Regulations for PG Programs in Engineering (R14PG)

and

Curriculum and Syllabus for M.Tech (CAD/CAM)

Kandula Srinivasa Reddy Memorial College of Engineering

(Autonomous)

KADAPA – 516 003 (A.P.)

(Affiliated to AICTE, Accredited By NBA & NAAC, Affiliated JNTUA, Anantapur)

(An ISO 14001 : 2004 Certified Institute)

I YEAR I SEMESTER SUBJECTS:

S.No	Course code	SUBJECTS		L	T	P	IM	EM	CR
1)	14211101	COMPUTATIONAL METHODS	BS	3	1	0	40	60	4
2)	14531102	FINITE ELEMENT METHODS	PJ	3	1	0	40	60	4
3)	14531103	COMPUTER INTEGRATED MANUFACTURING	PJ	3	1	0	40	60	4
4)	14531104	GEOMETRIC MODELING	PJ	3	1	0	40	60	4
5)	14531105	ADVANCES IN MANUFACTURING TECHNOLOGY	PJ	3	1	0	40	60	4
6)	14531106	ELECTIVE-I QUALITY ENGINEERING AND MANUFACTURING	PJ	3	1	0	40	60	4
	14531107	COMPUTER AIDED PROCESS PLANNING	PJ						
	14531108	DESIGN FOR MANUFACTURING	PJ						
	14531109	CONCURRENT ENGINEERING	PJ						
7)	14531110	MODELLING AND CNC LAB	PJ	0		3	50	50	2
		TOTAL		18	6	3	290	410	26

I YEAR II SEMESTER

S.No	Course code	SUBJECTS		L	T	P	IM	EM	CR
1)	14531201	ADVANCED OPTIMIZATION TECHNIQUES	PJ	3	1	0	40	60	4
2)	14531202	ROBOTICS	PJ	3	1	0	40	60	4
3)	14531203	COMPUTER GRAPHICS	PJ	3	1	0	40	60	4
4)	14531204	CNC TECHNOLOGY & PROGRAMMING	PJ	3	1	0	40	60	4
5)	14531205	MECHATRONICS	PJ	3	1	0	40	60	4
6)	14531206	ELECTIVE-II RAPID PROTOTYPING	PJ	3	1	0	40	60	4
	14531207	ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS	PJ						
	14531208	MECHANICS & MANUFACTURING METHODS OF COMPOSITES	PJ						
	14531209	AUTOMATION IN MANUFACTURING	PJ						
7)	14531210	CAD/CAM LAB	PJ	0	0	3	50	50	2
		TOTAL		18	6	3	290	410	26

I I YEAR (III & IV SEMESTERS)

S.No		SUBJECTS		IM	EM	CR
1)	**14532101**	**SEMINAR (III SEMESTER)**	PJ	**100**		**2**
2)	**14532201**	**PROJECT WORK**	PJ	**50**	**50**	**16**
		TOTAL		150	50	**18**

Legend :SC-Subject Category; L-Lecture Periods/weeks; T-Tutorial Periods/week; P-lab/Drawing Periods per week; IM –Internal Assessment Marks ;EM-End Exam Marks; CR-Credits

Term-Wise summary of Marks and Credits

Term	IM	EM	CR
First year-First semester	**290**	**410**	**26**
First year-Second semester	**290**	**410**	**26**
Second year-Third &Fourth	**100**		**2**
semesters	**50**	**50**	**16**
Total	**730**	**870**	**70**
	1600		

Composition of Curriculum

Subject category	TS	TC	%CR
Basic sciences	1	4	5.7
Professional major	15	66	94.3
	16	70	100

Legend: TS-Total subjects (including Audit subjects); TC- Total credits; %C-Percentage credits

	LIST OF ELECTIVES						
Subject	**Subject code**	**L**	**T**	**P**	**IM**	**EM**	**CR**
QUALITY ENGINEERING AND MANUFACTURING	**14531106**	**3**	**1**	**0**	**40**	**60**	**4**
COMPUTER AIDED PROCESS PLANNING	**14531107**	**3**	**1**	**0**	**40**	**60**	**4**
DESIGN FOR MANUFACTURING	**14531108**	**3**	**1**	**0**	**40**	**60**	**4**
CONCURRENT ENGINEERING	**14531109**	**3**	**1**	**0**	**40**	**60**	**4**
RAPID PROTOTYPING	**14531206**	**3**	**1**	**0**	**40**	**60**	**4**
ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS	**14531207**	**3**	**1**	**0**	**40**	**60**	**4**
MECHANICS AND MANUFACTURING METHODS OF COMPOSITES	**14531208**	**3**	**1**	**0**	**40**	**60**	**4**
AUTOMATION IN MANUFACTURING	**14531209**	**3**	**1**	**0**	**40**	**60**	**4**

