ACADEMIC REGULATIONS
COURSE STRUCTURE AND
DETAILED SYLLABUS

MECHANICAL ENGINEERING

For

M. Tech. (Engineering Design)
(Two Year Full Time Programme)

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(Autonomous)
Kukatpally, Hyderabad – 500 085, Telangana, India.

2015
### I – SEMESTER

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JNTUH COLLEGE OF ENGINEERING HYDERABAD
M.Tech. (Engineering Design) – Full Time w.e.f. 2015-16

Elective -I
1. Mechanical Behavior of Engineering Materials
2. Computational Methods
3. Computer Simulation of Machines.

Elective -II
2. Micro Controllers and Applications
3. Applied Tribology

Elective -III
1. Theory of Elasticity
3. Computer Aided Manufacturing

Elective -IV
1. Optimization Techniques & Applications
2. Instrumentation and Control systems
3. Design for Manufacturing and Assembly

Elective-V
1. Industrial Robotics
2. Neural Networks And Fuzzy Logics
3. Advanced Tool Design

Elective-VI
1. Vibration Analysis of Mechanical Systems
2. Random Vibrations
3. Vehicle Dynamics

Elective-VII
1. Experimental Stress Analysis
2. Fracture Mechanics
3. Advanced Finite Element and Mesh less Methods

Elective-VIII
1. Advanced Mechanics of Composite Materials
2. Nano Composites Design and Synthesis
3. Design For Process and Product Development
ADVANCED MECHANICS OF SOLIDS

Prerequisite: Applied Mechanics, mechanics of solids

Course Objectives: The course is intend
- To understand the concept of theory of elasticity equations for solving various engineering problems
- To analyse the internal stresses in curved beams and beams subjected to unsymmetrical bending.
- To Understand the deformations and stresses in non circular cross section members with torsional loading.
- To analyse the Hertz contact stresses

Course outcomes:
After completing this course, the student should be able to
- Determined the point of location of applied load to avoid twisting in thin sections used in aerospace applications.
- Understand the concept of distinguish between neutral and centroidal axes in curved beams.
- Understanding the analogy models developed for analyzing the non circular bars subjected to torsion, and also analyzing the stresses developed between rolling bodies and stress in three dimensional bodies.

Unit –I:
Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.
Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending, Deflection of straight beams due to nonsymmetrical bending.

Unit –II:

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

Unit –IV:
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.

Unit –V:
Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatic bar by its own weight twist of circular shafts of constant cross section, pure bending of plates.
Textbook:

References:
1. Advanced strength of materials by Den Hortog J.P.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
4. Strength of materials by Sadhu singh
ADVANCED MECHANICS OF MACHINERY

Prerequisite: Kinematics of machinery

Course Objectives: The course is intend to
- Fundamentals of plane and spatial mechanism
- Advanced kinematics of plane motion of mechanisms
- Synthesis of plane mechanisms- various methods
- Manipulator Kinematics for several types of robot arms: (a) Direct kinematics (b) Inverse kinematics

Course outcomes:
After completing this course, the student should be able to
- Understand the kinematic analysis of rolling bodies based on graphical, geometrical and analytical methods.
- Design of mechanisms by using graphically and analytically by involving function generator, rigid body guidance and path generation(Coupler curve) methods

Unit – I:
Advanced Kinematics of plane motion- I: Introduction to plane motion. Euler – Savary Equation, the Inflection circle, Analytical and graphical determination of $d_1$, Bobillier’s Construction, Collineation axis, Hartmann’s Construction, Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

Unit – II:
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, Freudenstein’s collineation – axis theorem, Carter –Hall circle.

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 Roto center triangle, Guiding a body through Four distinct positions: Burmester’s curve.

Unit – IV:

Unit – V:
Text Books:

Reference Books:
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design) L T P C
MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS (Elective - I) 4 0 0 4

Prerequisite: Physical metallurgy

Course objectives: To know the concepts and principles of various failures in materials.

Course outcomes:
After completing this course, the student should be able to
• Understand the different modes of failures like fracture, fatigue and creep of ductile and brittle materials

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

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

UNIT-III:

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. Goodman's rule and Miners rule. Micro mechanisms 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:

Text Books

References:
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)  

COMPUTATIONAL METHODS  
(Elective - I)  

Prerequisites: Mathematics I & II

Course Objectives: The course is intend to teach students how to apply computational methodologies to solve engineering problems when no closed-form or analytical solution may not exist. Transformations between time and frequency domains Fourier transforms, FFT and Laplace transforms need to be taught. Because numerical methods cannot be solved by hand calculator (Except for simple cases) algorithms and computer programs to implement for some of the numerical methods will be taught.

Course outcomes:
After doing this, student should be able to

- Have a Idea of accuracy & precision rounding off & truncation errors and their propagation
- Apply numerical techniques for solving linear algebraic equations, non-linear equations and differentiation and integration with due idea of above said concept
- Understand the interpolation methods, transformation techniques and regression Methods

Unit I:
Approximations and Errors: Accuracy and precision, definitions of round off and truncation errors, error propagation.
Linear Algebraic Equations: Formulations and solution of linear algebraic equations, Gauss elimination, LU decomposition, iteration methods (Gauss-Jacobi and Gauss-Siedel), convergence of iteration methods
Eigen values and Eigenvectors: Geometric meaning of Eigen values and Eigenvectors, Characteristic equation and determination of Eigen values and Eigenvectors, Power Method, Inverse Power Method, Similarity Transformations, Givens rotation method, Householder Transformation

Unit II:
Solution of non-linear equations: Bisection method, Fixed point iteration, Newton Raphson method, Solution of a set of non-linear equations
Interpolation methods: Newton's divided difference, interpolation polynomials, Lagrange interpolation polynomials

