COURSE STRUCTURE
AND
DETAILED SYLLABUS

for

M.Tech course

in

CAD / CAM

(MECHANICAL ENGINEERING)

(with effect from the Academic year 2012-2013)

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
(An Autonomous Institution approved by UGC and affiliated to JNTUH)
Yamnampet, Ghatkesar, R.R.District-501 301.

M.Tech. (CAD/CAM)
Course Structure and Syllabus
For the Academic Year: 2012-2013

I Year – I Semester:

Code	Subject	L	T	P	Credits	Internal marks	External marks
122CC01	Advanced CAD	3	1	--	3	40	60
122CC02	Advanced Finite Element Analysis	3	1	--	3	40	60
122CC03	CNC Machines & Robotics	3	1	--	3	40	60
122CC04	Advanced Mechanics of Solids	3	1	--	3	40	60
	Professional Elective – I	3	1	--	3	40	60
	Professional Elective – II	3	1	--	3	40	60
122CC71	Advanced CAD & CAM Lab	--	--	6	3	40	60
122CC72	Technical Paper writing & Seminar	--	--	3	2	50	--
	Total Credits	**18**	**6**	**9**	**23**	**330**	**420**

L - Lectures; T = Tutorial; P = Practical; C = Credits

Code	Professional Elective – I	Code	Professional Elective – II
122CC05	Process Design and Product Development	**122CC09**	Manufacturing Methods & Mechanics of Composites
122CC06	Design of Press Tools	**122CC10**	Design of Dies and Moulds
122CC07	Mechatronics	**122MB57**	Total Quality Management
122CC08	Synthesis of Mechanisms and Linkage Design	**122CC12**	Precision Engineering

I Year – II Semester:

Code	Subject	L	T	P	Credits	Internal marks	External marks
122CC13	Automation in Manufacturing	3	1	--	3	40	60
122CC14	Flexible Manufacturing Systems & CAPP	3	1	--	3	40	60
122CC15	Optimum Design of Mechanical Elements	3	1	--	3	40	60
122CC16	Design for Manufacturing & Assembly	3	1	--	3	40	60
	Professional Elective – III	3	1	--	3	40	60
	Open Elective	3	1	--	3	40	60
122CC73	Computer Aided Analysis and Robotics Lab	--	--	6	3	40	60
122CC74	Technical Seminar (Independent review Paper)	--	--	3	2	50	--
	Total Credits	**18**	**6**	**9**	**23**	**330**	**420**

L - Lectures; T = Tutorial; P = Practical; C = Credits

Code	Professional Elective – III	Code	Open Elective
122CC17	Rapid Prototyping, Tooling & Manufacture	**122MB47**	Entrepreneurship and Innovation
122CC18	Computational Fluid Dynamics	**122MB56**	Banking operations, Insurance & Risk Management
122CC19	Mechanical Vibrations & Condition Monitoring	**122BT37**	Culture, Values, Professional Ethics & Intellectual Property Rights
122CC20	Production and operation Management	**122IT03**	Data Base Management Systems

II Year - I Semester:

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
122CC75	Comprehensive Viva	--	--	--	2	50	--
122CC76	Project Seminar-I	--	--	--	2	50	--
122CC77	Project work (Part – I) (Project Status Report)	--	--	--	18	Grading	--
Total Credits		**--**	**--**	**--**	**22**	**100**	

Grading: Excellent, Good, Satisfactory, Unsatisfactory

II Year - II Semester:

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
122CC78	Project Seminar-II	--	--	--	2	50	--
122CC 79	Project work and Dissertation	--	--	--	20	--	Grading
Total Credits		**--**	**--**	**--**	**22**	**50**	**--**

Grading: Excellent, Good, Satisfactory, Unsatisfactory

L - Lectures; T = Tutorial; P = Practical; C = Credits

M.Tech. (CAD/CAM) I Year – I Sem.
122CC01 - ADVANCED CAD

L	T	P	C
3	1	-	**3**

Unit – I: **CAD Tools**:

Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

Geometric modeling:

Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves, hermite cubic splines, Bezier curves, B-splines rational curves

Unit – II: **Surface Modeling**:

Mathematical representation of surfaces, Surface model, Surface entities surface representation, parametric representation of surfaces, plane surface, ruled surface, surface of revolution, Tabulated Cylinder.

