and Image Processing by T. Pavidis, Springer Verlag.

M.Tech – I Sem.
MD 105 COMPUTATIONAL MATHEMATICS LAB

1. Generate a MATLAB and Python code for solving a system of linear equation using Gauss Elimination Method.
2. Generate a MATLAB and Python code for LU Decomposition (Factorization)
3. Generate a MATLAB and Python code for Iterative methods to solve equations using Jacobi Iteration.
4. Generate a MATLAB and Python code for Curve fitting
    i. Straight line fit
    ii. Polynomial Curve fit
5. Generate a MATLAB and Python code for Fourier transformation
    i. FFT Vs DFT
    ii. Interpolation by DFS
6. Generate a MATLAB and Python code for Euler's method differential equations
7. Generate a MATLAB and Python code for Runge – Kutta method differential equations
8. Generate a MATLAB and Python code for Matrices and Eigen values
    i. Eigen values and Eigen vectors
    ii. Jacobi method
9. Generate a MATLAB and Python code for Partial Differential equations
    i. Elliptical PDE
    ii. Parabolic PDE
    iii. The Crank – Nicholson method
    iv. Two dimensional parabolic PDE

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M.Tech – I Sem.
MD 106 DESIGN PRACTICE LAB - I

COURSE OBJECTIVES:

- Understand and draw part drawings with appropriate tolerances using CAD software package.
- Practice the students to generate 3D models, surface and assembly modeling using modeling software package
- Train the students in static and transient thermal analysis using FEA packages

I. Modeling

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

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

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

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

1. Steady state thermal analysis
2. Transient thermal analysis

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

REFERENCE:
User manuals of ANSYS package Version 9.0

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
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M.Tech – I Sem.
MD 107 RESEARCH METHODOLOGY AND IPR

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.

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Sri P.Sukumar Dr.R.R Das

M.Tech – I Sem.
MD 108 SOFT SKILLS

UNIT-I

Planning and Preparation, Word Order, Breaking up long sentences. Structuring Paragraphs and Sentences, Being concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II

Clarifying Who Did What, Highlighting your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT-III

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

UNIT-V

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

REFERNCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM Highman's book.

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4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

M.Tech – II Sem.
MD 201 ADVANCED FINITE ELEMENT METHODS

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

UNIT – II
One-dimensional elements: Bar, trusses, beams and frames, displacements, stresses and temperature effects.

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

UNIT – IV
Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration, Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle, Patch test.

UNIT – V
Finite elements in Structural Analysis: Static and dynamic analysis, eigen value problems, and their solution methods, case studies using commercial finite element packages.

TEXT BOOK:
1. Finite element methods by Chandrubatla & Belagondu.

REFERENCES:
1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 1994
2. Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill,1983.
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996

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Sri P.Sukumar Dr.R.R Das

M.Tech – II Sem.

MD 202 ADVANCED MACHINE DESIGN

UNIT-I

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 and Creative techniques, Material selection in machine design, design for safety and Reliability, concept of product design

UNIT-II

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,

UNIT-III

Fatigue failure theories: cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation

UNIT-IV

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.

UNIT-V

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. Team work and Ethics in engineering design: Team formation, functioning, discharge, team dynamics, Ethical issues considered during engineering design process

TEXT BOOKS:

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 McGrawHill International Book Company, New Delhi.

REFERENCES:

1. Fundamentals of machine elements by Hamrock, Schmid and Jacobian, 2nd edition, McGraw- Hill International edition.
2. Product design and development by Karl T. Ulrich and Steven D. Eppinger. 3rd edition, Tata McGraw Hill.
3. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall
4. Engineering Design / George E Dieter / McGraw Hill /2008
5. Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition /McGrawHill International edition.

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Sri P.Sukumar Dr.R.R Das

M.Tech – II Sem.
MD 2031 **THEORY OF PLASTICITY**
(PROGRAMME ELECTIVE - III)

COURSE OBJECTIVES:

- Course will be focused on the mathematical formulation of elasto-plastic constitutive relationship, including yield criteria, isotropic and kinematic hardening, flow rule.
- Finally practical engineering limit analysis will be discussed several examples will be given.
- Know the main physical features of elastoplastic deformations and their engineering implications.
- Have a good understanding of how to describe elastoplastic behaviour, including yield limit, loading-unloading phenomena, hardening and subsequent yield, flow rule for plastic flow, as well as evolution equations for characterising hardening, etc.
- Understand clearly relationship between the rate constitutive equations and path-dependent behaviour

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.

