ACADEMIC REGULATIONS & COURSE STRUCTURE

For

CAD/CAM

(Applicable for batches admitted from 2016-2017)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India
### I Semester

<table>
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<th>S.No.</th>
<th>Subject</th>
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<tr>
<td>1</td>
<td>Industrial Robotics</td>
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<td>2</td>
<td>Computer Aided Manufacturing</td>
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<td>Special Manufacturing Processes</td>
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<td>Geometric Modeling</td>
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<td><strong>Elective I</strong></td>
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<td></td>
<td>1. Computational Methods in Engineering</td>
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<td>2. Mechanical Vibrations</td>
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<td>3. Nano Technology</td>
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<td><strong>Elective II</strong></td>
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<td>1. Design for Manufacturing &amp; Assembly</td>
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<td>2. Mechatronics</td>
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<td>7</td>
<td>Advanced CAD Lab</td>
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**Total Credits** 20

### II Semester

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<tr>
<td>1</td>
<td>Modeling &amp; Simulation of Manufacturing Systems</td>
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<td>2</td>
<td>Optimization and Reliability</td>
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<td>Computer Graphics</td>
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<td>Finite Element Methods</td>
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<td><strong>Elective III</strong></td>
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<td>1. Quality Engineering in Manufacturing</td>
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<td>2. Fracture Mechanics</td>
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<td>3. Concurrent Engineering</td>
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<td>1. Mechanics and Manufacturing Methods of Composites</td>
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<td>3. Intelligent Manufacturing Systems</td>
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<td>Modeling and Analysis of Manufacturing Processes Lab</td>
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**Total Credits** 20
### III Semester

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<td>Comprehensive Viva-Voce</td>
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<td>Seminar – I</td>
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<td>Project Work Part - I</td>
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<td><strong>Total Credits</strong></td>
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### IV Semester

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<td>Project Work Part - II</td>
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<td><strong>Total Credits</strong></td>
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UNIT - I

CONTROL SYSTEM AND COMPONENTS: basic concepts and motion controllers, control system analysis, robot actuation and feedback components, Positions sensors, velocity sensors, actuators, power transmission systems, robot joint control design.

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.

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, 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
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.

REFERENCES:
3. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robotics and Control / Mittal R K & Nagrath I J / TMH
<table>
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<tr>
<th>UNIT - I</th>
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<tr>
<td>COMPUTER AIDED PROGRAMMING: General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors. Introduction to CAD/CAM software, Automatic Tool Path generation.</td>
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<tr>
<td>TOOLING FOR CNC MACHINES: Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, grinding.</td>
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<tr>
<td>POST PROCESSORS FOR CNC: Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP-based Post Processor: Communication channels and major variables in the DAPP-based Post Processor, the creation of a DAPP-based Post Processor.</td>
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<th>UNIT - IV</th>
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<th>UNIT - V</th>
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TEXT BOOKS:
2. CAD/CAM Principles and Applications, P.N.Rao, TMH

REFERENCES:
2. CAD / CAM Theory and Practice / Ibrahim Zeid, TMH
3. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
UNIT-I
SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT- II

UNIT- III
FABRICATION OF MICROELECTRONIC DEVICES: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

UNIT - IV
ADVANCED MACHINING PROCESSES: EDM, WireEDM, ECM, LBM, EBM, AJM, WJM – Principle, working, limitations and applications.

UNIT - V
RAPID PROTOTYPING: Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapid manufacturing

TEXT BOOKS:

REFERENCES:
2. MEMS & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH
3. Advanced Machining Processes / V.K.Jain / Allied Publications.
Unit - I  
Cubic splines –I: Definition, Explicit and implicit equations, parametric equations, Algebraic and geometric form of cubic spline, Hermite cubic spline, tangent vectors, parametric space of a curve, blending functions.

Unit - II  
Cubic Splines-II:  
four point form, reparametrization, truncating and subdividing of curve. Graphic construction and interpretation, composite pc curves.  
Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.

Unit - III  
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.

TEXT BOOKS:  

REFERENCES:  
Unit – I

Unit – II
**Boundary value problems and characteristic value problems:** Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

Unit – III
**Transformation Techniques:** Continuous fourier series, frequency and time domains, laplace transform, fourier integral and transform, discrete fourier transform (DFT), Fast fourier transform (FFT).

Unit – IV

Unit – V
**Partial differential equations:** Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria. Solving wave equation by finite differences-stability of numerical method -method of characteristics-wave equation in two space dimensions-computer programs.

