JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
MECHANICAL ENGINEERING
Course Structure For M. Tech (CAD/CAM) –(Regular) - w.e.f. 2009-10

		L	P	T	C
I - SEMESTER					
CA 101	Finite Element Methods	4	0	4	8
CA 102	Computer Integrated Manufacturing	4	0	4	8
CA 103	Geometric Modeling	4	0	4	8
CA 104	Advances in Manufacturing Technology	4	0	4	8
	Elective – I	4	0	4	8
	Elective – II	4	0	4	8
CA 113	Modelling And CNC Lab	0	3	3	4
II – SEMESTER					
CA 201	Advanced Optimization Techniques	4	0	4	8
CA 202	Computer Graphics	4	0	4	8
CA 203	Robotics	4	0	4	8
CA 204	CNC Technology & programming	4	0	4	8
	Elective – III	4	0	4	8
	Elective – IV	4	0	4	8
CA 213	Computer Aided Design Lab	0	3	3	4
III & IV SEMESTERS					
	Seminar	-	-	-	4
	Project	-	-	-	24
	GRAND TOTAL				**132**

ELECTIVE – I

CA 105	Nano Technology
CA 106	Computational Methods
CA 107	Quality Engineering and Manufacturing
CA 108	Non Destructive Evaluation

ELECTIVE – II

CA 109	Design for Manufacturing
CA 110	Computer Aided Process Planning
CA 111	Mechatronics
CA 112	Fracture, Fatigue & Creep deformation

ELECTIVE – III

CA 205	Mechanics of Metal Cutting and Tool Design
CA 206	Product Engineering
CA 207	Cellular Manufacturing Systems
CA 208	Rapid Prototyping

ELECTIVE – IV

CA 209	Advanced Geometrical Modeling
CA 210	Artificial Intelligence & Expert Systems
CA 211	Mechanics and Manufacturing methods of Composites
CA 212	Concurrent Engineering

UNIT - I

Formulation Techniques:

Unit – I

Introduction: Fundamental concepts in Manufacturing and Automation, Automation Strategies, Economic analysis in production, fundamentals of CAD / CAM, product cycle and CAD/CAM, Automation and CAD/CAM, Scope of CIM, Automated flow lines, Transfer mechanisms, methods of Line balancing.

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.

Unit – III

NC part programming: Introduction – NC coding system, manual part programming, part programming with APT, NC part programming using CAD/CAM, manual data input.

Unit – IV

Computer controls in NC: NC controllers' technology - Computer Numerical Control (CNC), Direct Numerical control (DNC).

Unit – V

Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

Unit – VI

Flexible Manufacturing Systems: Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.

Unit – VII

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.

Unit – VIII

Computer integrated manufacturing: 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:

1. Automation, Production systems and Computer Integrated Manufacturing Systems – Mikel P.Groover, PHI Publishers

References:

1. CAD/CAM - Mikell P.Groover, and Emory W.Zimmers.Jr. PHI Publishers
2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers
3. CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers

Unit - I

Introduction: Definition, Explicit and implicit equations, parametric equations.

Unit - II

Cubic Splines-1: Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves.

Unit - III

Cubic Splines-2: Graphic construction and interpretation, composite pc curves.

Unit - IV

Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.

Unit – V

B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.

Unit – VI

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 – VII

Solids: Tricubic solid, Algebraic and geometric form.

Unit – VIII

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

Text Books:

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

REFERENCES:

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

Unit - I

Welding Processes: Fusion and Solid state welding process, Automation in Welding, Design aspects of welds, Weldability of aluminium alloys, titanium alloys and High strength low alloy steels, Non destructive testing of welds, Residual stresses and distortion in weldments.

Unit - II

Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

Unit - III

Un-conventional Machining Methods-I:

Abrasive jet machining **-** Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments.

Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

Unit - IV

Un-conventional Machining Methods-II:

Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.

Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

Unit - V

Un-conventional Machining Methods-III:

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes.

Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications, and limitations.

Unit - VI

Rapid Prototyping: Working principle, methods-Steriolithography, Laser sintering, Fused deposition method, applications and limitations.

Unit – VII

Nano Technology: Nano milling processes, wet milling, dry milling, nano materials, fabrication of nano tubes, advantages of nano tubes, mechanical properties.

Text Books:

1. Manufacturing Technology - P. N. Rao, TMH Publishers
2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers

References:

1.Production Technology - HMT
2.Manufacturing Science - Cambel
3.Welding Technology - R.S, Parmar,
4.Introduction to Nanotechnology - Poole and Owens, Wiley (2003).

CA 105 **NANO TECHNOLOGY** **4-0-8**

(Elective)

Unit-I

Introduction

Size and shape dependence of material properties at the nanoscale, why is small good? limits to smallness, scaling relations, can nanorobots walk and nanoplanes fly? Nanoscale elements in conventional technologies

Unit-II

Top-down and bottom-up nanofabrication

The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, Electron beam lithography, Soft lithography: nanoimprinting and microcontact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

Unit-III

Self assembly and self-organization

Functional coatings with self assembled monolayers of molecules and nanoparticles Langmuir-Blodgett films, layer-by-layer growth.

Unit-IV

Imaging/characterization of nanostructures

General considerations for imaging,Scanning probe techniques: SEM, STM, AFM, NSOM.

Unit-V

Metal and semiconductor nanoparticles

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

Unit-VI

Semiconductor and metal nanowires

Vapor/liquid/solid growth and other synthesis techniques,,Nanowire transistors and sensors.

Unit-VII

Carbon nanotubes

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

Unit-VIII

Mechanics at nanoscale

Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nanomachines,Nanofluidics, filtration, sorting,Molecular motors

Text Books:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

References:

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing (2006).

CA 106 COMPUTATIONAL METHODS 4-0-8
(Elective)

Unit – I

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs

Unit – II

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

Unit – III

Optimization:

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

Unit – IV

Boundry value problems and charecteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

Unit – V

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

Unit – VI

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

Unit – VII

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

Unit – VIII

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw hill
2.Curtis F.Gerald, partick.O.Wheatly,"Applied numerical analysis"Addison-wesley,1989
3.Douglas J..Faires,Riched Burden"Numerical methods"Brooks/cole publishing company,1998.Second edition.

References:

1.Ward cheney &David Kincaid "Numerical mathematics and computing"Brooks/cole publishing company1999,fourth edition.
2.Riley K.F.M.P.Hobson&Bence S.J,"mathematical methods for physics and engineering"Cambridge university press,1999.

CA 107 QUALITY ENGINEERING AND MANUFACTURING 4-0-8
(Elective)

UNIT-I

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.

UNIT-II

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-III

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components.

UNIT-IV

Parameter and tolerance design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT-V

Design of Experiments: Introduction, Task aids and Responsibilites for DOE process steps, DOE process steps description.

Analysis of variance (ANOVA): no-WAY anova, One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT-VI

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

UNIT-VII

Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean

UNIT-VIII

ISO-9000 Quality system, BDRE,6-sigma, bench marking, quality circles-brain storming-fishbone diagram-problem analysis.

TEXT BOOKS:

1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition, 1995.

REFERENCES:

1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl. Edition, 1989.
2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.

CA 108 **NON - DESTRUCTIVE EVALUATION** **4-0-8**

(Elective)

Unit – I

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

Unit – II

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

Unit – III

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

Unit – IV

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

Unit – V

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

Unit – VI

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

Unit – VII

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

Unit – VIII

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

Text books:

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

CA 109 **DESIGN FOR MANUFACTURING** **4-0-8**

(Elective)

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

UNIT – VI

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

UNIT – VII

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

UNIT VII

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

Text Books:

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

Reference Books:

1. ASM Hand book Vol.20

CA 110 COMPUTER AIDED PROCESS PLANNING 4-0-8

(Elective)

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.