Unit – III: **Parametric Representation of Synthetic Surfaces**

Hermite Bi cubic surface, **Bezier** surface, **B**- Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

Unit – IV: **Geometric modelling-3D**

Solid modeling, Solid Representation, Boundary Representation (l3-rep), Constructive Solid Geometry (CSG). CAD/CAM Exchange: Evaluation of data-exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

Unit – V : Collaborative Engineering

Collaborative Design Approaches in Design and Development, Collaborative environment, Integrated product development, Collaborative Design, Collaborative Design Principles, Changing design approaches , Collaborative design Tools, Design Systems, A web based virtual reality for collaborative product review and customization.

Unit – VI: **Product Life Cycle Management through CAD**

Introduction – the path to PLM, PLM life cycle model, the threads of PLM (CAD, EDM, PDM, CIM), weaving threads in to PLM, Characteristics of PLM, PLM elements, developing PLM strategy.

Students will be given Engineering Component and student has to design the components and produce its drawing and present it as assignment.

TEXT BOOK:

1. CAD/CAM Theory and Practice / Ibrahim Zeid / Mc Graw Hill international.
2. Computer aided design and manufacturing –Lalit Narayana/Mallikarjun Rao

REFERENCE BOOKS:

1. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw lull international.
2. CAD/CAM / P.N.Rao / TMH.

M.Tech. (CAD/CAM) I Year – I Sem.

122CC02 –ADVANCED FINITE ELEMENT ANALYSIS

L	T	P	C
3	1	-	3

Unit – I: Solutions of Finite Element Equations:

Introduction, Solution of Equilibrium Problems (boundary values problems), Guass elimination and Choleski methods, Solutions of Eigen value problems, Jacobi and power methods, Solution of propagation problems(initial value problems),Runga-Kutta method and finite difference method

Unit – II: **Analysis of Space truss and frame Elements:**

Introduction to truss and beam elements, Element formulation of space truss element and frame element, characteristics of stiffness matrices.

Unit – III : A**nalysis of structural plates:**

Introduction, Triangular membrane element, rectangular plate element, FEA of plates in bending, Analysis of triangular and rectangular plates bending.

Unit – IV : **Analysis of free and forced undamped vibrations:**

FE formulations of equation of motion, Natural frequencies and mode shapes of uniform stepped bars, beams and planer trusses, othogonilisation of modes, Dynamic response (forced vibration analysis) of stepped axial bar and beam.

Unit – V: Analysis of unsteady state Heat Transfer Problems:

Introduction to differential equations to unsteady state heat transfer problems, FE formulation, Time dependant temperature distribution in 1D fins and plane walls. Heat transfer problems with radiation.

Unit – VI: Analysis of Inviscid and incompressible flows:

Introduction to partial differential equations to steady state fluid flow, Potential function formulation, Stream function formulation, Finite element solutions, Numericals on 1D flow.

TEXT BOOKS:

1. "The Finite Element Methods in Engineering", S.S. Rao, Butterworth-Heinemann, 4th Edition-2004.

2. Finite and Boundary Element methods in Engineering:O.P.Gupta,Oxford &IBH Publishing Co.Pvt.Ltd.

3. "Introduction to Finite Elements in Engineering", Tirupathi R.Chandrupatla and Ashok D. Belagundu, Pearson Education (Singapore) Pte Ltd, 2006.

REFERENCE BOOKS:

1. "Concepts and Applications of Finite Element Analysis", Robert Cook, Wiley India, Pvt., Ltd., 4th Edition-2007

2. "An Introduction to Finite Element Methods", J.N. Reddy, Tata Mc Graw Hill, 2008.
3. "First Course in the Finite Element Method", Platteville Daryl Logan &Daryl Logan, Nelson Engineering, 2007.

4. "Finite Element Procedures", K.J. Bathe, PHI Learning, 2009.