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 – II

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

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 – III

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

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.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

UNIT – IV

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 – V

Bounding surface theory: Uniaxial and multiaxial loading anisotropic material behaviour

Theroms of limit analysis : Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorms, examples and problems.

TEXT BOOK:

1. Theory of Elasticity by S.P. Timoshenko & J.K Goodier, MGH

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.
3. Theory of plasticity, Sadhu Singh

COURSE OUTCOMES:

- Describe the elastic and plastic behaviour from stress-strain curves for materials;
- Recognize typical plastic yield criteria established in constitutive modelling
- Understand the physical interpretation of material constants in mathematical formulation of constitutive relationship
- solve analytically the simple boundary value problems with elasto-plastic properties
- Develop constitutive models based on experimental results on material behaviour

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride

Sri P.Sukumar Dr.R.R Das

M.Tech – II Sem.

MD 2032 SIGNAL ANALYSIS AND CONDITION MONITORING (PROGRAMME ELECTIVE - III)

COURSE OBJECTIVES:

- To develop understanding of various types of signals and their analysis like FFT, filtering, windowing etc.
- The student will undertake practical analysis of stationary, non-stationary and transient signals of various mechanical system components.
- Ability to apply condition monitoring techniques like vibration monitoring, thermo graphyetc to the mechanical systems.
- To study the various detectors, recorders etc and analyse their response time.

Ability to implement different ISO standards for mechanical systems

UNIT-I

Introduction, Basic concepts.Fourier analysis.Bandwidth. Signal types. Convolution.
Signal analysis: Filter response time. Detectors.Recorders.Analog analyzer types.

UNIT-II

ANALYSIS OF STATIONARY SIGNALS: Stepped filter analysis. Swept filter analysis. High speed analysis.Real-time analysis.

UNIT-III

ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS: Choice of window type. Choice of window length.Choice of incremental step.Practical details.Scaling of the results.

UNIT-IV

ANALYSIS OF TRANSIENTS: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth).Analysis by repeated playback (variable bandwidth).

UNIT-V

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, active, passive hybrid methods of condition monitoring

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

TEST BOOK:

1. Condition Monitoring of Mechanical Systems / Colcote.

REFERENCES:

1. Frequency Analysis /R.B.Randall.
2. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
3. Theory of Machines and Mechanisms/ Amitabh Ghosh& AK Malik/ EWP

COURSE OUTCOMES:

- Ability to analyse various types of signal and its analysis like FFT, filtering, windowing etc.
- Enhance the students abilities to apply different types of signals in the form of stationary, non stationary and transient for mechanical components.
- Able to apply condition monitoring techniques to industrial machinery for health monitoring.
- Able to compare the response of mechanical system behaviour with ISO standards

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride

Sri P.Sukumar Dr.R.R Das

M.Tech – II Sem.
MD 2033 COMPUTATIONAL FLUID DYNAMICS
(PROGRAMME ELECTIVE - III)

COURSE OBJECTIVES:

- Develop an understanding of introductory concepts in computational fluid mechanics with emphasis on the numerical solution of ordinary and partial differential equations
- solution of ODEs by numerical integration; finite difference and finite volume methods for parabolic, elliptic, and hyperbolic PDEs (techniques for single and multi-dimensional problems); numerical linear algebra
- Ability to implement and utilize various numerical methods and basic mathematical analysis for canonical problems in fluid mechanics.
- Able to understand formulation of 2D & 3D problems using FVM
- To get acquainted with the application of standard variational problems

UNIT – I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination.

Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT – II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations.

Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT – III

Formulations of incompressible viscous flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Formulations of compressible flows: potential equation, Eluer equations, Navier-stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.

UNIT – IV

Finite volume method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – V

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

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride

Sri P.Sukumar Dr.R.R Das

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.