Unit - III

Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation, and applications.

Unit – IV

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

Unit –V

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 –VI

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 –VII

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.

Unit –VIII

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 Books:

1.Automation , Production systems and Computer Integrated Manufacturing System – Mikell P.Groover

2.Computer Aided Design and Manufacturing – Dr.Sadhu Singh.

3.Computer Aided Engineering – David Bedworth

CA 111 **MECHATRONICS** **4-0-8**

(Elective)

Unit – I

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

Unit – II

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

Unit – III

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

Unit – IV

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

Unit – V

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

Unit – VI

Manufacturing data bases: Data base management system, CAD/CAM data bases, graphic data base, introduction to object oriented concepts, objects oriented model language interface, procedures and methods in creation, edition and manipulation of data.

Unit – VII

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

Unit – VIII

Machine vision: Feature and pattern recognition methods, concepts of perception and cognition in decision-making.

Text books:

1. DA Bradley, "Mechatronics - Designing intelligent machines", open university, London.
2. Michel B.Histand and david G. Alciatore, "Introduction to Mechatronics and Measurement systems", Tata Mc Graw Hill.
3.C.W.desilva, " Control sensors and actuators", Prentice Hall.

CA 112 FRACTURE FATIGUE & CREEP DEFORMATION 4-0-8

(Elective)

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

UNIT-VI

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

UNIT-VII

Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. 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-VIII

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

Text Books

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

A – MODELLING LAB

1.Generation of the following curves using "C" language

i. Bezier curves
ii. Splines
iii. B-Splines.

2.Generation of the following surfaces using "C" language

i. Bezier surfaces
ii. B-Splines surfaces

3.Generation of solids using "C"

i. Constructive solid geometry
ii. Boundary representation

B – CNC LAB

1.Generation of part programs on CNC Lathe machine to perform the following operations:
i) Step Turning
ii) Taper Turning and
2.Part program for thread cutting using Canned cycle
3.Generation of part programs on CNC drilling machine
4.Generation of part programs on CNC milling machine to perform
i) Slot milling
ii) End milling and
5. Cutting tool path generation using any one simulation package for different machining operations
6. Graphical simulation of tool path

Suggested Software Packages: I-DEAS, Uni-graphics, Iron CAD, Edge-CAM etc.

CA 201 ADVANCED OPTIMIZATION TECHNIQUES 4-0-8

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

UNIT - VI

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

UNIT – VII

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

UNIT VIII

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

Text Books:

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

References:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers

2. Genetic Programming- Koza

3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

CA 202 **COMPUTER GRAPHICS** **4-0-8**

(Add from ICG of B.Tech IV – II Mech.)

Unit - I

Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.

Unit - II

Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

Unit - III

Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

Unit - IV

Line CLIPPING: Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, mid point sub division algorithm.

Unit - V

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

Unit - VI

Transformations: Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

Unit - VII

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

Unit - VIII

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

Text Books:

1.Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.

2.Computer Graphics-Donald Hearn & M.P. Bakers.

3.Computer graphics-Harrington.

CA 203 **ROBOTICS** **4-0-8**

Unit – I

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

Unit – II

Matrix transformations: Introduction, robots as a mechanisms, matrix representation-representation of a point in a space, representation of a vector in space, representation of a frame at the origin of a reference frame, representation of a frame in a reference frame, representation of a rigid body.

Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis, representation of combined transformations, transformations relative to the rotating, inverse of transformation matrices.

Unit – III

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

Unit – IV

Differential motions and Velocities:

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

Unit – V

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

Unit – VI

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

Unit – VII

Robot Actuators: Introduction,charecterics of Actuating systems-weight, power to weight ratio, operating pressure, stiffness Vs compliance,comparision of actuating systems, hydraulic devices, pneumatic devices,

Electric motors-DC motorcar motors, Brushless DC motors, direct Drive electric motors, servomotors, stepped motors.