Unit III:
Differentiation and integration: High accuracy differentiation formulae, extrapolation, derivatives of unequally spaced data, Gauss quadrature and integration
Transform techniques: Continuous Fourier series, frequency and time domains, Laplace transform, Fourier integral transform, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)
Unit IV:
**Regression methods:** Linear and non-linear regression, multiple linear regression, general linear least squares
**Statistical methods:** Statistical representation of data, modeling and analysis of data, test of hypotheses

Unit V:
**Ordinary Differential Equations:** Initial and boundary value problems, Eigen value problems. Euler Method, Modified Euler Method, Runge-Kutta Methods, Adams Bashforth Moulton Methods
**Partial Differential Equations:** Classification of PDEs, Solution to Elliptic and Parabolic equations

**Text Books:**

**Reference Books:**
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)

COMPUTER SIMULATIONS OF MACHINES
(Elective- I)

Prerequisite: Kinematics of machinery

Course Objectives: The course is propose to
- Impart how to simulate the mechanisms in dynamic and kinematic mode.
- understand the numerical solutions of non linear algebraic equations.
- understand the kinematic simulations using simulink.
- Introduce the simulating the dynamics of slider on inclined plane
- Understand the mechanisms of two link planar robot

Course outcomes:
After completing this course, the student should be able to
- Understand and apply the simulation methodologies for different mechanical systems

UNIT I:

UNIT II:

UNIT III:

UNIT IV:
Introducing Dynamics: Simulating the slider on inclined plane, Adding the Pendulum, Assembling the Matrix Equation, Creating a Dynamic Simulation, Setting Initial conditions and Running Simulation

UNIT V:

Text Books:
2. CAD/CAM – Ibrahim zeid, TMH.
3. Mat Lab – Raj Kumar Bansal et al, Pearson Education
Prerequisite: CAD/CAM

Course objectives: The course is intend to
- Making the student understand how graphics created in computer world is the main goal of this course.
- Learn modeling curves (B-spline and Bezier)
- Learn modeling Bezier and B-spline surfaces
- Learning how to rescale, transmit (shift), shear (skew), and rotate different graphical objects is another goal.
- Familiarity with advanced techniques such as subdivision and reconstruction
- Mastery of object construction and manipulation methods including lofting, surface of revolution, boundary representation, cell decomposition and tabularization.

Course outcomes:
After completing this course, the student should be able to
- Understand the background of mathematical equations used for development of modeling software modules to develop the various structural related applications.

Unit – I:
Introduction: Definition, Explicit and implicit equations, parametric equations.
Cubic Splines: 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 – II:
Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.
B-Spline Curves: B-Spline basis, equations, knot vectors, properties and derivatives.

Unit – III:
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 – IV:
Transformations: 2-D and 3D
Solids: Tricubic solid, Algebraic and geometric form.

Unit – V:
Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

Text Books:
- CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
- CAD/CAM concepts and Applications, Alavala, PHI

References:
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M.Tech. I Year I-Sem (Engineering Design)  L  T  P  C
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MICRO CONTROLLERS AND APPLICATIONS
(Elective - II)

Prerequisite: None

Course objectives: The main purpose of this course is
• To provide sufficient detailed knowledge of a microcontroller so that students can breadboard and program a microcontroller and demonstrate its function in a real-time application.

Course outcomes:
After completing this course, the student will be able to
• Comprehend the architecture and instruction set of microcontrollers.
• Outline the knowledge on real time control interrupts & timers.
• Design control peripherals and high power devices.
• Analyze real time operating system for MCUs & MCU based industrial applications.
• Comprehend the architecture of 16 bit (8096/80196) & ARM microcontrollers.

UNIT-I: Overview Of Architecture & Microcontroller Resources

UNIT-II : 8051-Microcontrollers Instruction Set
Basic assembly language programming – Data transfer instructions – Data and Bit-manipulation instructions – Arithmetic instructions – Instructions for Logical operations on the test among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT-III: Real Time Control
INTERRUPTS: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – Non-maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051.

TIMERS: Programmable Timers in the MCU’s – Free running counter and real time control – Interrupt interval and density constraints.

UNIT-IV: Systems Design
Digital And Analog Interfacing Methods:
UNIT-V: Real Time Operating System For Microcontrollers:

Text Books:

Reference Books:
6. Microprocessors, Nilesh B. Bahadure, PHI Learning PVT. Ltd.
APPLIED TRIBOLOGY
(Elective - II)

Prerequisite: Applied mathematics and statistics, Fluid mechanics, Theoretical mechanics, Material Mechanics

Course objectives: The course is intend to
- Design of surfaces in contact is a critical problem for mechanical engineering.
- This is an interdisciplinary course which deals with fundamentals of surface contact, friction, wear and lubrication.
- The Topics in this course include description and modeling of engineering surfaces, popular surface contact theories, major modes of friction, wear, lubrication and adhesion.

Course outcomes:
After completing this course, the student should be able to
- Have a knowledge of surface topography and know how to model a rough engineering surface;
- Have a clear overall picture about the basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of friction surfaces;
- Have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem;
- Know the methods to reduce the friction for engineering surface and failure analysis.

Unit – I
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 – II

Unit – III

Unit – IV
Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.
Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants - additives - lubrication systems and their selection – selection of pump, filters, piping design - oil changing and oil conservation.

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

Text Books:

References:
Prerequisite: Mechanics of solids

Course Objectives: The course is intend to

- Introduce to students the concepts of stresses, strains and stress-strain relationships, as well as the basic theory of elasticity.
- Develop students with an understanding of how stresses and strains within engineering components are related to both loads and displacements imposed at their boundaries and to inertial loads.
- Prepare students for the use of different methods to analyze the stresses and strains within engineering components.
- Allow students become familiar with problem formulations and solutions in elasticity; and prepare students for future study in advanced engineering mechanics.