(14211101) COMPUTATIONAL METHODS

Th	C
4	4

Course Objectives

1) To solve a given system of linear equations by using various methods like Gaussidal method and relaxation method
2) To find Eigen valves and Eigen vectors of a matrix using power method and Jacobi's method
3) Derive quadrature formula for a function whose values are given at certain points by choosing Newton's interpolation function for the function
4) Calculate the remainder terms in the quadrature formulae like trapezoidal rule, Simpson's rule, and Romberg's method and Gaussian quadrature
5) Approximate functions that fit with the given data by least squares technique through a first and second degree polynomial
6) Solve Laplace equations using Gauss seidel method
7) Solve one dimensional heat equation using Crank –Nicoleson method
8) Solve wave equation by finite difference method

UNIT-I

Introduction to numerical methods Applied to Engineering Problems: Solving set of equations-calculation of inverse of a matrix usinhg crout's method. Iterative methods- Gauss-Seidel iteration method-Relaxation method.Eigen values and eigen Vectors of a matrix-Power method- Jacobi's method

UNIT-II

Numerical Integration: Newton- cote's quadrature formulae-Trapezoidal rule- Simpson's Rules-Romberg's method- Gaussian Quadrature formulae-Numerical Evaluation of Double integrals.

UNIT-III

Curve Fitting and Boundary Value problems: Method of Least squares fitting a straight line a second degree parabola, an exponential curve-Boundary valve problems-finite difference method-Rayliegh- Ritz method-Galerkin's method

UNIT-IV

Numerical Solutions Of Partial Differential Equations: Classification of partial differential equations of second order- Finite difference approximation to derivatives- Solution of Laplace equation using Guass seidel method- Solution of Poisson equation

UNIT-V

Parabolic and hyperbolic partial differential equations:

Solution of one dimensional heat equation using crank-Nicoleson method- Solution of wave equation by finite difference method

TEXT BOOKS:

1. Introductory Methods of Numerical Analysis, SS Sastry, PHI
2. Numerical methods for Engineers, Steven C,Chapra, Raymond P.canale,Tata Mc-Graw Hill.
3. Numerical methods in Engineering and science B.S Grewal ,Khanna Publishers.

REFERENECS

1. Aplied Numerical Analysis, Curtis F.Gerald, Partick .o. Wheatly,Addison-wesley,1989
2. Numerical Methods, Douglas j.Faires, Riched Burden, Brooks/ cole publishing company, 1998. Second edition.
3. Numerical methods,s arumugam A.Thangapandi issac, A somasundaram SCITECH publishers.

(14531102) FINITE ELEMENT METHODS

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Course objectives:

The objectives of this course is to teach the fundamentals of Finite Element Methods with emphasis on the underlying theory, assumptions and modeling issues, revision of matrix algebra, introduction to formulating system equations for structural problems, concept of shape functions, properties and usage of linear, quadratic and cubic shape functions. The students will learn the fundamentals of Finite Element Methods including discrete system analysis, steady state and transient heat transfer analysis, static and dynamic analysis of structures of various elements. The student will learn the iso parametric and axi-symmetric formulations and numerical integrations

UNIT – I

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

UNIT – II

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, Assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection Problems. Examples: one dimensional fin,

UNIT – III

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, and temperature effects.

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT – IV

Two dimensional problems: CST, LST, four noded and eight noded rectangular elements, Lagrange basis for triangles and rectangles.

Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions.

Heat Transfer problems: Conduction and convection, examples: two-dimensional fin.

UNIT – V

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration. Finite elements in Structural Dynamics: Dynamic equations, Eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement, Pascal's triangle.