M.Tech.(CAD/CAM) I Year – I Sem.
122CC03 - CNC MACHINES AND ROBOTICS

L	T	P	C
3	1	**-**	**3**

Unit – I : **Features of NC Machines:**

Fundamentals of numerical control, advantages of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems; Features of N/C Machine Tools, Design consideration of NC machine tool, Methods of improving machine accuracy, Concept of Machining Centers.

Unit – II : **NC Part Programming :**

Manual programming-basic concepts, tape specifications and tape formats, functions controlled by NC (G&M codes, speed, feed tool change etc.), point to point and contour programming, canned cycles, parametric programming.

Computer-aided programming:

General information, APT programming, examples of APT programming, (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors, introduction of STEP NC.

Unit – III : **System drives and devices:**

Hydraulic motors, DC motors, stepping motors and AC motors, feedback devices, encoders, resolvers, the inductosyns, tachometers, linear motors and integrated spindle motors.

Interpolators:

DDA integrator, hardware interpolators, for linear and circular interpolation, DDA software interpolators and CNC software interpolators, the reference pulse technique, sampled data technique.

Unit – IV : **DNC systems and adaptive control:**

Introduction, Type of DNC systems, Advantages and disadvantages of DNC, adaptive control with optimization, adaptive control with constraints, adaptive control of machining processes like turning, grinding, etc.

Unit – V: **Robotics**:

Classification and structure of Robotic systems, structure of continuous path robot systems, drives and control systems, control approaches for robots.

Unit – VI:

Robot arm kinematics, the direct kinematics problem and inverse kinematic solutions, planning of manipulator trajectories, robot sensors, range sensors, proximity sensors, touch sensors, force and torque sensors, programming, manual teaching, lead through teaching, programming languages, storing and operating task programmes, robot selection and application.

TEXT BOOKS:

1. Yoram Koren, 'Computer control of manufacturing systems' Mcgraw Hill intl, (1983).

2. C.S.P. Rao, 'CAD/CAM, Hi-Tech publishers, Hyd, 2004

3. Mittal and Nagrath, 'Robotics and Control', Tata Mc Graw Hill.

REFERENCE BOOKS:

1. James .V.Valentino and Joseph Goldenberg, ' Introduction to Computer Numerical control' Prentice Hall, Englewood cliff, New Jersey

2. David Gibbs and Thomes Crandall 'CNC Machining and Programming- an introduction' Industrial press Inc., 2003

3. R.D.Klafter, T.A., Chnielewski and Michael Negin, 'Robotic Engineering – An integrated approach – Prentice Hall, New Delhi, 1994

M.Tech. (CAD/CAM) I Year – I Sem.
122CC04 - ADVANCED MECHANICS OF SOLIDS

L	T	P	C
3	1	**-**	**3**

Unit – I: **Energy Methods**: Hooke's law and the Principle of Superposition, Work done by forces and the elastic strain energy stored, Reciprocal relation, generalized forces and displacements, Castigliano's first theorem, fictitious load method, Theorem of Virtual work, Castigliano's second theorem. Case studies of statically determinate and indeterminate structures, closed ring subjected to concentrated and uniform loads, stresses in chain links.

Unit – II: **Shear Centre**: Bending axis and shear center; shear center for axi-symmetric and unsymmetrical sections. Unsymmetrical bending: Bending stresses in beams subjected to unsymmetrical bending; deflection of straight beams due to unsymmetrical bending.

Unit – III: **Curved bean theory**: Winkler Bach formula for circumferential stress, limitations, correction factors; Radial stresses in curved beams

Unit – IV: **Torsion**: Torsion of a cylindrical bar of circular cross Section; Saint-Venant's semi-inverse method; Linear elastic solution; Prandtl elastic membrane (soap film) analogy; torsion of narrow rectangular cross sections; hollow thin wall torsion members, multiply connected cross sections.