COURSE OUTCOMES:

- An ability to identify, formulate, and solve engineering problems by approximating complex physical systems in fluid flow by simplified canonical models.
- Knowledge of fluid mechanics and its mathematical description.
- An ability to apply knowledge of math and science to engineering by describing continuous fluid-flow phenomena in a discrete numerical sense.
- An ability to use the techniques, skills, & engineering tools necessary for engineering practice by applying numerical methods to a "real-world" fluid-flow problem, integrating various numerical techniques in formulating a numerical solution method for that problem

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Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride

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M.Tech – II Sem.
MD 2034 COMPOSITE MATERIALS
(PROGRAMME ELECTIVE - III)

COURSE OUTCOMES: At the end of the course, the student shall be able to:
CO1. Understand composite material and their reinforcements
CO2. Select constituent materials glass, carbon, aramid, ceramic fibers and resins
CO3. Understand engineering mechanics, analysis and design, macro and micro mechanics of composites
CO4. Develop and processing of metal- matrix, ceramic -matrix and carbon- carbon composites
CO5. Understand and analyze the properties and performance of composites

UNIT I

Introduction: History and basic concept of composites. Definition and Classification of Composites, MMC, PMC, CMC. Reinforcing fibres- Natural fibres (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, polyethylene (UHMWPE), polybenzthiazoles etc.

UNIT II

Fundamental concepts:

Particulate fillers-importance of particle shape and size. Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites. Nanocomposites, short and continuous fibre reinforced composites, critical fibre length, and anisotropic behaviour.

UNIT III

Fabrication techniques: pultrusion, filament winding, prepreg technology, injection and compression moulding, bag moulding, resin transfer moulding, reaction injection moulding.

UNIT IV

Properties and performance of composites: Properties and microstructure of high-strength fiber materials (glass, carbon, polymer, ceramic fibers) and matrix materials (polymer, metal, ceramic, and carbon matrices). Specific strength and stiffness of high-performance composites. Rule ofmixtures. Stress, strain transformations.

UNIT V

Failure criteria: Hygrothermal stresses, bending of composite plates, analysis of sandwich plates, buckling analysis of laminated composite plates, inter-laminar stresses, First Order Shear Deformation Theory (FSDT). Applications: Industrial, aerospace, automobile, house hold etc.

TEXT BOOKS:

1. Steven L. Donaldson, ASM Handbook Composites Volume 21, 2001.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

2. Krishan K. Chawla, Composite Materials, Science and Engineering, Springer, 2001.
3. Suresh G. Advani, E. Murat Sozer, Process Modelling in Composites Manufacturing, 2nd Ed. CRC Press, 2009

M.Tech – II Sem.
MD 2035

(PROGRAMME ELECTIVE - III)

UNIT I

Introduction to Soft Computing: Concept of computing systems, "Soft" compiting versus "Hard" computing, Characteristics of Soft computing Some applications of Soft computing techniques.

UNIT II

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

UNIT III

Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to proablistic search techniques Basic GA framework and different GA architectures,GA operators: Encoding,

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

UNIT IV

Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs
Some applications with MOEAs.

UNIT V

Artificial Neural Networks: Biological neurons and its working, Simulation of biolgical neurons to problem solving, Different ANNs architectures, Training techniques for ANNs,
Applications of ANNs to solve some real life problems.

TEXT BOOKS:

1. Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
2. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.

REFERENCES:

1. Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K. Kasabov, MIT Press, 1998.
2. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
3. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
4. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
5. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
6. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
7. Soft Computing, D. K. Pratihar, Narosa, 2008.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

M.Tech – II Sem.
MD 2041 EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS
(PROGRAMME ELECTIVE - IV)

UNIT-I

Measurement of cutting forces: Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and Strain measurements by photoelasticity, Holography, interferometer, Moir techniques, strain gauge rosettes.

UNIT-II

Temperature Measurement: Circuits and instrumentation for different transducers viz., bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers.

Flow Measurement: Transducers for flow measurements of Non-compressible fluids, Obstruction and drag methods. Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques, Shadow graphs, Schilieren photography. Interferometer.

UNIT-III

Metallurgical Studies: Optical and electron microscopy, X-ray diffraction, Bragg's Law and its application for studying crystal structure and residual stresses. Electron spectroscopy, electron microprobe.

Surface Measurement: Micro hardness, roughness, accuracy of dimensions and forms. 3-D Co-ordinate measuring machines.

UNIT-IV

Experiment design & data analysis: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization.