TEXT BOOK:

1. Finite element methods by Chandraputla & Belagondu.
2. Finite element Analysis by Daryl.L.Logan
3. Finite Element Analysis by S.S.Rao

REFERENCES:

1. Finite element method in Heat transfer and fluid dynamics, . J.N.Reddy, CRC press,1994
2. Finite Element Method, Zienckiwicz O.C. & R. L. Taylor,McGraw-Hill,1983.
3. Finite Element of Nonlinear continua, . J. N. Oden, McGraw-Hill, New York, 1971
4. Finite element procedures, . K. J. Bathe, Prentice-Hall, 1996

(14531103) COMPUTER INTEGRATED MANUFACTURING

Th	C
4	4

Course objectives:

1. To understand the role of computer in manufacturing
2. To introduce hardware and software components for soft automation.
3. To conduct on automatic data capture systems
4. To provide an in depth understanding of control of manufacturing, automated material handling, storage and retrieval systems
5. To introduce group technology and concurrent engineering and develop skill in the developing automated process plans using variant and generative approaches
6. To take up case studies on FMS and CIM systems

Unit – I

Introduction: Fundamental concepts in Manufacturing and Automation, Automation Strategies, Economic analysis in production, Fundamentals of CAD / CAM, Product cycle and CAD/CAM

Numerical control machines: Introduction, basic components of an NC system, the NC procedure, NC coordinate system, NC motion control system, application of numerical control and Economics of Numerical control.

Unit – II

NC part programming: Introduction, the Punch tape in NC, Tape code format, Manual part programming. NC programming with manual data input.

Computer controls in NC: NC controller's technology, Computer Numerical Control (CNC) and Direct Numerical control (DNC).

Unit – III

Group Technology: Part families, Parts classification and coding, Production flow analysis, Composite part concept, Machine cell design and Benefits of GT.

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

Unit – IV

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 – V

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

M.Tech. I Semester (CAD/CAM)

(14531104) GEOMETRIC MODELING

Th	C
4	4

Course Objective:
The students will learn principles and practices used in the creation of 3D models; mathematical principles of geometric modeling; theory and application of modeling techniques, study representation schemes for curves, surfaces, solids, and other spatial data and the impact of representation on graphics algorithms. Topics include spline curves and surfaces, quadric surfaces, and how to design, program and analyze algorithms and systems for interactive 3D shape modeling.

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

Unit – III
Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.
B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.

Unit – IV
Surfaces: Bicubic surfaces, Coon’ s surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.

Unit – V
Solids: Tricubic solid, Algebraic and geometric form.
Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

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 Publisher

(14531105) ADVANCES IN MANUFACTURING TECHNOLOGY

Th	C
4	4

Course objective:

To develop the ability to understand the advanced manufacturing techniques evolved in manufacturing scenario.
To study the Advanced techniques in Welding processes
To study the Surface processing operations
To study the Different types of unconventional Machining Methods
To study about Rapid prototyping and Nano Technology

Unit - I

Welding Processes: Fusion and Solid state welding process, Automation in Welding, Design aspects of welds, 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, applications and limitations, recent developments. Ultrasonic machining: Elements of the process, machining parameters, applications and limitations.

Un-conventional Machining Methods-II:

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.

Unit - IV

Un-conventional Machining Methods-III: Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages and 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 - V

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

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).

M.Tech. I Semester (CAD/CAM)

Elective- I

(14531106) QUALITY ENGINEERING AND MANUFACTURING

Th	C
4	4

Course Objectives

To explain basic quality concepts of Quality engineering and manufacturing, its tools and techniques used in engineering.

To familiarize:

1. Various theories about quality engineering and manufacturing
2. Planning and manufacturing for quality, its tools and techniques
3. Supporting tools and techniques for TQM
4. Design of Experiments for quality
5. Failure patterns and preventive maintenance

UNIT-I

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design 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, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT-III

Design of Experiments: Introduction, Task aids and Responsibilities 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-IV

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

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

UNIT-V

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 HillIntl. Edition, 1989.
2. Taguchi methods explained: Practical steps to Robust Design,Papan P.Bagchi,Prentice Hall Ind. Pvt. Ltd., New Delhi

M.Tech. I Semester (CAD/CAM)

Elective-I

(14531107) COMPUTER AIDED PROCESS PLANNING

Th	C
4	4

Course objectives:

The objective of this subject is

1. To understand the concept of process planning and various methods of process planning using computer
2. To understand the geometric model of the component in CAD technology of computer graphics in order to describe part features for process planning.
3. To understand the Steps involved in variant type computer aided process planning and generative type computer aided process planning.
4. Understanding the concept of Group technology to implement variant type computer aided process planning.
5. To understand the principle of NC, CNC, Machining Centre and various methods of part programming.