Unit – V: **Elastic Stability of Columns**:
Concept of buckling, columns under one or more axial, concentrated load(s) and with / without eccentricity: Euler's buckling load, Secant and Johnson's formulae; treatment of column buckling stability problem as an Eigen-value problem, related case studies. Energy methods for buckling problems: theorem of stationary potential energy, energy and stability considerations, application to buckling problems, The Rayleigh-Ritz method

Unit – VI: **Introduction to Fracture Mechanics**:
Why structures fail, the fracture mechanics approach to design, effect of material properties on fracture, Linear Elastic Fracture Mechanics (LEFM): stress concentration effect of flaws, the Griffith energy balance, the energy release rate, stress analysis of cracks, plane stress versus plane strain, fracture modes. Elastic—Plastic Fracture Mechanics (EPFM): crack tip opening displacement, Green's theorem, the J-contour integral. Design considerations: K as a failure criterion, J-integral as a fracture criterion

TEXT BOOK:

1. "Advanced Mechanics of Solids", Third Edition, L.S.Srinath, TATA McGraw-Hill
2. "Advanced Mechanics of Materials", Sixth Edition, Arthur P. Boresi, Richard J. Schmidt., Wiley International

REFERENCE BOOKS:

1. "Strength of Materials", Sadhu Singh
2. "Fracture Mechanics: Fundamentals and Applications", Second Edition, T.L.Anderson, CRC Press

M.Tech. (CAD/CAM) I Year – I Sem.

122CC05: PROCESS DESIGN AND PRODUCT DEVELOPMENT
(Professional Elective –I)

L	T	P	C
3	1	-	**3**

Unit-I

Introduction to Product Design, Thoughts for the Reader and Students of Product Design, Product Development Versus Design, Types of Design and Redesign, Customer Satisfaction-Voice of the Customer, Customer Populations, types of Customer Needs, Customer Need Models, Gathering Customer Needs Need Gathering Methods, Organizing and Prioritizing Customer Needs, Grouping Interpreted Needs, Grouping the Needs-Affinity Diagram Method.

Unit-II

Establishing Product Function-Why Functional Decomposition?, Motivation, Function Modeling Basics, Functions and Constraints, Modeling Process.

Unit-III

Generating Concepts, concept generating process, basic methods; Information gathering and Brainstorming, Information Gathering-Conventional Aids, Traditional Brainstorming, Advanced Methods, Directed search, systematic search with physical principles, systematic search with classifying schemes, theory of inventive problem solving, Morphological Analysis-Develop concepts for each product function, combining solution Principles-Digression-function sharing, Product Application fingernail clipper, Concept selection-Introduction, Factors that determine effective decision making, design evaluations, information quality, estimating technical risibility, concept selection process.

Unit-IV

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

Unit-V

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

Unit-VI

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

TEXT BOOKS:

1. Integrated product and process design and development by Edward B.Magrab, Satyandra K.Gupta et al, CRC Press, 2nd Edition.
2. Engineering Design by George E.Dieter, Linda C.Schmidt, McGraw-Hill, Iternational Edition, 4th Edition.

REFERENCE BOOKS:

1. "Product design and development" karl Ulrich & Steven Eppinger (MC Graw Hill Publications)

M.Tech. (CAD/CAM) I Year – I Sem.
122CC06 - DESIGN OF PRESS TOOLS
(Professional Elective –I)

L	T	P	C
3	1	-	**3**

Unit-I: Presses & Press Working:

Classification of Mechanical, Hydraulic, and pneumatic presses Press Characteristics, safety devices in presses. Principles of stretch forming machines, principles of feeding and unloading equipment. Design principles of presses.

Unit-II : Design of Dies:

Introduction, terminology, shearing dies- types of dies - analysis process shearing clearance - size and tolerances of die opening and punch - force, power, energy in shearing -loading center, shearing with inclined edges - strip layouts, economical stock - Utilization.

Unit-III : Theory of Shearing & Various Types of dies:

Theory of shearing ,Dies &Punches Compound dies, progressive dies, stock feeding devices - earn actuated die, horn dies (type, sub-press dies)- precision shearing dies, shaving dies, lamination dies- Bending dies, theory of bending development of blank, spring back, curling, flanging and press brake dies, bending on press brake.

Unit-IV : Split dies and various types of press tool components

Split dies, rules of development for split dies, inserts, types of punches, punch holders, punches - strippers - calculation of springs and rubber ejector, shedders, stops - pilots - stock guides - alignment system design for press tools.