Course outcomes:
After completing this course, the student should be able

- To know the definition of stress and deformation and how to determine the components of the stress and strain tensors.
- To know how to apply the conditions of compatibility and equations of equilibrium.
- To use the equilibrium equations stated by the displacements (Lame equations) and compatibility conditions stated by stresses (Beltrami-Michell equations).
- To define state of plane stress, state of plane strain in Cartesian and cylindrical coordinate systems.
- To determine the boundary restrictions in calculations.
- To solve the basic problems of the theory of elasticity by using Airy function expressed as biharmonic function.
- A few examples in 3-D stress analysis will be provided.

UNIT-I

UNIT-II
Two dimensional problems in rectangular co-ordinates-solution by polynomials - saint-vanant's principle-determination of displacements-bending of simple beams-application of corier series for two dimensional problems-gravity loading.

UNIT-III
Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates – displacements - displacement for symmetrical stress distribution - simple symmetric and asymmetric problems - general solution of two-dimensional problem in polar coordinates - application of general solution in polar coordinates.
UNIT-IV

UNIT- V
Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars-solution of torsional problems by energy method - use of soap films in solving torsion problem - hydro dynamical analogies - torsion of shafts, tubes, bars etc.

Text Books:
1. Theory of Elasticity by Timeshanko, McGrawhill Publications

References:
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)  
PLASTIC DEFORMATION OF METALS  
(Elective- III)

Prerequisite:
Successful completion of the course is conditional on the knowledge of applied mathematics and physics, materials science, elasticity, strength, and plasticity, and a grasp of metal-forming technologies.

Course objectives: The course is intend to
- Introduce students to the principles of metal shaping by pressure;
- discuss the equipment and sequence of technological operations involved in the various methods of metal shaping by pressure; and
- provide students with opportunities to practically appreciate the essence of the methods of pressure shaping of metals as industrial manufacturing processes.

Course outcomes:
After completing this course, the student should be able to
- Understand the different mechanisms of metal forming and related mathematical theories.
- Understanding different metal forming methods and related flow stress relations.

UNIT - I:
Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method temperature of metal working, hot working, cold working, friction and lubricants.

UNIT - II:
Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

UNIT - III:
Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. problems on flow stress ,true strain and forging load.
Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

UNIT - IV:
Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes. Problems on extrusion load.

UNIT - V:
Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.
Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment and computer applications in metal forming. problems on Blanking force, Blank diagram in Cup Diagram, Maximum considering shear.

**Text Books:**
2. Principles of Metal Working / Sunder Kumar

**References:**
1. Principles of Metal Working processes / G.W. Rowe
2. ASM Metal Forming Hand book.
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design) L T P C

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COMPUTER AIDED MANUFACTURING
(Selective - III)

Prerequisite: None

Course Objectives: The course is intend to
- To make the students familiar with computer aided programming, different tooling for CNC.
- To use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
- To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP), Computer aided quality control and Flexible manufacturing systems.

Course outcomes:
After completing this course, the student should be able to
- To familiarize the components of computer aided manufacturing and to introduce CNC machines and computer aided process planning.
- CNC machines and its constructional features and part programming
- Basics of concepts of FMS GT, computer aided inspection, Automated material handling systems and Computer aided production planning.

Unit – I

Unit – II
Numerical control machines: Introduction- basic components of an NC system - the NC procedure - NC coordinate system, NC motion control system - application of numerical control- Economics of Numerical control.
NC part programming: Introduction – NC coding system, manual part programming, part programming with APT, NC part programming using CAD/CAM, manual data input.

Unit – III
Computer controls in NC: NC controllers’ technology - Computer Numerical Control (CNC), Direct Numerical control (DNC).

Unit – IV
Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.
Flexible Manufacturing Systems: Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.
Unit – V

**Computer aided planning systems:** Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning (MRP), mechanism of MRP, benefits, and Capacity Planning, Adaptive control machining systems, adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.

**Text books:**
2. CAD / CAM Concepts and Applications, Alavala, PHI.

**References:**
3. CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers
OPTIMIZATION TECHNIQUES & APPLICATIONS
(Elective- IV)

Prerequisite: Operations Research

Course Objectives: The course is intend to
- To introduce the advanced optimization techniques such as classical optimization techniques, numerical optimization techniques and genetic algorithms.
- Learn the knowledge to formulate optimization problems

Course outcomes:
After completing this course, the student should be able to
- Learn various optimization techniques
- Develop a optimization model for a given problem
- Solve the model using suitable optimization technique.
- Analyze the sensitivity of a solution to different variables.
- Use and develop optimization simulation software for variety of industrial problems

UNIT- I:

UNIT- II:

UNIT- III:
Simulation – Introduction – Types- steps – applications: inventory & queuing – Advantages and disadvantages

UNIT- IV:
Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

UNIT- V:
Geometric Programming: Polynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P(≤ type only)

TEXT BOOKS:
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

REFERENCE BOOKS:
1. S.D. Sharma / Operations Research
2. Operation Research / H.A. Taha / TMH
3. Optimization in operations research / R.L. Rardin
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)  

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INSTRUMENTATION AND CONTROL SYSTEMS  
(Elective - IV)

Prerequisite: None

Course objectives: The course is intend to
- provide knowledge on the fundamentals of measurement science and measuring instruments
- To provide a knowledge on the basics of control system theory

Course outcomes:
After completing this course, the student should be able to
- Know general configuration of instrument, static and dynamics characteristics, Calibration analysis
- Know various properties to be measured
- Know various instruments for measuring above said properties
- Do calibrate the instrument when use it for measuring the given property.

UNIT – I


UNIT-II

Electrical transducers: Sliding contact resistive transducer, thermistors, variable self-inductance transducer, variable mutual-inductance transducer, linear variable differential transformer, rotational variable differential transformer, variable reluctance transformer. Capacitive Transducers, Ionization transducer, electronic transducer, electromagnetic transducer, piezoelectric transducer, photoelectric transducer,

UNIT – III

Measurement of displacement: Comparators, optical flats, interferometer, autocollimator.

Measurement of Stress and Strain: Principle of strain gages, selection and installation of bonded metallic strain gages, circuitry for the metallic strain gages, temperature compensation.