Data Analysis: Deterministic and random data, uncertainty analysis, test of significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

UNIT-V

Taguchi Methods: Experimental design and planning with Orthogonal arrays and linear graphs. Additive cause-effect model, Optimization of response level. Identification of Design and noise factors. Performance evaluation and Optimization by signal to noise ratios. Concepts of loss function and its application.

TEXT BOOKS:

1. Jack Philip Holman, Experimental Methods for Engineers, 7th edition, McGraw-Hill, 2001
2. V. C. Venkatesh, H. Chandrasekaran, Experimental Techniques in Metal Cutting, Eastern economy edition, Prentice-Hall of India, 1987

REFERENCES:

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, Time Series Analysis: Forecasting and Control, 5th Edition, John Wiley & Sons, 2015

2. Richard C. Dove, Paul H. Adams, Experimental stress analysis and motion measurement: theory, instruments and circuits, techniques, C. E. Merrill Books, 1964
3. Bagchi Tapan P, Taguchi Methods Explained: Practical Steps to Robust Design, Prentice-Hall (India), 1993.

Dr. K.Meera Saheb | Dr. V.V.Subba Rao | Dr.N.Mohan Rao | Dr. K.Mallikarjuna Rao
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M.Tech – II Sem.
MD 2042 DESIGN WITH ADVANCED MATERIALS
(PROGRAMME ELECTIVE - IV)

COURSE OBJECTIVES:

- Advanced materials and production technology;
- Characterisation of materials structure and properties
- The microstructure and properties of advanced materials;
- The relationships between processing,
- The design and operation of processes to engineer materials with advanced properties;
- The mathematical modelling of processes to engineer materials with advanced properties.

UNIT – I

Fundamentals of material science: Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening.

Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

UNIT – II

Motivation of selection, cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue and creep, use of material property charts for material selection.

UNIT – III

Modern metallic Materials: Dual phase steels, micro alloyed, high strength low alloy (HSLA) Steel, maraging steel, intermetalics, Ni and Ti aluminides, super alloys.

UNIT – IV

Non metallic materials: Polymeric materials and their molecular structures, production techniques for fibers, foams, adhesives and coatings, structure, properties and applications of engineering polymers. composites; Introduction, reinforcement, types of composite materials, - properties, processing and application of composite materials.

UNIT – V

Smart materials, shape memory alloys, metallic glass, quasi crystal and nano crystalline materials.

TEXT BOOKS:

1. Mechanical behavior of materials/Thomas H.Courtney/2nd Edition, McGraw-Hill, 2000
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill, 1998
3. Material selction in mechanical design by M.F Ashby. Bott

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

REFERENCES:

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.

COURSE OUTCOMES:

- Characterise materials structure and properties
- Acquaint the knowledge of understanding the microstructure and properties of advanced materials.
- Design and operation of processes to engineer the required properties in a given material

Model the processes to engineer the required properties in a given material.

M.Tech – II Sem.
MD 2043 MECHATRONICS
(PROGRAMME ELECTIVE - IV)

COURSE OBJECTIVES:

- Fundamentals of mechatronics
- Various sensors, actuators used and their applications to mechatronic systems
- Modelling and simulation of physical systems
- Controllers used in electro-mechanical systems
- Integration of various elements in the mechanical, electrical and control systems engineering

UNIT – I

Introduction: Definition of Mechatronics products, design considerations and trade offs. Overview of Mechtronic products. Intelligent machine Vs Automatic machine economic and social justification.

Actuators and drive systems: Mechanical, Electrical, hydraulic drive systems, Characteristics of mechanical, Electrical, Hydraulic and pneumatic actuators and their limitations.

UNIT – II

Motion Control: Control parameters and system objectives, Mechanical Configurations, Popular control system configurations. S-curve, motor/load inertia matching, design with linear slides.

Motion Control algorithms: Significance of feed forward control loops, shortfalls, fundamentals concepts of adaptive and fuzzy – control. Fuzzy logic compensatory control of transformation and deformation non- linearity's.

UNIT – III

Sensor interfacing: Analog and digital sensors for motion measurement, digital transducers, human-Machine and machine- Machine inter facing devices and strategy.

Architecture of intelligent machines: Introduction to Microprocessor and programmable logic controls and identification of systems. System design classification, motion control aspects in design.