Unit-V :

Theory of drawing, Draw Dies, Various types of draw-dies. Deep drawing dies &shallow drawing dies. Rectangular draw dies. Trimming dies. Defects in deep drawing blank development, strain factor, calculation of force, Ironing (application of rubber and hydraulic system) -

Unit-VI :

Application of CAD/CAM soft-ware in designing of die-casting dies. Plastic moulds and press tools

TEXT BOOKS:

1. *Fundamentals of tool Design*- ASTME, Prentice Hall, New Delhi, 1987
2. Heinrich Makelt, *Mechanical Presses*, Edward Arnold, London, 1968

REFERENCE BOOKS:

1. Geoffrey Rowe W., An *Introduction to the Principles of Metal Working*, Edward Arnold, 1977.
2. Sheet metal working Read & Eary, *Mechanical Processing in Materials*, 1967.
3. *Die design Hand book* - Wilson, Mc Graw Hills, New York, 1965.
4. Eary and Redds, *Shear Working of Metals*, Prentice Hall, New Delhi, 1969.

M.Tech. (CAD/CAM) I Year – I Sem.
122CC07 - MECHATRONICS
(Professional Elective –I)

L	T	P	C
3	1	**-**	**3**

Unit-I:
Introduction: Definition of Mechatronics Measurement systems, Control systems, Microprocessor – based controller, Response of systems, the mechatronics approach, traditional and mechatronics designs, possible mechatronics design solutions, case studies of Mechatronic systems .
Actuators and Motion Control: Pneumatic, Hydraulic, Mechanical and Electrical actuation systems and their limitations, Motor/Load inertia matching. Design with linear slides.

Unit-II:
Dynamic responses of systems: Modeling dynamic systems, first- order systems, second – order systems Performance measures for second – order systems, system identification.
System transfer functions: The transfer function, first – order systems, second – order systems, Systems in series, systems with feedback loops, Effect of pole location on transient response.

Unit-III:
Frequency response: Sinusoidal input, phasors, frequency response, bode plots, performance specifications, and stability**.**
Closed Loop Controllers: Continuous and discrete processes, control modes, two-step mode, proportional mode, derivative control, integral control, PID controller, digital controllers, control system performance, controller tuning, velocity control, adaptive control.

Unit-IV:
Architecture of intelligent Machines: Introduction to Microprocessor and programmable logic controllers and identification of system, System design Classification. Motion control aspects in Design.

UNIT-V:
Sensors: Introduction, position and speed measurement, stress and strain measurement, temperature measurement vibration and acceleration measurement, pressure and flow measurement, semiconductor sensors and Microelectromechanical devices.
Machine Vision: Feature and Pattern Recognition methods, concepts of perception and cognition in decision making.

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.

TEXT BOOK:
1. W. Bolton, "Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering", Pearson Education 3rd Edition.

REFERENCE BOOK:
2. Michel B. Histand and David G. A1ciatore, "Introduction to Mechatronics and Measurement systems", "Tata MC Graw".

M.Tech. (CAD/CAM) I Year – I Sem.
122CC08 –SYNTHESIS OF MECHANISMS AND LINKAGE DESIGN
(Professional Elective –I)

L	T	P	C
3	1	**-**	**3**

Unit-I

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

Unit-II

Advanced Kinematics of plane motion-II : Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation-axis theorem, Carter-Hall circle, The circling-point curve for the Coupler of a four bar mechanism.

Unit-III

Introduction to Synthesis-Graphical Methods-I: The Four bar linkage, Guiding a body through Two distinct positions, Guiding a body through three distinct positions, The Roto center triangle, Guiding a body through Four distinct positions, Burmester's curve.

Unit-IV

Introduction to Synthesis-Graphical Methods-II: Function generaton-General discussion, Function generation: Relative-Roto center method, Overlay method, Function generation-Velocity- pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

Unit-V

Introduction to Synthesis – Analytical Methods: Function; Freudenstien's equation, Precision point approximation, Precision-derivative approximation, Path Generation;

Unit-VI:

Design of Four-bar Linkage: specified instantaneous conditions, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

TEXT BOOKS:

1. Jeremy HIrschhorn, Kinematics and Dynamics of plane mechanisms, Mc Gra-Hill, 1962
2. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, E.W.P. Publishers.