Measurement of Force: Proving ring, strain gage load cell, piezoelectric load cell, hydraulic load cell, pneumatic load cell.

Measurement of Pressure: High pressure measurement, low pressure measurement.

UNIT – IV:

Measurement of Flow: Variable area flow meters, turbine flow meter, magnetic flow meter.

Measurement of liquid level: Capacitance level detector, radar and microwave level sensors, ultrasonic level gages, nuclear level sensors.

Measurement of temperature: Thermocouples, thermistors, optical pyrometer.
Measurement of acceleration and vibration: seismic displacement pickup, seismic velocity pickup, seismic acceleration pick up, piezoelectric accelerometer.

**UNIT-V:**

**Control system and their classification:** Introduction - Classification of control systems - Transfer function, block diagrams, system stability-Routh stability - Hurwitz stability.

**Hydraulic and Pneumatic controls systems:** Functional operation of - proportional control- Proportional plus integral control - Proportional plus derivative control- Proportional plus derivative plus integral control - Hydraulic control systems – Pneumatic control systems.

**Text Books :**
1. Principles of Industrial Instrumentation and control systems, Alavala, Cengage Learning
2. Mechanical Measurements and controls by D.S.Kumar

**References:**
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)  

DESIGN FOR MANUFACTURING AND ASSEMBLY  
( Elective - IV)

Prerequisite: Production technology

Course objectives: The course is intend to
- Understand the design rules and considerations with reference to various manufacturing processes
- To discuss capabilities and limitations of each manufacturing process in relation to part design and cost
- To examine DFM principles including how the design affects manufacturing cost, lean manufacturing, six sigma, etc.

Course outcomes:
After completing this course, the student should be able to
- Understand how a design can be made suitable for various manufacturing processes.
- To study the various factors influencing the manufacturability of components
- To study the use of tolerances in manufacturing
- Application of this study to machining, casting and joining processes

UNIT I:
Introduction: Design philosophy – Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design.

UNIT II:
MACHINING PROCESS: 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.
METAL CASTING: Appraisal of various casting processes, Selection of casting process, General design considerations for casting – casting tolerances – Use of Solidification Simulation in casting design – Product design rules for sand casting.

UNIT III
FORGING – Design factors for Forging – Closed die forging design – parting lines of dies – Drop forging die design – General design recommendations

UNIT IV:

UNIT V:
DESIGN FOR ASSEMBLY : General design guidelines for Manual Assembly - Development of Systematic DFA Methodology - Assembly Efficiency - Classification System for Manual handling- Classification System for Manual Insertion and Fastening - Effect of part symmetry on handling time - Effect of part thickness and size on handling time - Effect of weight on handling time - Effect of symmetry , Further design guidelines.

Text books:

Reference books:
3. Product Design/ Kevin Otto and Kristin Wood/ Pearson Education
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)

KINEMATICS AND DYNAMICS LABORATORY

Prerequisite: None

Course objectives: The course is intend to
• To perform experiments which are related to engineering mechanics subject (Statics and Dynamics) in order to understand the behaviour of different mechanical equipments studied in theory

Course Out comes:
The student will be able to:
• Calculate natural frequency, mode shapes and balancing (static dynamic) of mechanical systems
• Perform direct and inverse kinematic analysis of planar and spatial robot.

(A Minimum of 10 experiments are to be conducted)

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.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Engineering Design)  L T P C

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SOFT SKILLS LAB
(Activity-based)

Prerequisite: Basic grammar

Course Objectives:
- To improve the fluency of students in English
- To facilitate learning through interaction
- To illustrate the role of skills in real-life situations with case studies, role plays etc.
- To train students in group dynamics, body language and various other activities which boost their confidence levels and help in their overall personality development
- To encourage students develop behavioral skills and personal management skills
- To impart training for empowerment, thereby preparing students to become successful professionals

Course Outcomes:
- Developed critical acumen and creative ability besides making them industry-ready.
- Appropriate use of English language while clearly articulating ideas.
- Developing insights into Language and enrich the professional competence of the students.
- Enable students to meet challenges in job and career advancement.

INTRODUCTION
Definition and Introduction to Soft Skills – Hard Skills vs Soft Skills – Significance of Soft/Life/Self Skills – Self and SWOT Analysis

1. Exercises on Productivity Development
   - Effective/ Assertive Communication Skills (Activity based)
   - Time Management (Case Study)
   - Creativity & Critical Thinking (Case Study)
   - Decision Making and Problem Solving (Case Study)
   - Stress Management (Case Study)

2. Exercises on Personality Development Skills
   - Self-esteem (Case Study)
   - Positive Thinking (Case Study)
   - Emotional Intelligence (Case Study)
   - Team building and Leadership Skills (Case Study)
   - Conflict Management (Case Study)

3. Exercises on Presentation Skills
   - Netiquette
   - Importance of Oral Presentation – Defining Purpose- Analyzing the audience-
     Planning Outline and Preparing the Presentation- Individual & Group
     Presentation- Graphical Organizers- Tools and Multi-media Visuals
   - One Minute Presentations (Warming up)
   - PPT on Project Work- Understanding the Nuances of Delivery- Body
     Language – Closing and Handling Questions – Rubrics for Individual
     Evaluation (Practice Sessions)

4. Exercises on Professional Etiquette and Communication
   - Role-Play and Simulation- Introducing oneself and others, Greetings,
     Apologies, Requests, Agreement & Disagreement….etc.
• Telephone Etiquette
• Active Listening
• Group Discussions (Case study)- Group Discussion as a part of Selection Procedure- Checklist of GDs
• Analysis of Selected Interviews (Objectives of Interview)
• Mock-Interviews (Practice Sessions)
• Job Application and Preparing Resume
• Process Writing (Technical Vocabulary) – Writing a Project Report Assignments

5. Exercises on Ethics and Values
Introducion — Types of Values - Personal, Social and Cultural Values - Importance of Values in Various Contexts
• Significance of Modern and Professional Etiquette – Etiquette (Formal and Informal Situations with Examples)
• Attitude, Good Manners and Work Culture (Live Examples)
• Social Skills - Dealing with the Challenged (Live Examples)
• Professional Responsibility – Adaptability (Live Examples)
• Corporate Expectations

Note: Hand-outs are to be prepared and given to students.
Training plan will be integrated in the syllabus.
Topics mentioned in the syllabus are activity-based.