UNIT – IV

Machine vision: Feature and pattern recognition methods, concepts of perception and cognition in decision-making, basics of image processing, binary and grey scale images, sharpening and smoothening of images.

UNIT – V

Micromechatronic Sytems: Micro sensors, micro actuators, smart instrumentation, micro-fabrication methods – lithography, etching, micro-joing.

TEXT BOOKS:

1."Designing intelligent machines", open university, London.MichelB.Histand and david G. Alciatore.
2.Introduction to Mechatronics and Measurement systems, Tata McGraw Hill.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

3.C.W.desilva, " Control sensors and actuators, Prentice Hall.

COURSE OUTCOMES:

- Identify and explain various elements of a mechatronics system
- Model and simulate simple physical systems
- Suggest appropriate sensors and actuators for an engineering application
- Write simple microcontroller programs
- Build simple homemade projects using electronic devices integrating with mechanical systems

M.Tech – II Sem.
MD 2044 **TRIBOLOGY**
(PROGRAMME ELECTIVE - IV)

COURSE OBJECTIVES:

- To provide broad based understanding of the interdisciplinary subject 'tribology' and surface characterization techniques.
- To learn about the contact of solid surfaces and their interactions consequences of wear, wear mechanisms, wear theories and analysis of wear problems
- To understand the genesis of friction, the theories/laws of sliding and rolling friction
- To learn about the principles of lubrication, lubrication regimes, theories of hydrodynamic, elastohydrodynamic and mixed/ boundary lubrication
- To learn about tribotesting and experimental techniques in tribology and tribologicalmodelling and simulation
- To learn about tribology of different machine components and emerging areas such as micro/nano tribology

UNIT – I
Introduction: Nature of surfaces and contact-Surface topography-friction and wear mechanisms, wear maps, effect of lubricants- methods of fluid film formation.
Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants- additives- lubrication systems and their selection.
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
Hydrostatic Bearings: Thrust bearings – pad coefficients- restriction- optimum film thickness-journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.
UNIT – IV
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 – V
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.
Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography.
Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.
TEXT BOOKS:
1.Rowe WW& O' Dionoghue,"Hydrostatic and Hybrid bearing design " Butterworths& Co.Publishers Ltd,1983.
2.Collacott R.A," Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London 1977.

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Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

3. Bernard J.Hamrock, " Fundamentals of fluid film lubricant", McGraw-Hill Co.,1994.

REFERENCES:

1.Neale MJ, (Editor) " Tribology hand Book"NeumannButterworths, 1975.
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

COURSE OUTCOMES:

- Students will demonstrate basic understanding of friction, lubrication and wear rocesses.
- Students will become familiar with mathematical tools used to analyze tribological processes.
- To enhance students' awareness of tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals and braking systems.
- Students will become familiar with common anti-friction and anti-wear components and the lubricants used therein.
- Students will be able to describe the detailed operation of selected anti-friction or anti-wear components.
- Students will be exposed to design a tribological system for optimal performance. Students will be able to develop technical project reports and technical presentations

M.Tech – II Sem.
MD 2045 EXPERIEMNTAL MODAL ANALYSIS
(PROGRAMME ELECTIVE - IV)

UNIT I

Theoretical basis for modal analysis:
Overview of modal analysis, Vibrations of single and multiple degree of freedom (SDOF, MDOF) systems, Frequency response functions (FRFs) for SDOF/MDOF systems. Types of FRFs. Orthogonality of modes and their application in modal analysis, Theory of undamped, proportionally damped, and non-proportionally damped SDOF/MDOF systems, Analyses for complex modes and sensitivity analysis of modal models

UNIT II

FRF measurement considerations:
Introduction to test planning, Excitation of structures (electromagnetic and electrohydraulic shakers, hammers, etc.), Transducers and amplifiers for measurements (force transducer, accelerometers, laser vibrometers, signal conditioners, amplifiers etc.), Actuator/sensor placement considerations, Revision of Fourier analysis and Fourier transforms, Discussions on aliasing, leakage, windowing, filtering and averaging, Role of excitations signals in structural testing

UNIT III

Modal Parameter Extraction Methods: Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III