REFERENCE BOOKS:

1. Allen S.Hall Jr., Kinematics and Linkage Design, PHI, 1964.
2. J.E Shigley and J.J. Uicker Jr Theory of machines and mechanisms, Mc Graw-Hill, 1995.
3. Mohsen Shahinpoor, A robot engineering text book, harper & row publishers, New York, 1987.
4. Joseph Duffy, Analysis of mechanisms and Robot manipultors, Edward Arnold, 1980.

M.Tech. (CAD/CAM) I Year – I Sem.
122CC09 - MANUFACTURING METHODS & MECHANICS OF COMPOSITES
(Professional Elective –II)

L	T	P	C
3	1	**-**	**3**

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: Fibers - Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers.

Classification: Polymer matrix, Metal matrix, Ceramic matrix and Carbon composites

Unit – II : Micromechanics of Lamina:

Volume and Mass fraction, density, Evaluation of the four elastic moduli and ultimate strength of unidirectional lamina.

Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man lay-up, Pultrusion RTM.

Unit – III : Machro Mechanical Analysis of a Lamina :

Hooke's law for different types of materials, Hooke's Jaw 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 – IV : Strength Failure Theries of Lamina:

Maximum principal and strain theories, Tsai-Hill failure theory. Hygro -Thermal stresses and strains.

Unit – V: Analysis of laminated composite:

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

Unit – VI: Failure, Analysis and Design of Laminates:

Symmetric laminates, cross-ply laminates, Angle ply laminates, Antisymmetric laminates, balanced laminates, Quasi-static laminates. Failure criterion for a laminate, design of a laminated composite.

TEXT BOOKS:

1. R. M. Jones, Mechanics of Composite Materials, Me Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M.Danie), Oxford University Press, 1994.
3. Autar K.Kaw " Mechanics of composite materials, CRC press, D.C.

REFERENCE BOOKS:

1. D. Agarwal and L. 3. Broutman, Analysis and performance of fiber Composites, Wiley-Interscience. New York, 1980.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

M.Tech. (CAD/CAM) I Year – I Sem.
122CC10 - DESIGN OF DIES & MOULDS
(Professional Elective –II)

L	T	P	C
3	1	-	**3**

Unit – I : Thermo Plastic and Thermo setting Plastics, the dies and their components:

Design principles for dies of thermo-plastic and thermo-setting components. Impression core cavities, strength of cavities, guide pillars and bushes, ejection systems, cooling methods, bolster types. Split moulds, methods of actuating the splits, moulds of threaded components, internal & external under cuts, moulds with under - feed systems. Design principles and standards for Transfer and compression molding dies. Design of Tools: Mould for a spindle component with sleeve, pin ejection. Mould with splits Multicavity mould with stripper plate, inserts, ejectors.

Unit –II : Design of Die casting dies and their Elements:

Design of Dies for metal mould Castings, Die casting and Shell moulding.

Design of casting cavity, sprue, slug, fixed and movable cores, finger cam, core, pin, draft, ejector pins, ejector plate, gate, goose-neck, nozzle, over-flow, platen plunger, runner, slot, slide, vent, water line. Design of hot chamber, cold chamber machines, vertical, horizontal" die locking machines, toggle and hydraulic systems, injection systems, rack and pinion, knockout pins and plates, hydraulic ejection, other parts of die casting machines.

Unit – III : Various types of dies assembly and Inspection:

Design of various types of dies - Single cavity, multi cavity, combination, unit dies. Alignment of dies with sprue. Design approach for die elements. Selection of materials and heat treatment for die casting dies and elements - die casting alloys - types of die casting alloys, Case studies on executed dies and design details. Finishing, Trimming, and inspection. Gravity die casting - Die design with cores and inserts - Bulk forming tools.

Unit – IV : Forging die design and various methods of forging:

Open die forging, Advantages of open die forging over closed die forging. Calculation of allowances and tolerances. Methods of open die forging. Design of dies. Closed die forging. Preparation of material for forging. Calculation of raw-stock, cutting off, heating in furnaces. Allowances and tolerances for closed die forging as per IS: 3469 1974.