SUGGESTED SOFTWARE:
The following software from ‘train2success.com’
  o Preparing for being Interviewed
  o Positive Thinking
  o Interviewing Skills
  o Telephone Skills
  o Time Management
  o Team Building
  o Decision making

SUGGESTED READING:
12. The Hindu Speaks on Education by the Hindu Newspaper
ADVANCED MACHINE DESIGN

Prerequisite: Design of machine elements

Course objectives: The course is intend to
• To design machine components which are subjected to fluctuating loads.
• To distinguish different design criterions and their procedure to carry out the required
design steps for designing mechanical components.
• To design machine components/parts based on creep criterions.

Course outcomes:
After completing this course, the student should be able to
• Ability to analyze behaviour of mechanical elements under different loads
• Understand the design of different transmission elements of automobile
• Ability to analyze mechanical elements critically.

Unit- I : Shafts and Axles:
Introduction, Causes of failure in Shafts and Axles And Stresses in Shafts, Materials for
Shafts and Axles, Methods of Manufacturing of Shafts, Designing of Straight Shafts, Pure
Tensional Load, Designing for Rigidity and Stiffness, Design of Axles, Flexible Shafts.

Unit- II : Rope drive:
Fibre ropes, rope drives for power transmission, fibrous Ropes used in Hoisting Tackle, Wire
Ropes, Materials, Wire Rope Construction, Applications of Ropes, properties of various
types of Ropes, Approximate wire Diameters and Effective Cross- section of Ropes: Fiber
cores for steel wire ropes, Working loads, Friction and Efficiency wire rope, sheaves and
Drum, rope fasteners, Selection of wire rope, design procedure.

Unit- III : Chain drives:
Types of Chain drives, construction of Chains, Roller Chains, Silent Chains, selection of a
chain, Design of the chain Drive, Good design practice.

Unit- IV : Gear drives:
Design calculations for helical gears, Definitions, double helical , Gear tooth proportions,
Design calculations, forces acting in a Bevel gear, Worm gear drives, worm wheel,
designation of a worm gear drive, Materials, efficiency of Drive, Heat Dissipation, Design of
worm Gearing, Forces on worm gears, advantages and disadvantages of worm gear drives.

Unit- V : Power screws:
Function, Types of Power screws , Multiple threads, Comparison of square and trapezoidal
threads, Power screw drive, Efficiency of screws, square threads, Trapezoidal Threads,
stresses in screws design calculations, design procedure, other types of screws, differential
and compounds screws , ball baring screws.

Text books:

References:
1. Machine Design by Schaum series
2. Mechanical Engineering design by J.E. Shigley
FINITE ELEMENT AND BOUNDARY ELEMENT METHODS

Prerequisite: None

Course objectives: The course is intended to
• To equip the students with the Finite Element Analysis fundamentals.
• To enable the students to formulate the design problems into FEA.
• To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
• To introduce basic concepts of framing dynamic problems in FEA.
• To keep track of the moving boundary at different instants of time.

Course outcomes:
After completing this course, the student should be able to
• Understand the background of mathematical equations used for development of modeling software modules to develop the various structural related applications.
• Identify mathematical model for solution of common engineering problems.
• Solve structural, thermal, fluid flow problems.
• Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.

UNIT - I

UNIT - II

UNIT - III

UNIT - IV
generation (body force term), Three-dimensional analysis, tackling kernel singularity, Axisymmetric kernel, Mixed boundary condition.

UNIT - V

**Boundary Element Formulation for Electrostatic Problems:** Introduction, Basic Relation-Boundary condition, other relations. Boundary Integral Relation, Fundamental solution, Discretization and Matrix Formulation – Determination of term C(p)m. Illustrative Examples – Loose - fit , loaded pin in hole, Cam- tappet contact problem.

**Text Book:**

**References:**
1. Finite Element Methods, Alavala, PHI.
5. Concepts and applications of finite element analysis – Robert Cook - Wiley
INDUSTRIAL ROBOTICS
(Elective - V)

Prerequisite: None

Course objectives: The course is intend
• 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.

Course outcomes:
After completing this course, the student should be able to
• Understand with the automation and brief history of robot and applications.
• To familiarized with the kinematic motions of robot and good knowledge about robot end effectors and their design concepts.
• Write Programming methods & various Languages of robots.

UNIT I:
Control System And Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics , Power Transmission Systems.

UNIT II:
Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

UNIT III:
Robot Dynamics: Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller.
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, Robotics application.
UNIT IV:
**Robot Programming:** Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations.
**Robot Languages:** Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT V:
**Robot Cell Design and Control:** Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.
**Robot Applications:** Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

TEXT BOOKS:
1. Introduction to Robotics Mechanics & Control/ John J.Craig/Pearson
2. Industrial robotics / Mikell P.Groover / McGraw Hill.

REFERENCE BOOKS:
2. Robot Analysis/Lung Wen Tsai/John Wiley & Sons
NEURAL NETWORKS AND FUZZY LOGICS  
(Elective-V)

Prerequisites: None

Course objectives: The course is intend
• To cater the knowledge of Neural Networks and Fuzzy Logic Control and use these for controlling real time systems.