UNIT IV

Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

UNIT V

Applications and advanced topics: Model correlation. Concepts of modal assurance criterion and some of its variants, Dynamic substructuring, Modal reduction and expansion, Model updating, Advanced curve fitting for modal parameter extractions, Testing of weakly nonlinear structures

Learning Resources:

1. W T Thomson., " Theory of Vibrations with Applications", CBS Publishers
2. S S Rao, " Mechanical Vibrations", Addison-Wesley Publishing Co.
3. Leonard Meirovitch, " Fundamentals of Vibration", McGraw Hill International Edison.
4. J P Den Hartog, "Mechanical Vibrations", Mc Graw Hill.
5. Srinivasan, " Mechanical Vibration Analysis", Mc Graw Hill.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

6. Nuno Manuel Mendes Maia et al," Theoretical and Experimental Modal Analysis", Wiley John & sons, 1999
7. Modal Analysis, by Jimin He and Zhi-Fang Fu, Butterworth-Heinemann

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M.Tech – II Sem.
MD 205 MACHINE DYNAMICS LAB

COURSE OBJECTIVES:

1. Calculate natural frequency, mode shapes and balancing (static dynamic) of mechanical systems
2. Perform direct and inverse kinematic analysis of planar and spatial robot.
3. Get exposed to identify the various failure modes.

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 natural frequency and mode shape of multi degree freedom system
4. Static balancing of disc
5. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
6. Field balancing of the thin rotors using vibration pickups.
7. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.
8. Diagnosis of a machine using FFT analyzer.(FFT)
9. Direct kinematic analysis of a robot.
10. Inverse kinematic analysis of a robot.
11. Determination of friction, wear using pin-on-disc.
12. Experimental modal analysis of Beams (ME Scope)

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
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M.Tech – II Sem.
MD 206 DESIGN PRACTICE LAB – II

OBJECTIVES:

To know the method of programming the microprocessor and pneumatic experiments in basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept.

LIST OF EXPERIMENTS:

Part: A- MECHATRONICS

1) Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
2) Testing of circuits using basic pneumatic trainer kits.
3) Tircuits with logic sequence using Electro pneumatic trainer kit.
4) Tequential circuits in Electro pneumatic kit using PLC.
5) Testing of fluid power circuits to control (i) Velocity (ii) direction and (iii) force of single and double acting actuators.
6) Study of sequential and hydraulic motor circuit using hydraulic systems.
7) Servo controller interfacing for open loop.
8) Servo controller interfacing for closed loop.
9) PID controller interfacing.
10) Stepper motor interfacing with 8051 Micro controller.
(i) Full step resolution (ii) half step resolution

Part: B – Material Characterization

1) Microscopy: Different microscopy techniques, Resolution, Magnification, Depth of field Imaging – theory and concepts.
2) Optical Microscopy: Grain size estimation, Phase Percentage Estimation
3) XRD- Estimation of Crystal planes, Crystal size, phase analysis etc.
4) X-ray microanalysis: EDS, EPMA (Surface analysis)
5) XRD, EBSD, SEM (Applications to crystallography)
6) X-ray methods (EDS, XRF)
7) Spectroscopy (IR, Raman)
8) FTIR, UV Visible Spectrophotometer
9) Sputtering, PVD/CVD Coatings

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Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

10) Testing of Materials- Micro hardness, Tensile strength, Flexural strength, Wear, Abrasion

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Dr. B.Venkatesham | Dr. Prasanth Kumar | Dr.Ch.Ratnam | Sri Ravi Kiran Saride
Sri P.Sukumar | Dr.R.R Das

M.Tech – II Sem.

MD 207 VALUE EDUCATION

UNIT I

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgements

UNIT II

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration.

Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism.Love for nature ,Discipline

UNIT III

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship.

UNIT IV

Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation.

Doing best for saving nature

UNIT V

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.

TEXT BOOK:

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University, Press, New Delhi

M.Tech – II Sem.

MD 208 **MINI PROJECT**

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

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Sri P.Sukumar Dr.R.R Das

M.Tech – III Sem.

MD 3011 INDUSTRIAL ROBOTICS

(PROGRAMME ELECTIVE - V)

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation scheme, work volume, robot drive systems, control systems and dynamic performance, precision of movement.
CONTROL SYSTEM AND COMPONENTS: basic concepts and motion controllers, control system analysis, robot actuation and feedback components.

SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators, power transmission systems

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller. Robot joint control design.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

MACHINE VISION: Functions, Sensing and Digitizing-imaging devices, Lighting techniques, Analog to digital single conversion, image storage: Image processing and Analysis-image data reduction, Segmentation, feature extraction, Object recognition. Training the vision system, Robotic application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching, capabilities and Limitations of lead through methods.
ROBOT LANGUAGES: Textual robot Languages, Generations of robot programming languages, Robot language structures, Elements and function.

UNIT - V

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride

Sri P.Sukumar Dr.R.R Das

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work cell controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.

REFERENCES:

1 Robotics / Fu K S/ McGraw Hill.
2 Robotic Engineering / Richard D. Klafter, Prentice Hall
3 Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4 Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley
5 Introduction to Robotics by SK Saha, The McGrah Hill Company, 6th, 2012
6 Robotics and Control / Mittal R K & Nagrath I J / TMH

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
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M.Tech – III Sem.
MD 3012 ADVANCED OPTIMIZATION TECHNIQUES
(PROGRAMME ELECTIVE - V)

COURSE OBJECTIVES:

- To introduce the advanced optimization techniques such as classical optimization techniques, numerical optimization techniques and genetic algorithms.
- Learn the knowledge to formulate optimization problems

UNIT - I

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 - II

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 - III

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,

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

UNIT – IV

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

UNIT V

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 and general optimization model of a machining process.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

TEXT BOOKS:

1. Optimal design – JasbirArora, McGraw 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

COURSE OUTCOMES:

- Students at the end of the course learn advanced optimization techniques to show real-life problems
- Students can able to formulate and solve various practical optimization problems in manufacturing and service organizations

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

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Sri P.Sukumar Dr.R.R Das

M.Tech – III Sem.
MD 3013 **ADDITIVE MANUFACTURING**
(PROGRAMME ELECTIVE - V)

UNIT I
Additive Manufacturing Process: Basic Principles of the Additive Manufacturing Process, Generation of Layer Information, Physical Principles for Layer Generation. Elements for Generating the Physical Layer, Classification of Additive Manufacturing Processes, Evaluation of the Theoretical Potentials of Rapid Prototyping Processes.

UNIT II
Machines for Rapid Prototyping: Overview of Polymerization: Stereolithography (SL), Sintering/Selective Sintering: Melting in the Powder Bed, Layer Laminate Manufacturing (LLM) and Three-Dimensional Printing (3DP).

UNIT III
Rapid Prototyping: Classification and Definition, Strategic Aspects for the Use of Prototypes, Applications of Rapid Prototyping in Industrial Product Development. Rapid Tooling: Classification and Definition of Terms, Properties of Additive Manufactured Tools, Indirect Rapid

UNIT IV
Tooling Processes: Molding Processes and Follow-up Processes, Indirect Methods for the Manufacture of Tools for Plastic Components, Indirect Methods for the Manufacture of Metal Components.

UNIT V
Direct Rapid Tooling Processes: Prototype Tooling: Tools Based on Plastic Rapid Prototyping Models and Methods, Metal Tools Based on Multilevel AM Processes, Direct Tooling: Tools Based on Metal Rapid Prototype Processes.

TEXT BOOKS:

1. Andreas Gebhardt Jan-Steffen Hötter, Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser Publications, 6915 Valley Avenue, Cincinnati, Ohio.
2. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
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Manufacturing, Second Edition, Springer New York Heidelberg Dordrecht London.

REFERENCES:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid
3. Tooling: Technologies and Industrial Applications", CRC press, 2000.

M.Tech – III Sem.

MD 3014 MECHANICS OF COMPOSITE MATERIALS

(PROGRAMME ELECTIVE - V)

COURSE OBJECTIVES:

The objective for this course is to understand the mechanics of composite materials. This understanding will include concepts such as anisotropic material behavior strength theories, micro mechanics and the analysis of laminated composites. The students will undertake a design project involving application of fiber reinforced composites.

UNIT-I

Introduction to Composites, Classification, matrix materials, reinforced matrix of composites.