Unit I

Introduction to process planning, Information required for process planning system, Steps in process planning, Route sheet, Manual approach, Computer aided process planning: Retrieval CAPP system, Generative CAPP system, Hybrid approach, CAPP applications, Facts about CAPP technology, Criteria for selecting a CAPP system, Benefits of CAPP and Limitations of CAPP

Unit II:

Introduction to group technology, Benefits of group technology, Part family, Methods of grouping the parts into part family: The visual inspection method, Part classification and coding system, MICLASS classification and coding system, Opitz classification system, Production flow analysis , Composite part, Limitations of group technology, Application of group technology in CAPP, Retrieval CAPP system: Principle, Structure of Retrieval CAPP system, Advantages ,Disadvantages, Applications and MIPLAN system

Unit – III

Generative CAPP system: Principle of Generative CAPP system, Essential elements in a generative CAPP system, Implementation of generative CAPP systems, Advantages, Disadvantages and Applications

Selection of manufacturing sequence: Identifying machinable volumes or pockets required in machining process, Setup planning, Attaching pockets to setups, Determining holding method, Alternative sequences, Quantitative methods for optimal selection and Computer method for sequencing operations for assembly lines

Unit –IV

Factors affecting selection of manufacturing process, Manufacturing possesses for metals, Machining process, Cutting parameters, Different approaches for solving speed/feed selection problem, Elements of cost in manufacturing operation, Optimization model to predict the optimum speed, Breakeven analysis in selection of process.

Computerized packages for layout analysis: Travel charts, Relationship charts, computerized relative allocation of facility technique, automated layout design program and computerized relationship layout planning,

Unit –V

Determination of manufacturing tolerances: Design tolerances, Manufacturing tolerances, Need of tolerances in design and manufacturing, Tolerance allocation ,Tolerance analysis models for assemblies: Worst case, Statistical, Tolerance allocation methods: Allocation by proportional scaling, Allocation by constant precision factor, Tolerance allocation using optimization techniques, Automatic tolerance analysis, Advantages of integrated approach over sequential approach

Simulation in manufacturing or machining, Advantages of simulation, Types of simulation, Techniques of simulation: Simulation using general purpose languages, Simulation languages, High-level simulators, Simulation software packages, Steps in simulating a machining process using software, NC tool path generation

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

M.Tech. I Semester (CAD/CAM)

Elective-I

(14531108) DESIGN FOR MANUFACTURING

Th	C
4	4

Course Objectives

To enable the students to understand the Design for manufacture and assembly

To familiarize

1. DFM approach and Processes
2. Selective assembly& Thermal stress in weld joints
3. Metal casting joining
4. Form design of castings and Extrusion & sheet metal work

UNIT – I

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

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

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 and 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 and product design rules for sand casting.

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 and design of brazed joints.

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

UNIT – V

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

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,

REFERENCES:
1. ASM Hand book Vol.20

M.Tech I Semester (CAD/CAM)

Elective-I

(14531109) CONCURRENT ENGINEERING

Th	C
4	4

Course objectives
1. To study the principles of concurrent engineering and its implementation
2. To familiarize with the basics of concurrent engineering
2. To study the tools and methodologies available in CE
3. To study various approaches to CE
4. To study the other related aspects of CE

UNIT I
Introduction to Concurrent Engineering, Definitions, Historical Background, Goals of CE, Need for CE, Development process with CE Role of CAD/CAM in CE and Product life cycle

UNIT II
Concurrent Engineering Tools & Techniques, Quality function Deployment, Value function analysis, Failure Mode & Effect Analysis, Design for Manufacture & Assembly, Design for X , Taguchi's Robust Design approach ,Pugh process , customer Focused Design , rapid prototyping and simulation.

UNIT III
Implementing CE in an organization, concurrent engineering teams, their roles and responsibilities, Organizational functions to support CE team environment, Setting Team goals, measuring performance of team & managing a CE Team, Limitations of team

UNIT IV
Design for manufacture & Assembly, Design for economics, Design for X, Product Data Management, Agile manufacturing and rapid prototyping& simulation.