Course outcomes:
After completion of this course, the student should be able to
• Learn concepts of neural networks and fuzzy logics
• Understand the topology of multi-layer perception, recurrent neural networks and Fuzzification & Defuzzification.
• Understand the basic structure and operation of Fuzzy logic control systems


UNIT-V: Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

Text Books:
ADVANCED TOOL DESIGN

(Elective - V)

Prerequisite: Production technology

Course objectives: The course is intend to
- Describe tool design methods and punch and die manufacturing techniques
- Select material for cutting tools and gages;
- classify various cutting tools and gages and identify their nomenclature
- Describe the principles of clamping, drill jigs and computer aided jig design
- Design fixtures for milling, boring, lathe, grinding, welding;
- identify fixtures and cutting tools for NC machine tools
- Explain the principles of dies and moulds design

Course Outcomes:
At the end of the course the students will be able to
- Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools apply the design procedures for different types of design problems such as gear box design, guide way
- Design, shaft loading and its associated parts, rolling bearings, die design and jigs and fixtures and so on.

UNIT I:

Design of Cutting Tools: Single point cutting tools, Milling cutters, Drills, Selection of carbide steels.

UNIT II:
Determination of shank size for single point carbide tools, determining the insert thickness for carbide tools.

Design of Jigs and Fixtures: Basic principles of location and clamping; Locating methods and devices. Jigs – Definition, Types.

UNIT III:
General considerations in the design of Drill jigs, Drill bushing, Methods of Construction. Fixtures – Vice fixtures, Milling, Boring, Lathe Grinding fixtures.


UNIT IV:
Cutting action in Punch and die operations. Die clearance, Types of Die construction. Die design fundamentals – Blanking and piercing die construction, pilots, stripper and pressure pads presswork material, Strip layout, Short run tooling for piercing.

UNIT V:
Design of Sheet Metal Bending, Forming and Drawing Dies: Bending dies, Drawing dies, Forming dies, Drawing operations, Variables that effect metal flow during drawing. Determination of blank size, Drawing force, single and double action draw dies.

Text Books:
M.Tech. I Year II-Sem (Engineering Design)  

VIBRATION ANALYSIS OF MECHANICAL SYSTEMS  
(Elective-VI)

Prerequisite: None

Course objectives: The course is intend
- To prepare the student to understand the fundamentals of vibrations of various physical models for single and multi degree freedom systems
- To make the student apply numerical methods to various physical systems and their response to vibrations.
- Exposure to vibration measurement of industrial equipment using instruments

Course Outcomes:
At the end of the course the students will be able to
- To study the vibrations in machine elements and how to control them.
- Ability to analyze the mathematical model of linear vibratory system to determine its response
- Obtain linear mathematical models of real life engineering systems
- Determine vibratory responses of single and multi degree of freedom systems to harmonic, periodic and non-periodic excitation

Unit-I

Unit-II

Unit-III

Unit-IV
solution of the Eigen value problems – solution of the characteristic equation, orthogonality of normal modes, repeated Eigen values.

Unit-V
Determination of Natural Frequencies and Mode Shapes:

Text books:
2. Elements of Vibration Analysis by Meirovitch.

References:
1. Mechanical Vibrations by G.K. Groover.
2. Vibrations by W.T. Thomson
5. Mechanical Vibrations – V.Ram Murthy.
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RANDOM VIBRATIONS
(Elective - VI)

Prerequisites: Probability & Statistics, Kinematic of machinery and Dynamics of machinery.

Course objectives: The course is intend
- To introduce the fundamental ideas of random vibrations.
- To deal in some depth with digital spectral analysis, which involves the measurement and analysis of random vibrations

Course outcomes:
After completing this course, students should be able to
- Apply tools from probabilistic modeling to analyze dynamic systems while accounting for variability and uncertainties that are inevitably present in real engineered systems.
- Classify random excitations as stationary or non-stationary
- Discuss important properties of random processes
- Define and compute power spectral density functions
- Compute auto-and cross-correlation functions, and relate them to power spectral
- Density functions Describe the dynamic response of a multi-degree-of-freedom system to a stochastic excitation
- Quantify the distributions of peak loads and peak responses from a system subject to stochastic excitation

UNIT I: PROBABILITY THEORY:
Random Vibrations - Probability distribution and density functions - Excreted values - Conditional probability - Characteristic and log characteristic functions - Chebyshev inequality - Functions of random variables.

UNIT – II : RANDOM PROCESSES - I:
Concept of stationary and ergodicity - Evolutionary nonstationary process - Auto and cross correlation and covariance Functions - Mean square limit, differentiability and inerrability - Spectral decomposition.

UNIT III: RANDOM PROCESSES - II:

UNIT IV : RANDOM VIBRATIONS - I:
Response of linear single and multi - degree of freedom systems to stationary excitation - Response of continuous systems - Normal mode method.

UNIT V : RANDOM VIBRATIONS - II:
Level crossing, peak and envelop statistics - First excursion and fatigue.

Text Books :

References:

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M.Tech. I Year II-Sem (Engineering Design)  
VEHICLE DYNAMICS  
(Elective - VI)

Prerequisite: Automobile Engineering

Course objectives: The course intends

• To understand the fundamentals of dynamics of different vehicle tyres,
• To impart the design of suspension and mechanisms of steering

Course Outcomes:
At the end of the course the students will be able to

• The focus of Automotive System Dynamics is to introduce the fundamentals of vehicle dynamics and the performance indices and evaluation criteria of vehicles, to analyze the influence of vehicle configuration and design parameters on vehicle performance.

UNIT I:

UNIT II:
Three dimensional Mechanisms, Multi-Body Systems Design, Introduction to 3D vehicle design.

UNIT III:
Suspension Design: Computer models using Bond Graph Technology, Drive train dynamics, vehicle performance

UNIT IV:

UNIT V:
Wheeled Vehicle Handling – Handling control loop, vehicle transfer function, Kinematic behavior of vehicles with rigid wheels and with complaint tyres: Neutral steer point, static margin, over and under-steer. Solution with two degree of freedom in the steady state: Stability factor, characteristic and critical speeds. Tracked Vehicle Handling – Analysis of sprocket torques and speeds, required to skid steer a tracked vehicle. Extension of theory to include three degrees of freedom.