Unit – VIII

Robot sensors: Introduction, sensor characteristics,

Position sensors-potentiometers, encoders, LVDT, Resolvers, time of travel displacement sensor, Velocity sensors-Encoders, Tachometers, differentiation of position signal,

Accelerating sensors, force and pressure sensors-piezoelectric, force sensing resistor, strain gauges, Torque sensors, light and infrared sensors, touch and tactile sensors, proximity sensors-magnetic proximity sensors, optical proximity sensors, Ultrasonic proximity sensors, inductive proximity sensors, capacitive proximity sensors, eddy current proximity sensors, sniff sensors.

Text Books:

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

References:

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

CA 204 CNC TECHNOLOGY & PROGRAMMING 4-0-8

(Elective)

Unit – I

Introduction to CNC Machine tools: Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.

Unit – II

Constructional features of CNC machine tools: Introduction, Spindle drives, Transmission belting, axes feed drives, Slide ways, Ball screws.

Unit – III

Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).

Unit – IV

Feedback devices: Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.

Unit – V

Electro-magnetic analogue position transducers: Principle, advantages, characterstics, Synchros, Synchro-Resolvers, Inductos, Laser interferometer.

Unit – VI

Control Systems and interface: Open and closed loop systems, Micro processor based CNC systems, block diagram of typical CNC system, description of hard ware and soft interpolation systems, Standard and optional features of CNC control systems.

Unit – VII

APT programming: APT language structure, APT geometry, Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motion commands, continuous path motion commands, post processor commands, control commands, Macro subroutines, Part programming preparation for typical examples.

Unit – VIII

Economics and Maintenance of CNC machine tools: Introduction, factors influencing selection of CNC machines, Cost of operation of CNC machines, Maintenance features of CNC machines, Preventive maintenance, Documentation, Spare parts, Training in Maintenance.

Text Books:

1.Computer Numerical Control Machines – Dr.Radha Krishnanan, New Central Book Agency

2.Computer Numerical Control Machines – Hans B.Keif and T. Frederick Waters Macmillan/McGraw Hill

References:

1.CNC Machines – B.S. Aditahn and Pabla

2.CNC Machining technology – Springer – Verlag

3.Computer Numerical Machine tools - G.E. Thyer, NEWNES

CA 205 MECHANICS OF METAL CUTTING AND TOOL DESIGN 4-0-8 (ELECTIVE)

UNIT-I

Single point cutting tool: Various systems of specifications, single point cutting tool, geometry and their and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

UNIT-II

Multi point cutting tools: Drill geometry, design of drills, rake & relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed & feed-machining time-design-from cutters.

UNIT-III

Grinding: Specifications of grinding of grinding wheel, mechanics of grinding, effect of grinding conditions on wheel wear and grinding ratio, depth of cut, speed, machining time, temperature, power.

UNIT-IV

Dynamometry: Requirements, Force Measurements, Electric Transducers, Bonded Strain Gages, Wheatstone Bridge. Lathe, Milling, Drilling and Grinding Dynamometers. Piezoelectric Dynamometer, Single Abrasive Grain Dynamometer.

UNIT-V

Cutting Fluids: Types, mixing, selection, low speed and high speed cutting fluid action, Direction of fluid application, Cryogenic cooling, vapors and mist, Health and Safety considerations, dry machining.

UNIT-VI

Tool life and tool wear: Theories of tool wear-adhesion, abrasive and diffusion wear mechanisms, forms of wear, tool life criteria and machinability index.

UNIT-VII

Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting, effect of tool angle, economics, cost analysis, mean co-efficient of friction.

UNIT-VIII

Cutting temperature: Sources of heat in metal cutting, influence and metal conditions, temperature distribution, zones, experimental techniques, analytical approach. Use of tool-work thermocouple for determination of temperature. Temperature distribution in metal cutting.