UNIT-II

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-III

Macromechanical 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

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

Macromechanical 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,hybrid laminates

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

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Sri P.Sukumar Dr.R.R Das

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
M.TECH. (Machine Design) Course Structure (R19)
With effect from 2019-2020

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao

Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride

Sri P.Sukumar Dr.R.R Das

UNIT-V

Failure, Analysis, and Design of Laminates: Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, static analysis of laminated plates

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, McGraw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van NostrandRainfold, New York, 1969.

COURSE OUTCOMES:

- Some understanding of types, manufacturing processes, and applications of composite materials
- Ability to analyze problems on macromechanical behavior of lamina
- Ability to analyze problems on micromechanical behavior of lamina
- Ability to analyze problems on macromechanical behavior of laminate
- Ability to analyze problems on bending and vibration of laminated plates and beams

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
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Sri P.Sukumar Dr.R.R Das

M.Tech – III Sem.
MD 3015 VEHICLE DYNAMICS
(PROGRAMME ELECTIVE - V)

UNIT-I

Introduction to Vehicle Dynamics: Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.

UNIT-II

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.

UNIT-III

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.

UNIT-IV

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.

UNIT-V

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.

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Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

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.

M.Tech
MD 3021 **INDUSTRIAL ROBOTICS**
(OPEN ELECTIVE)

Course Objectives:

- To impart knowledge on robot configurations, components, sensors and actuators used in robotics.
- To develop programming techniques for industrial robots, kinematic and dynamic analysis for simple planner robots, robot cell design and applications

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. **CONTROL SYSTEM AND COMPONENTS:** basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

Dr. K.Meera Saheb Dr. V.V.Subba Rao Dr.N.Mohan Rao Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham Dr. Prasanth Kumar Dr.Ch.Ratnam Sri Ravi Kiran Saride
Sri P.Sukumar Dr.R.R Das

ROBOT LANGUAGES: Textual robot Languages, Generation, Robot language structures, Elements in function.

UNIT - V

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work cell controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.

TEXT BOOKS:

3. Industrial Robotics / Groover M P /Pearson Edu.
4. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.

REFERENCES:

7 Robotics / Fu K S/ McGraw Hill.
8 Robotic Engineering / Richard D. Klafter, Prentice Hall
9 Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
10 Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley
11 Introduction to Robotics by SK Saha, The McGrah Hill Company, 6th, 2012
12 Robotics and Control / Mittal R K & Nagrath I J / TMH

Course Outcomes:

The students will be able to

1. Identify various robot configuration and components,
2. Select appropriate actuators and sensors for a robot based on specific application
3. Carry out kinematic and dynamic analysis for simple serial kinematic chains,
4. Write a program for pick and place operations and design a cell for a small manufacturing unit

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Sri P.Sukumar Dr.R.R Das

M.Tech
MD 3022 **OPERATIONS RESEARCH**
(OPEN ELECTIVE)

Course Outcomes: At the end of the course, the student should be able to
1. Students should able to apply the dynamic programming to solve problems of discreet and
   continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Syllabus Contents:

UNIT I:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex
Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex
method - sensitivity analysis - parametric programming

UNIT III:
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow
problem - CPM/PERT

UNIT IV
Scheduling and sequencing - single server and multiple server models - deterministic inventory
models - Probabilistic inventory control models - Geometric Programming.

UNIT V
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic
Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXT BOOKS:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

REFERENCES:

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Sri P.Sukumar Dr.R.R Das

1. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3. Pannerselvam, Operations Research: Prentice Hall of India 2010
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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Dr. B.Venkatesham | Dr. Prasanth Kumar | Dr.Ch.Ratnam | Sri Ravi Kiran Saride
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M.Tech – III Sem.

DISSERTATION

(PHASE I)

Dr. K.Meera Saheb | Dr. V.V.Subba Rao | Dr.N.Mohan Rao | Dr. K.Mallikarjuna Rao
Dr. B.Venkatesham | Dr. Prasanth Kumar | Dr.Ch.Ratnam | Sri Ravi Kiran Saride
Sri P.Sukumar | Dr.R.R Das

M.Tech – IV Sem.

DISSERTATION

(PHASE II)

Dr. K.Meera Saheb | Dr. V.V.Subba Rao | Dr.N.Mohan Rao | Dr. K.Mallikarjuna Rao

Dr. B.Venkatesham | Dr. Prasanth Kumar | Dr.Ch.Ratnam | Sri Ravi Kiran Saride

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