UNIT V
Introduction JIT, Design, development & management for JIT , Implementation of JIT, supply product Life cycle management, Project time management , Techniques of time management and Collaborative product commerce simple case studies in CE

TEXT BOOKS

1. Thomas A. “Concurrent Engineering”, Salomone, Maarcel Dekker Inc.New York, 1995.
2. Moustapha .I “Concurrent Engineering in product Design Development” New Age International (p) Ltd., 2003.

REFERENCES

1. Prasad, “Concurrent Engineering fundamentals - Integrated Product Development”, Prentice Hall, 1996.
2. Sammy G. Sinha, “Successful implementation of concurrent product & process”, Wiley, John &Sons, Inc., 1998.
3. Anderson M.M. & Hein L. Berlin, “Integrated Product Development”, Springer Verlog, 1987.

M.Tech. I Semester (CAD/CAM)

(14531110) MODELLING AND CNC LAB

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3	2

Course Objectives:

1. To Under how to use C Language for creating various curves and surfaces used for design
2. To understand the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem
3. To have better knowledge in finite element analysis software, applied to structural and heat transfer components at various loading conditions.

A MODELLING:

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. Typical tasks of Modeling using PRO/E, IDEAS, CATIA solid modeling packages
   Surface modeling
   Solid Modeling
   Drafting and Assembly

B ANALYSIS:

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

- I. Static Analysis
- II. Modal Analysis
- III. Thermal Analysis
- IV. Transient analysis

M.Tech. II Semester (CAD/CAM)

(14531201) ADVANCED OPTIMIZATION TECHNIQUES

Th	C
4	4

Course Objectives:

To understand and apply operation research techniques to design and production problems

To understand concept of linear programming techniques and obtaining optimal solution using various linear programming techniques

To understand Assignment Problem in order to solve process planning problem

To understand various non linear programming techniques to solve nonlinear programming problems with constrains and without constraints

To learn search techniques to solve nonlinear programming problems with constrains and without constraints.

To understand genetic algorithm in order to solve nonlinear programming and travelling salesman problem

To learn genetic programming in order to generate programs

Applying above techniques to solve design and manufacturing problems

UNIT - I

Linear programming: Two-phase simplex method, Big-M method, Duality, Applications of linear programming to design and manufacturing.

Assignment problem: Hungarian algorithm, Degeneracy, Applications, Unbalanced problems, Traveling salesman problem.

UNIT – II

Non linear programming: Non linear programming formulation, Cases of nonlinear programming problem, Extreme points, Single variable and multi variable optimization without constraints, Nonlinear programming with constraints: Graphical solution, Lagrange multiplier method and Kuhn-Tucker conditions

Search methods: Limitations of classical optimization techniques, Interval of uncertainty, Search methodology for unconstrained non linear programming problem: Fibonacci sequence, Powell's quadratic interpolation method, Multi dimensional search method without constraints: Univariate method, Steepest descent algorithm, Newton Raphson method

UNIT – III

Integer linear programming: Definition, Integer linear programming techniques, Branch and Bound algorithm for obtaining optimal solution and Gomory cutting plane algorithm

UNIT - IV

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, Working principle, Reproduction, Crossover, mutation, Termination criteria, , Application of genetic algorithm for solving unconstrained nonlinear programming problem and Traveling salesman problem, Draw backs 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.

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, Minimization of weight of a cantilever beam, 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. Operations research,K.Rajagopal,PHI
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

M.Tech. II Semester (CAD/CAM)

(14531202) ROBOTICS

Th	C
4	4

Purpose: To provide knowledge of sensors used in Robotics
Learning Objectives: To make the student to understand
1. The basics and the latest technology of sensors used in robotics.
2. The different sensing variables
3. Robot vision system
4. Robot programming

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.

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.

Unit – II

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

Unit – III

Differential motions and Velocities:

Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame, Differential

changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

Unit – IV

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

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

Unit -- V

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

Robot sensors: Introduction, sensor characteristics, Position sensors-potentiometers, encoders, LVDT, Resolvers, time of travel displacement sensor, Velocity sensors-Encoders, Tachometers, differentiation of position signal.