TEXT BOOKS:

2. Metal cutting Principle/MC Shaw/ Oxford and IBH Publications, New Delhi, 1969
3. Fundamentals of machining / Boothryd / Edward Amold Publishers Ltd. 1975.

REFERENCES:

1. Metal cutting theory and cutting tool design / V. Arshinov and G.Alekseev / Mir Publishers, Moscow.
2. Fundamentals of Metal cutting and machine tools / B.L Junega, G.S. Sekhom and Nitin Seth / New Age International Publishers.

CA 206 PRODUCT ENGINEERING 4-0-8
(Elective)

UNIT I

Product Design Process: Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioral Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees.

Modeling and Simulation: Role of Models in Engineering Design, Mathematical Modeling, Similitude and Scale Models, Computer Simulation, Geometric Modeling on Computer, Finite-Element Analysis.

UNIT II

Materials Selection: Problem of Materials Selection, Performance Characteristics of Materials, Materials Selection Process, Sources of Information on Materials, Economics of Materials, Evaluation Methods for Materials Selection, Cost versus Performance Relations, Weighted Property Index, Cost Comparison, Value Analysis, Materials Systems, Materials Substitution

UNIT III

Interaction of Materials, Processing, and Design: Role of Processing in Design, Classification of Manufacturing Processes, Economics of Manufacturing, Design for Castings, Forgings, Sheet-Metal Forming, Machining, Powder Metallurgy, Welding.
Residual Stresses in Design, Design for Heat Treatment, Design for Assembly, Design for Brittle Fracture, Fatigue Failure, Corrosion Resistance. Designing with Plastics

UNIT IV

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

UNIT V

Overstress Failure and Load - Strength Interference: Failure Mechanisms, Electrical and Mechanical Overstress, Overstress Reliability Models, Safety Margin and Loading Roughness, Normally Distributed Load and Normally Distributed Strength, Safety Factors and Derating, Multiple Load Reliability, Time Dependent Stress-Strength Reliability Models, Design for Quality.

Mean stress effects, effect of notches, strain life models, accumulating damage,
Stress intensity factor and crack growth models, Fatigue crack propagation,
Wear of rolling and sliding elements, Aging interactions and Creep, Fatigue-creep interactions, grain growth effects, fatigue mitigation. Elements of corrosion, corrosion rates, corrosion prevention

UNIT VI

Test environment and stresses; thermal, vibration, electrical, and combined environments, temperature testing, vibration testing, test effectiveness. Accelerated testing and data analysis, accelerated factors. Weibull probability plotting, testing with censored data .

UNIT VII

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

Product Design for Safety, Product Safety and User Safety Concepts, Examples of Safe Designs.

Design Standardization and Cost Reduction: Standardization Methodology, Benefits of Product Standardization; International, National, Association and Company Level Standards; Parts Modularization

UNIT VIII

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

TEXT BOOKS

1 Engineering Design , George E. Dieter, McGRAW-HILL
2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans, Springer Verlag
3. **The Product Management Handbook,** Richard S. Handscombe, McGRAW-HILL

CA 207 CELLULAR MANUFACTURING SYSTEMS 4-0-8

(Elective)

UNIT 1

Cellular manufacturing: Introduction, Group machining Concept, Principle, Terminology, characteristics, Perspectives, Objectives, Techniques, Applications, Factors to be considered for implementation, factors influencing the success of cellular manufacturing.

Unit II

Cell formation techniques: Design and Manufacturing Attributes, Cell Design and Representation of the Problem. Cell Formation Techniques – Traditional methods, Similarity coefficient methods, Array based methods. Cell Design Considerations, Data Structure and Influence on the Solution.

Unit III

Processing the Exceptional Components: Introduction, Processing Exceptional Components, Models for Eliminating Exceptional Components.