Unit-V : Design and calculation of upsetting dies:

Die blocks for forging operations. Design of fuller impression, Roller impression, Bender impression, Blocker impression, Finisher impression. Swaging tools. Planning layout of multi impression dies. Flash and cutter calculations- additional operations on forging, piercing, and trimming dies, coining dies. Horizontal forging machines. Design of upsetting dies. Calculations on upsetting dies - Press forging reducer rollers. Forging equipment. Layout of forge shop. Roll forming, wire drawing forward & backward extrusion.

Unit-VI : Various types of die casting, Injection mould machines:

Selection of Injection machines and die casting dies by weight of component etc., support equipment for polymer handling, scrap reclaim mould temperature 3D model analysis and geometry validation. Plastic flow analysis and simulation.

Application of CAD/CAM technology using various softwares. Designing of runners, gates, ejector pins and locating them using mould flow software.

TEXT BOOKS:

1. Rushnoff S.E., *Forging* & *Forming Metals*, Taraporewala, Bombay, 1952. .

2. Dochlar H.H., *Die Casting Dies*, Mc Grawhill, 1951.

REFERENCE BOOKS:

1. I.S. Standards, BSI., New Delhi.

2. Pye *R.G.W.,Injection Mould Design*, Longman scientific & Technical Publishers, London, 1989.

3. Die design hand book Wilson Mc Graw Hill.

M.Tech. (CAD/CAM) I Year – I Sem.
122CC11- TOTAL QUALITY MANAGEMENT
(Professional Elective –II)

L	T	P	C
3	1	**-**	**3**

Unit - I: **Introduction:**

The concept of TQM, Quality and Business performance,' attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

Unit – II: **Customer Focus and Satisfaction:**

Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer - Supplier relationships. Bench Marketing: Evolution of Bench Marketing; meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

Unit – III: **Organizing for TQM:**

The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles.

Unit – IV: **Productivity, Quality and Reengineering:**

The leverage of Productivity and Quality, Management systems V s. Technology, Measuring Productivity, Improving Productivity Re-engineering.

Unit – V : **The Cost of Quality:**

Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

Unit - VI: **IS09000:**

Universal Standards of Quality: ISO around the world, The IS09000 ANSl/ASQCQ-90. Series Standards, benefits of IS09000 certification, the third party audit, Documentation IS09000 and services, the cost of certification implementing the system.

TEXT BOOK:

1. "Total Quality Management" by Joel E.Ross.

REFERENCE BOOKS:

1. "Beyond TQM" by Robert L.Flood.
2. "Statistical Quality Control" by E.L.Grant.

M.Tech. (CAD/CAM) I Year – I Sem.
122CC12 – PRECISION ENGINEERING
(Professional Elective –II)

L	T	P	C
3	1	**-**	**3**

Unit-I: CONCETPS OF ACCURACY
Introduction-Concept of Accuracy of Machine Tools-Spindle ad Displacement Accuracies-Accuracy of numerical Control Systems-Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

Unit-II: GEOMETIC DEIMENSIONING AND TOLERANCING:
Tolerance Zone Conversions-Surfaces, Equalizing Datums-Datum Feature of Representation-form controls, Orientation Controls-Logical Approach to Toleancing.

Unit-III: DATUM SYSTEMS
Design of freedom, Grouped Datum Systems-different types, two and three mutually perpendicular grouped datum planes Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair an tongue-slot pair-Computation of Transnational and rotational accuracy, Geometric analysis and application.

Unit IV: TOLERANCE ANALYSIS
Process Capability, Mean Variance, skewness, kurtosis, Process Capability Metrics, Cp, Cpk Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerance sure fit law, normal law and truncated normal law.

Unit V: TOLERANCE CHARTING TECHNIQUES
Operation sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining: Datum Features-functional and manufacturing Components design-Machining Considerations, Redesign for manufactured, Examples.

Unit-VI: MEASURING SYSTEMS PROCESSING:
In processing or in situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

TEXT BOOKS:
1. Precision Engineering in Manufacturing/Murthy R.L/New Age International (P) Limited, 1996.
2. Geometric Dimensioning and Tolerancing/James D.Meadows/Marcel Dekker inc. 1995.