Text Books:

References:
1. Vehicle stability – Dean Karnopp, Dekker Mechanical Engineering
4. Fundamental of Vehicle Dynamics- Gillespie T.D, SAE USA.
EXPERIMENTAL STRESS ANALYSIS
(Effective - VII)

Prerequisite: None

Course objectives: The course is intended to
- Provide knowledge about different experimental stress analysis techniques. These are very much needed to validate the design outputs.

Course Outcomes:
At the end of the course the students will be able to
- Know the working principle of strain gauges and do the model analysis using different theorems.
- Know the concepts of photoelasticity and its applications.
- Use the various Non-destructive testing methods.

UNIT-I

UNIT-II
Model Analysis - Structural similitude – Use of models – Structural and dimensional analysis – Buckingham Pi Theorem – Muller Breslau’s principle for indirect model analysis – Use of Begg’s and Eney’s deformeters – Moment indicators – Design of models for direct and indirect analysis.

UNIT-III

UNIT-IV

UNIT-V

Textbooks:
1. Experimental stress analysis by Dally and Riley, Mc Graw-Hill

References:
1. Experimental stress analysis by Sadhu Singh, Danapathi Rai Publications
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M.Tech. I Year II-Sem (Engineering Design)  L  T  P  C
FRACTURE MECHANICS
(Elective - VII)

Prerequisite: None

Course objectives: The course is intend
- 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.

Course Outcomes:
At the end of the course the students will be able to
- Predict material failure for any combination of applied stresses.
- Estimate failure conditions of a structure
- Determine the stress intensity factor for simple components of simple geometry
- Predict the likelihood of failure of a structure containing a defect

UNIT I:
Introduction to fracture Mechanics: The Crack tip plastic Zone, Methods for Measuring
Fracture Toughness.

UNIT II:
Strength of cracked bodies - potential energy and surface energy – Griffith’s theory – Irwin –
Orwin extension of Griffith’s theory to ductile materials – Stress analysis of cracked bodies –
Effect of thickness on fracture toughness – Stress intensity factors for typical geometries.

UNIT III:
PHYSICAL ASPECTS OF FATIGUE:
Phase in fatigue life - Crack initiation – Crack growth - Final fracture - Dislocation – Fatigue
fracture surfaces. Safe Life and Fail safe design philosophies Importance of Fracture
Mechanics in Aerospace structure – Applications to composite materials and structures.

UNIT IV:
STATIC ASPECTS OF FATIGUE BEHAVIOUR:
Low cycle and high cycle fatigue - Coffin- Manson’s Relation – Transition Life – Cyclic strain
hardening and softening – Analysis of load histories – Cycle counting techniques –
Cumulative damage – Miner’s theory, other theories.

UNIT V:
Dynamic Fracture, Stress Corrosion Cracking, Corrosion Fatigue, Fatigue - Crack
Propagation under Variable - Amplitude Load Fluctuation, Fatigue - Crack Initiation, Fatigue
- Crack Propagation under Constant - Amplitude Load Fluctuation.

Text Books:

References:
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ADVANCED FINITE ELEMENT AND MESH LESS METHODS
                                          (Elective-VII)

Prerequisite: Solid State physics and FEM

Course objectives: The course is intend to systematically explores and establishes the
theory, principles, and procedures that lead to mesh-free methods. Course in Mesh Free and
Other Advanced finite element gives basic understanding and application of a class of
emerging numerical methods.

Course Outcome:
• To perform complete FE formulations for engineering analysis
• To write codes for a finite element model
• To use commercial FEA software to solve engineering problems
• To apply finite element methods in design engineering components or systems
• To Learn mesh free method types, mesh free shape functions, weak form types
• Have the ability to be able to solve problems by using mesh free methods
• to solve a problem by writing a computer code containing mesh free method

Advanced Finite Element

Unit-I
Bending of Plates and Shells: Review of Elasticity Equations-Bending of Plates and Shells-
Finite Element Formulation of Plate and Shell Elements-Conforming and Non Conforming
Elements - Co and C1 Continuity Elements-Application and Examples.

Non-Linear Problems
Introduction-Iterative Techniques-Material non-Linearity-ElastoPlasticity-Plasticity- Visco
plasticity-Geometric Non linearity-large displacement Formulation-Application in Metal
Forming Process and contact problems

Unit-II
Dynamic Problem
Direct Formulation - Free, Transient and Forced Response - Solution Procedures-Subspace
Iterative Technique -Houbolt, Wilson, New mark - Methods – Examples

Unit-III
Fluid Mechanics and Heat Transfer
Governing Equations of Fluid Mechanics-Inviscid and Incompressible Flow-Potential
Formulations-Slow Non- Newtonian Flow-Metal and Polymer Forming-Navier Stokes
Equation-Steady and Transient Solutions. Error Estimates And Adaptive Refinement Error
norms and Convergence rates- high refinement with adaptivity-Adaptive refinement

MESHLESS METHODS
Unit-IV
Overview on Meshless Methods and Their Applications: Approximation Function, Numerical
Implementation, Applications

Unit-V


Text Books:
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year II-Sem (Engineering Design) 

ADVANCED MECHANICS OF COMPOSITE MATERIALS  
(Elective - VIII)

Prerequisite: None

Course objectives: The course is intended 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.

Course Outcomes:
At the end of the course the students will be able to

- understanding of types, manufacturing processes, and applications of composite materials.
- basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
- Ability to analyze problems on macro and micro mechanical behavior of lamina
- Ability to analyze problems on macro mechanical behavior of laminate
- An ability to predict the loads and moments that cause an individual composite layer and a composite laminate to fail and to compute hygro thermal loads in composites.
- An ability to compute the properties of a composite laminate with any stacking sequence.
- An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.