**TEXT BOOKS:**
1. Steven C.Chapra, Raymond P.Canale “Numerical Methods for Engineers” Tata Mc-Graw Hill
2. Curtis F.Gerald, Partick.O.Wheatly,”Applied numerical analysis”Addison-Wesley, 1989

**REFERENCES:**
3. Kreysis, Advanced Mathematics
MECHANICAL VIBRATIONS
(ELECTIVE - I)

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

Unit II
Response to Non Periodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

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

Unit IV
Numerical Methods: Rayliegh’s, Stodola’s, Matrix iteration, Rayleigh-Ritz Method and Holzer’s methods

Unit V

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

References:
1. Vibrations by W.T. Thomson
NANO TECHNOLOGY
(ELECTIVE - I)

UNIT-I
Introduction, Size and shape dependence of material properties at the nanoscale, scaling relations, can nanorobots walk and nanoplanes fly, Nano scale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nano machines, Nano fluidics, filtration, sorting, Molecular motors, Application of Nano Technology.

UNIT-II

UNIT-III
Imaging/characterization of nanostructures General considerations for imaging, Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM.

UNIT-IV
Metal and semiconductor nanoparticles Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nano particles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

UNIT-V
Carbon nanotubes
Structure and synthesis, Electronic, vibrational, and mechanical properties, How can C nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement?

TEXT BOOKS:

REFERENCES:
1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003)
DESIGN FOR MANUFACTURING AND ASSEMBLY
(ELECTIVE- II)

UNIT - I

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.

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

REFERENCE:
1. ASM Hand book Vol.20
MECHATRONICS
(ELECTIVE - II)

UNIT-I
Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II
Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT-III
Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems:
Mechanical actuating systems and electrical actuating systems.

UNIT-IV
Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V
System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

TEXT BOOKS:

REFERENCES:
4. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
COMPUTER AIDED PROCESS PLANNING
(EFFECTIVE - II)

Unit - I
Introduction to CAPP: Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

Unit - II
Generative CAPP system: Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.
Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation, and applications.

Unit – III
Selection of manufacturing sequence: Significance, alternative manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples.

Determination of machining parameters: reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

Unit – IV
Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

Unit – V
Generation of tool path: Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

Implementation techniques for CAPP: MIPLAN system, Computer programming languages for CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

TEXT BOOK:

REFERENCES:
1. Automation , Production systems and Computer Integrated Manufacturing System – Mikell P.Groover
3. Computer Aided Engineering – David Bedworth
Students shall carry out the modeling and FE analysis of the following to predict deflection and stress distributions:

1. Trusses – 2D and 3D
2. Beams
3. Plate with Plane stress condition
4. Plate with Plane strain condition
5. Cylinders – Axi-symmetric condition
6. Natural frequencies of Beam
Unit-I
**Introduction to System and simulation:** Concept of system and elements of system, Discrete and continuous system, Models of system and Principles of modeling and simulation, Monte carlo simulation, Types of simulation, Steps in simulation model, Advantages, limitations and applications of simulation, Applications of simulation in manufacturing system

Unit-II
**Review of statistics and probability:** Types of discrete and continuous probability distributions such as Geometric, Poisson, Uniform, Geometric distribution with examples, Normal, Exponential distribution with examples.

Unit-III
**Random numbers:** Need for RNs, Technique for Random number generation such as Mid product method, Mid square method, and Linear congruential method with examples
Test for Random numbers: Uniformity - Chi square test or Kolmogorov Smirnov test,
Independency- Auto correlation test
Random Variate generation: Technique for Random variate generation such as Inverse transforms technique or Rejection method

Unit-IV
**Analysis of simulation data:** Input data analysis, Verification and validation of simulation models, Output data analysis
Simulation languages: History of simulation languages, Comparison and selection of simulation languages
Design and evaluation of simulation experiments: Development and analysis of simulation models using simulation language with different manufacturing systems

Unit-V
**Queueing models:** An introduction, M/M/1 and M/M/m Models with examples, Open Queueing and Closed queueing network with examples
**Markov chain models and others:** Discrete time markov chain with examples, Continues time markov chain with examples, stochastic process in manufacturing, Game theory

TEXT BOOKS:
UNIT - I

UNIT - II
NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead’s Simplex search method, Gradient of a function, Steepest descent method, Newton’s method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.

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, drawbacks of GA,
GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.
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
APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

UNIT V
RELIABILITY: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis.

TEXT BOOKS:
1. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Reliability Engineering by L.S.Srinath
REFERENCES:
2. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers
Unit - I
**Raster scan graphics:** Raster scan and random scan architecture, Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

**Filling algorithms:** polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of anti-aliasing and half toning.

Unit - II
**Line CLIPPING:** Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, midpoint sub division algorithm.