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

(14531203) COMPUTER GRAPHICS

Th	C
4	4

Course Objective:

The students will learn principles and practices used in the creation of 3D models; mathematical principles of geometric modeling; theory and application of modeling techniques, Study representation schemes for curves, surfaces, solids, and other spatial data and the impact of representation on graphics algorithms. Topics include spline curves and surfaces, quadric surfaces, and how to design, program and analyze algorithms and systems for interactive 3D shape modeling.

Unit - I

Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.
Raster scan graphics: Line drawing algorithms – DDA & Bresenham's algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.
Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm.

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
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 - IV

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

Unit - V

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

Text Books:

1. Mathematical Elements for computer graphics, David. Rodgers, TMH
2. Computer Graphics C version, Donald Hearn and M.Pauline Baker,Pearson/PHI
3. Computer Graphics Principles & Practice, C.Foley, Vndom, Fener, Hughes,2/e, Pearson Publications.

REFERENCES:
1. CAD/CAM Theory, Ibrahim Zeid, TMH

2. Computer Graphics second edition, Zhigand xiang, Roy Plastock, Schaum'soutlines, TMH.
3. Computer Graphics, Steven Harrington, TMH
4. Principles of computer Graphics, Shalini Govil, PHI, 2005, Springer.
5. Computer Graphics and Automation, M.C. Trivedi, Jaico Pub./ Pearson Education

M.Tech II Semester (CAD/CAM)

(14531204) CNC TECHNOLOGY & PROGRAMMING

Th	C
4	4

Course Objective

To provide knowledge on principle, constructional features, programming, tooling and work holding devices in CNC machine tools

Upon completion of this subject, student will be able to:

1. Understand of CNC machine tools and machining centres
2. Describe constructional features of CNC machine tools
3. Explain drives and tooling systems used in CNC machine tools
4. Understand feedback and adaptive control of CNC machines
5. Write simple programs for CNC turning and machining centres
6.To understand economics and maintenance of CNC machine Tools

Unit – I Introduction to CNC Machine tools: Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.
Constructional features of CNC machine tools: Introduction, Spindle drives, Transmission belting, axes feed drives, Slide ways, Ball screws.

Unit – II Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).
Feedback devices: Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.

Unit –III Electro-magnetic analogue position transducers: Principle, advantages, characterstics, Synchros, Synchro-Resolvers, Inductos, Laser interferometer.
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 – IV 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 – V 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

M.Tech. II Semester (CAD/CAM)

(14531205) MECHATRONICS

Th	C
4	4

Course Objectives

To study about various, sensors, transducers, microprocessors and

1. To study the Actuators and drive systems, used in mechanical engineering
2. To study how motion controls can be used to do simple applications in mechanical engineering
3. To study about Architecture of intelligent machines and sensors its applications

Unit – I Introduction: Definition of Mechatronic products, design considerations and tradeoffs, Overview of Mechtronic products. Intelligent machine Vs Automatic machine economic and social justification, **Actuators and drive systems:** Mechanical, Electrical, hydraulic drive systems, Characteristics of mechanical, Electrical, Hydraulic and pneumatic actuators and their limitations.

Unit – II Motion Control: Control parameters and system objectives, Mechanical Configurations, Motion Control algorithms: Significance of feed forward control loops, shortfalls, fundamentals concepts of adaptive and fuzzy – control. Fuzzy logic compensatory control of transformation and deformation non- linearity‟s

Unit –III Architecture of intelligent machines: Introduction to Microprocessor and programmable logic controls and identification of systems. System design classification, motion control aspects in design, **Manufacturing data bases:** Data base management system, CAD/CAM data bases, graphic data base, introduction to object oriented concepts, objects oriented model language interface.

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

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

Text books:

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

Elective-II

(14531206) RAPID PROTOTYPING

Th	C
4	4

Course Objectives

1. To study the basics of RPT
2. To study the various process in RP
3. To study the principles of Rapid tooling and reverse engineering
4. To study the Rapid tooling-Direct ,Indirect soft & Hard tooling

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.