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

UNIT-II
Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT-III

UNIT-IV
UNIT-V

Text Books:

References:
JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year II-Sem (Engineering Design)  
NANO COMPOSITES DESIGN AND SYNTHESIS  
(Effective - VIII)

Prerequisite: None

Course Objectives:
The course is intend to cover nano composites, reinforcing nanostructures dispersed in various matrix materials like polymers, ceramics, metals, etc,. The subject covers mainly the synthesis methods, modeling and evaluation of nano composites.

Course Outcomes:
At the end of the course the students will be able to
• To synthesize and evaluate nanostructure reinforce matrix material
• To understand the importance of various nano material matrix
• To discuss various application including aerospace applications

Unit-I:
Introduction to Nano composites, Composites Material, Mechanical properties of Nano composite material: stress-strain relationship, toughness, strength, plasticity.

Unit-II:
Ceramic-Metal Nano composites, ceramic based nano porous composite, metal mat nano composites, Polymer-based nano composites carbon nano tube based nano composites and Natural nano bicomposites, Biomimetic nano composites and Biologically inspired nanocomposites; Nano composites for hard coatings; DLC coatings; Thin film nanocomposite ; Modeling of nano composites.

Unit-III:
Synthesis methods for various nano composite materials : sputtering, mechanical alloying, sol-gel synthesis, thermal spray synthesis etc.

Unit-IV:
Nano Indentation, Types of indentation: OLIVER & Pharr, Joslin- Oliver, Vickers indenter process.

Unit-V:
Processing of polymer Nanocomposites, properties of nanocomposites, Salt infiltrator Powder mixing, Intrusion method, exfoliation & interaction, Gel-casting impregnation techniques: Hot melt impregnation, solution impregnation.

Text Books:
2. Introduction to Nano Technology by Charles. P.Poole Jr and Frank j.Owens, Wiley India Pvt Ltd.

Reference Books
1. Encyclopedia of Nanotechnology by H.S. Nalwa
**Design for Process and Product Development**
(Selective - VIII)

**Prerequisite:** None

**Course Objectives:** The course is at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

**Course Outcomes:**
At the end of the course the students will be able to
- Should know types of customer needs, need gathering methods
- Establish the product function and constraints and modeling process
- Should know environmental objectives global issues, Regional and Local issues and DFE Methods
- Should develop physical models and know design of experiment principles
- Should design the product for robustness.

**Unit-I**

**Unit-II**

**Unit-III**

**Unit-IV**
Environmental Objectives, global issues, Regional and Local issues. Basic DFE Methods; Design Guidelines, application. Life cycle assessment, weighted sum assessment methods. Life cycle assessment method. Techniques to reduce environmental impact - design to minimize material usage, design for disassembly design for recyclability and design for remanufacturing design for high - impact material reduction design for energy efficiency.
Unit- V

Physical Models and Experimentation: Design of experiments - basic of designed experiments, basic method - two factorial experiments, extended method – interactions, Design of experiments: Reduced tests and fractional experiments, full factorial inefficiencies, orthogonality, base design method, Higher dimensions fractional factorial designs. Statistical analysis of experiments - degrees of freedom, correlation coefficient.

Design for Robustness: Quality design theory, general robust design model, robust design model construction. Basic method: Taguchi’s method, noise variable matrix, design variable matrix, experimental matrix, single to noise ratios, selection of a target design, parameter design and the Taguchi philosophy. Advantage analysis - Probability Theory Sizing the variation, general robust design Problem formulation.

Text Books:
1. Integrated product and process design and development by Edward B.Magrab, Satyandra K Gupta et al, CRC Press, 2nd Edition
ADVANCED COMPUTER AIDED DESIGN AND ANALYSIS LABORATORY

Prerequisite: None

Course objectives: The course is intend to
- 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

Course Outcomes:
At the end of the course the students will be able to
- Students should be able to use CATIA and Pro-E and software for modeling, tolerance & GD&T analysis of a product.
- Students should be able to use CATIA software to model a consumer product and industrial robot.
- Students should be able to carry out structural, Harmonic and fracture analysis using FEA software.

Note: Conduct any Ten exercises from the list given below:

1. Two- dimensional drawing using CAD software.
2. Three- dimensional drawing using CAD software.
3. Various Dimensioning and tolerancing techniques on typical products using CAD software.
4. Assembly and animation of simple assemblies like screw jack, bolt-nut mechanism, etc.
5. Truss analysis using FEA software.
7. Frame analysis using FEA software.
8. Buckling analysis of columns using FEA software.
9. Harmonic analysis using FEA software.
10. Fracture analysis using FEA software.
11. Analysis of laminated composites using FEA software.
12. Couple-field analysis using FEA software.
13. Modal Analysis
14. Transient dynamic analysis.
15. Spectrum analysis
Prerequisites: None

Course Objectives:

Course Outcomes: At the end of the course, the student will be able to:
• Identify and compare technical and practical issues related to the area of course specialization.
• Outline annotated bibliography of research demonstrating scholarly skills.
• Prepare a well organized report employing elements of technical writing and critical thinking
• Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.
COMPREHENSIVE VIVA – VOCE

Prerequisites: None

Course Outcomes:
- Comprehend the knowledge gained in the course work
- Infer principles of working of mechanical components
- Demonstrate the ability in problem solving and to communicate effectively

PROJECT PHASE - I

Prerequisites: None

Course Outcomes:
- Identify a topic in advanced areas of Engineering Design, materials
- Review literature to identify gaps and define objectives & scope of the work
- Employ the ideas from literature and develop research methodology
- Develop a model, experimental set-up and / or computational techniques necessary to meet the objectives.

PROJECT PHASE - II

Prerequisites: None

Course Outcomes:
- Identify methods and materials to carry out experiments/develop code
- Reorganize the procedures with a concern for society, environment and ethics
- Analyze and discuss the results to draw valid conclusions
- Prepare a report as per the recommended format and defend the work.
- Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.