**Polygon clipping:** polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

Unit - III
**Rendering:** Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Z-buffer algorithm.

**Shading algorithms:** Constant intensity algorithm, Phong’s shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

Unit - IV
**Computer Animation:** Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification.

Unit – V
**Introduction to Multimedia:** Introduction, multimedia- systems, technology, architecture, trade-offs, contents, PC, Applications, data compressions, authoring system.

**Multimedia Authoring Tools:** Introduction, Types of authoring tools, Package based- in card authoring tools, Icon based authoring tools, Time based and presentation tools, object oriented authoring tools, author ware professional for windows (APW).

**TEXT BOOKS:**
UNIT - I

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

UNIT – III

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 Chandrupatla & Belagundu.

REFERENCES:
QUALITY ENGINEERING IN MANUFACTURING  
(ELECTIVE III)

UNIT - I
QUALITY VALUE AND ENGINEERING: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances. (N-type, S-type and L-type)

UNIT II:
TOLERANCE DESIGN AND TOLERANCING: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT – III
ANALYSIS OF VARIANCE (ANOVA): Introduction to ANOVA, Need for ANOVA, NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT - IV
ORTHOGONAL ARRAYS: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT - V
SIX SIGMA AND THE TECHNICAL SYSTEM: Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

TEXT BOOK:

REFERENCES:
FRACTURE MECHANICS
(ELECTIVE - III)

UNIT-I

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

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

TEXT BOOKS:

REFERENCES:
CONCURRENT ENGINEERING
(ELECTIVE - III)

UNIT I:
INTRODUCTION,
Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

USE OF INFORMATION TECHNOLOGY
IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

UNIT II:
DESIGN STAGE
Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design – Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

UNIT III:
MANUFACTURING CONCEPTS AND ANALYSIS
Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative, physical approach - An intelligent design for manufacturing system –

UNIT IV:

PROJECT MANAGEMENT
Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost

UNIT V
Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

TEXT BOOKS:

REFERENCES:
MECHANICS AND MANUFACTURING METHODS OF COMPOSITES  
(ELECTIVE - IV)

Unit – I

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made 
composites, Aerospace and structural applications, types and classification of composites, 
Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate 
composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic 
composites.

Unit – II

Micromechanics: Unidirectional composites, constituent materials and properties, elastic 
properties of a lamina, properties of typical composite materials, laminate characteristics and 
configurations. Characterization of composite properties.

Coordinate transformations: Hooke’s law for different types of materials, Hooke’s law for two 
dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of 
stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness 
modulus, off - axis compliance.

Unit – III

Elastic behavior of unidirectional composites: Elastic constants of lamina, relation ship 
between engineering constants and reduced stiffness and compliances, analysis of laminated 
composites, constitutive relations.

Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength 
of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain 
criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micro 
mechanical predictions of elastic constants.

Unit – IV

Analysis of laminated composite plates
Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, 
problems using thin plate theory.

Unit – V

Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, 
hand layup, pultrusion, RTM.

TEXT BOOKS:
   1975.

REFERENCES:
1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, 
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, 
MATERIALS TECHNOLOGY
(ELECTIVE - IV)

UNIT I:
Elasticity in metals, mechanism of plastic deformation, slip and twinning, 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, Yield criteria: Von-mises and Tresca criteria.

UNIT II:
Griffith’s Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller parameter, Deformation and Fracture mechanism maps.

UNIT III:
Fatigue, fatigue limit, features of fatigue fracture, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis. Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep.

UNIT IV:
MODERN METALLIC MATERIALS: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides. Processing and applications of Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

UNIT V:

TEXT BOOKS:

REFERENCES:
2. Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson
3. Material Science and Engineering/William D Callister/John Wiley and Sons
4. Plasticity and plastic deformation by Aritzur.
5. Introduction to Ceramics, 2nd Edition by W. David Kingery, H. K. Bowen, Donald R. Uhlmann
UNIT I:

UNIT II:
COMPONENTS OF KNOWLEDGE BASED SYSTEMS - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT III:
MACHINE LEARNING - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT IV:

UNIT V:

TEXT BOOKS:
1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006
Students shall carry out the modeling and FE analysis of at least three processes of each category given below.

1. Casting processes - Simulation of Solidification, temperatures, Residual stresses, metallurgical phases etc.
2. Forging processes - Simulation of cold working and hot working processes for extrusion, drawing, rolling, etc.
3. Forming Processes – Simulation of blanking, bending, deep drawing, etc.
4. Welding Processes – Simulation of arc, spot, laser welding, etc.