Unit IV

Evaluation of Cellular Manufacturing Solutions: Introduction, Static Evaluation of Cells, Measure of flexibility (MF), Selection of Solution, VEDO Analysis, Comparison of Different Methods.

Unit V

Scheduling in Cellular Manufacturing: Petrov's Approach, Integrated approach, MRP, Economics Lot Scheduling, Dynamic scheduling, Similarity Coefficient based Scheduling, Priority Based scheduling methods. Comparisons.

Unit VI

Line Balancing in Cellular manufacturing: Line balancing for cells, Design Factor in Line Balancing, Bowl Phenomena in Cellular Manufacturing environment, effect on production rates.

Unit VII

Inventory Control in Cellular manufacturing: Application of MRP, Boucher's Model , Period Batch Control (PBC), Lot size Harmonization, EBQ model

Unit VIII

Implementation Issues: Economic Justification of Cellular Manufacturing, Benefits and Limitations of Cellular Manufacturing, Organizational and Behavioral Issues.

TEXT BOOKS

1. B S Nagendra Parashar, "Cellular Manufacturing systems" PHI Learning Pvt Ltd, 2009
2. Andrew Kusaik, "Intelligent Manufacturing System"
3. MP Groover, "Automation, Production Systems, CIM"
4. Irani SA, "Cellular Manufacturing systems"
5. Kamrani AK, Parsaei HR and Liles DH, "Planning, Design and Analysis of Cellular Manufacturing systems"

CA 208 **RAPID PROTOTYPING** **4-0-8**

(Elective)

Unit-I

Introduction: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.

Unit –II

Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

Unit III

Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.

Unit IV

Solid ground curing: Principle of operation, Machine details, Applications,

Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details, Applications.

Unit –V

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, Object Quadra system.

Unit –VI

LASER ENGINEERING NET SHAPING (LENS)

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

Unit VII

Rapid Manufacturing Process Optimization: Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

Unit VIII

Allied Process: Vacuum casting, surface digitizing, Surface generation from point cloud, Surface modification- Data transfer to solid models.

TEXT BOOKS:

1. Paul F.Jacobs – **" stereo lithography and other RP & M Technologies"**, SME, NY 1996
2. Flham D.T & Dinjoy S.S **– " Rapid Manufacturing "** Verlog London 2001
3. Lament wood, **"Rapid automated "** , Indus Press New York.

CA 209 ADVANCED GEOMETRIC MODELING 4-0-8

(Elective)

Unit – I

Rational curves: Rational splines, Rational Beziers, Definition and Properties of NURBS Curves, Straight lines, Curves, arcs, Conics

Unit – II

Rational Surfaces: Definition and Properties of NURRS surfaces, Bilinear surfaces, Ruled surface**.**

Unit – III

Fundamental Geometric algorithms

Introduction, knot insertion, knot Refinement, Degree elevation, Degree Reduction

Unit – IV

Data Exchange: IGES, STEP, PHIGS.

Unit – V

Intersections: curve and curve, curve and surface

Unit – VI

Shape modification tools: Control point reportioning, weight modification

Unit – VII

Mass property calculation of solid models: Curve lengths, areas, movements of inertia etc.

Unit – VIII

Introduction to feature recognition: Taxorary, features for design, features for manufacturing

Text Books:

1. The Nurbbs book, Les piegl, Wayne tiller

REFERENCES:

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

CA 210 ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS 4-0-8

(Elective)

Unit-I

Artificial Intelligence : Introduction, definition, underlying assumption, Important of Al, Al & related fields State space representation, defining a problem, production systems and its characteristic, search and control strategies –Introduction, preliminary concepts, examples of Search , problems.

Unit-II

Uniformed or preliminary Concept: Examples of search problems, Uniformed or Blind Search, Informed Search, Or Graphs, Heuristic Search techniques- Generate and Test, Hill climbing, Best first search, Problem reduction, Constraint satisfaction, Means- Ends Analysis.