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

Unit IV

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

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

Unit –V

Rapid Tooling: Direct soft tooling- selective laser sintering of sand casting molds, Direct ACES injection molding, SL composite tooling, Indirect soft tooling-Arc spray metal tooling, silicone rubber molds, spin casting with vulcanized rubber molds, Castable resin molds, Castable ceramic molds, Plaster molds ,casting, Direct Hard tooling-Rapid tool, laminated metal tooling, Direct metal laser sintering tooling, Pro metal rapid tooling, Indirect Hard tooling- 3D keltool, EDM Eletrodes ,Eco tool, copy milling

Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc.Internet based software, Collaboration tools. **Rapid Manufacturing Process Optimization:** Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

TEXT BOOKS:

1. " stereo lithography and other RP & M Technologies**"**, Paul F.Jacobs, SME, NY 1996
2. " Rapid Manufacturing **",** Flham D.T & Dinjoy S.S, Verlog London 2001
3. "Rapid automated**"**, Lament wood, Indus Press New York.
4."Rapid Prototyping- Principles & Applications"-Third Edition ,world scientific publishing co pte Ltd

M.Tech. II Semester (CAD/CAM)

Elective-II

(14531207) ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

Th	C
4	4

Course Objectives

The course objectives include:

- To develop informed opinions about the present and past opinion leaders in the artificial intelligence debate.
- To develop a simple, informal expert system by performing an effort of knowledge engineering of a real, human expert.
- To develop a series of Web pages that will serve as a current "state of the art" review of the various AI application areas, areas which may be suggested by the instructor or brought to the course by participants.
- To experience some actual hands-on demonstration software while accomplishing the review of current applications areas in AI. Examples of such areas might include natural language processing (NLP), genetic algorithms or artificial life environments , neural nets or massively parallel computing environments, data mining, fuzzy logic, machine vision or speech, robotics, intelligent tutoring systems, etc.

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, Bestfirst 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.

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-IV

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

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-V

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

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

TEXT BOOKS

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

Elective-II
MECHANICS AND MANUFACTURING METHODS OF COMPOSITES
(14531208)

Th	C
4	4

Course objectives

To understand the variety of composite materials (anisotropic material) vis a vis metals and alloys from the view point of industrial applications.
To understand manufacturing methods of composites for economic production
To understand methods of analysis to help effective product design

Unit – I

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

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron 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

Unit – III

Coordinate transformations: Hooke‟s law for different types of materials, Hooke‟s law for twodimensional 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 – IV

Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship 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-V

Analysis of laminated composite plates

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

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

Text Books:

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

REFERENCES:

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

ELECTIVE-II

(14531209) AUTOMATION IN MANUFACTURING

Th	C
4	4

Course objective

To emphasize the knowledge on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively, and in synchronization with the marketing, sales, and customer service of the company.

UNIT – I

Over View Of Manufacturing And Automation: Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers

UNIT – II:

Material Handling And Identification Technologies: Material handling, equipment, Analysis. Storage systems, performance and location strategies, automated storage systems, AS/RS, types, Automatic identification methods, Barcode technology, RFID

UNIT – III:

Manufacturing Systems And Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells; Manual Assembly lines, line balancing Algorithms, Mixed model Assembly lines, Alternative Assembly systems. Automated production lines, Applications, Analysis of transfer lines

UNIT – IV:

Automated Assembly Systems: Fundamentals, Analysis of Assembly systems, Cellular manufacturing, part families, cooling, and production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis

UNIT – V:

Quality Control and Support Systems: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

TEXT BOOKS:

1. Automation, production systems and computer integrated manufacturing/ Mikell.P Groover/PHI/3rd edition/2012,.
2. Automation, Production Systems and CIM/ Mike J P. Grower/PHI

REFERENCES:

1. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers/2003.
2. Svstem Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley /96.
3. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009

4. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good Heart/

M.Tech. II Semester (CAD/CAM)

(14531210) CAD/CAM LAB

L	C
3	2

Course Objectives:

1. To impart hands on training on CNC Machine tools
2. To acquire practical knowledge through intensive practice on CNC Machines & related software
3. To develop part programs for various components.

PART A

Practice in part programming and operating of a machining centre tool planning and selection of sequences of operations.
Tool setting on a machine
Practice in APT based NC programming.

PART B

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: PRO/E, I-DEAS, Uni-graphics, Iron CAD, Edge-CAM etc.

PART C

Practice in Robot programming and its languages.
Robot simulation using software
Robot path control
Simulation of manufacturing system using CAM software, controller operating system commands