Unit III

Knowledge Representation Issues: Representations and Mapping, Approaches, Issues in Kr, Types of knowledge procedural Vs Declarative, Logic programming, Forward Vs Backward reasoning, Matching, Non monotonic reasoning and it logic.

Unit-IV

Use of Predicate Logic: Representing simple facts, Instance and is a relationships, Syntax and Semantics for Propositional logic, FOPL, and properties of Wffs, conversion to casual form, Resolution, Natural deduction

.

Unit-V

Statistical and Probabilistic Reasoning: Symbolic reasoning under uncertainly, Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster- Shafer Theory, Fuzzy Logic

Unit-VI

Expert Systems: Introduction, Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition, introduction, Recognition and classification process, learning classification patterns, recognizing and understanding speech.

Unit-VII

Introduction to Knowledge Acquisition: Types of learning, General learning model, and performance measures.

Unit-VIII

Typical Expert Systems: MYCIN, Variants of MYCIN, PROSPECTOR DENDRAL, PRUFF etc.
Introduction to Machine Learning: Perceptons, Checker Playing examples,
Learning, Automata, Genetic Algorithms, Intelligent Editors.

TEXT BOOKS

1. Elaine Rich & Kevin Knight**, " Artificial Intelligence"** , M/H 1983
2. Wendry B.Ranch**, "Artificial Intelligence in Business"**, Science & Industry – Vol -II application, Ph 1985.
3. Waterman, D.A., Addison, **" A Guide to Expert System" –** Wesley inc. 1986.
4. Hayes, Roth, Waterman, **"Building expert system"** D.A (ed), AW 1983.
5. S.M. and Kulliknowske, **"Designing Expert System"**, Weis, London Champion Hull 1984.

CA 211 MECHANICS AND MANUFACTURING METHODS OF COMPOSITES 4-0-8
(Elective)

Unit – I

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites,

Unit – II

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

Unit – III

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.

Unit – IV

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 – V

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.

Unit – VI

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 – VII

Analysis of laminated composite plates

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

Unit – VIII

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

Text Books:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M.Daniel, Oxford University Press, 1994.

References:

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

CA 212 CONCURRENT ENGINEERING 4-0-8

(Elective)

Unit-1

Introduction- Extensive, definition of CE, CE design methodologies- Organizing for CE- CE Tool box Collaborative product development.

Unit-II

Use of Information Technology: IT Support- Solid modeling-Product, Data management- Collaborative product commerce- Artificial Intelligence- Expert Systems- Software hard co-design

Unit -III

Design Stage: Life cycle design of products- opportunity for manufacturing enterprises-modality of concurrent engineering design.

Unit –IV

Automated analysis idealization control - concurrent engineering in optimal structure design- real time construction.

Unit –V

Manufacturing competitiveness-Checking the design process- conceptual design process mechanism- Qualitative, physical approach- an intelligence design for manufacturing for manufacturing system.

Unit VI

JIT system- low inventory- Modular- Modeling and reasoning for computer based assembly planning- Design of automated manufacturing

Unit VII

Project Management Life cycle Semi Realization- Design for Economics- Evaluation of design for manufacturing cost.

Unit VIII

Concurrent Mechanical design- Decomposition in concurrent Design-Negotiation in Concurrent Engineering Design studies- Product Realization Taxonomy- Plan project management on new product development- bottle neck technology development.

Text Books:

1. Anderson M M and Hein, L Berlin, Spinger Verlog- **" Integrated product Development"**
2. Cleetus J Concurrent research Center, Morgan Town – **"Design for Concurrent Engineering"**

I. Modeling using IDEAS solid modeling package

Surface modeling
Solid Modeling
Drafting and
Assembly

II. FE Analysis using Ansys Package for different structures that can be discritised with 1-D,2-D & 3-D elements to perform the following analysis:

1. Static Analysis
2. Modal Analysis
3. Thermal Analysis
4. Transient analysis