REFERECE BOOKS:
1. Engineering Design-A Systematic Approach / Matousek /Blackie & Son Ltd., London.

M.Tech.(CAD/CAM) I Year – I Sem.
122CC71 – ADVANCED CAD AND CAM LAB

L	T	P	C
-	-	6	2

CAD Lab:

Creation of working drawing, creating geometry, constraining the profile, extracting a part using tools, creating pattern of holes, translating rotating, mirroring, managing the specification tree. Creating sheets and views, creating text and dimensions, creating an assembly, moving components, assembling existing component<;, creating bill of materials, creating wire frame and surface geometry using generative shape design and sweep tools. Generation of Ferguson's cubic surface patches, Bezier surface patches. Coons patches. Import and export of drawing from other software.

1. Solid modeling features in modeling , extrusion, blend revolve, sweep rib, tweak Blend cut etc. using Pro/E
2. Advanced solid modeling commands swept-blend , variable sweep boundary blend Patterning using Pro-E Software
3. 3D-Modeling of truss bearing bracket and converting in to Production drawing using Pro-E software
4. 3D Modeling & assembly of Oldham coupling using Pro-E and converting this in to Production drawing
5. 3D Modeling & assembly of Knuckle joint, cotter with spigot ends , U-joint with crank arm using Pro-E
6. 3D Modeling of angle bearing and converting this in to part drawing , preparing Bill of Material using Pro/E software
7. Introduction to Pro-Manufacturing
8. CNC Code generation Example turning component
9. CNC Code generation Example mill component
10. Analysis of Simple component using Pro-Mechanica
11. Modeling and meshing using Hyper works Software –EX-1
12. Mesh Optimization using Hyper works Software-EX-2

CAM Lab:

Features and selection of CNC turning and milling centers, Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles. Practice in part programming and operating a machining center, tool planning and selection of sequences of operations, tool setting on machine, practice in manual part programming.

Programs on CNC Lathe:

1. Exercise on Facing, Turning, Step Turning and Taper turning.
2. Exercise on Pattern repetition through sub program.
3. Exercise on Thread cutting.

Programs on CNC Mill:

4. Exercise on Profile cutting
5. Exercise on Circular & Rectangular Pocketing
6. Exercise on Mirroring

M.Tech. (CAD/CAM) I Year – I Sem.
122CC72 - TECHNICAL PAPER WRITING & SEMINAR

L	T	P	C
-	-	3	2

There shall be two seminar presentations during I year I semester and I year II Semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.

In the First semester the report must be in the form of the review paper with a format used by IEEE / ASME etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 10 marks
- Final Report : 10 marks
- Presentation : 30 marks

A Student has to concentrate on the following sections while writing technical paper or presenting seminar.

Contents:

- Identification of specific topic
- Analysis
- Organization of modules
- Naming Conventions
- Writing style
- Figures
- Feedback
- Writing style
- Rejection
- Miscellaneous

References:

Teach Technical Writing in Two Hours per Week by Norman Ramsey

For Technical Seminar the student must learn few tips from sample seminars and correcting himself, which is continues learning process

Reference Links:
http://www.cs.dartmouth.edu/~scot/givingTalks/sld001.htm
http://www.cse.psu.edu/~yuanxie/advice.htm
http://www.eng.unt.edu/ian/guides/postscript/speaker.pdf

Note: A student can use any references for this process, but must be shared in classroom.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 10 marks
- Final Report : 10 marks
- Presentation : 30 marks

M.Tech. (CAD/CAM) I Year – II Sem.
122CC13 - AUTOMATION IN MANUFACTURING

L	T	P	C
3	1	-	**3**

Unit – I:

Introduction: Basic principles of automation. Types of automated systems - degree of Mechanization, Index for degree of Mechanization for various automated operations. Automatic loading and feeding of work pieces and Types. Basic Elements of Automated systems. Functions of advanced Automation.

Unit – II :

Fluid power controls in Automation: Relative advantages of various controls - Hydraulic, pneumatic and Electrical controls for automatic location, loading and clamping – Automatic control devices. Servo controls, Mechanical servo and Electro hydraulic servo systems. Sensors, Actuators.

Unit – III :

Design of hydraulic circuits, Design of pneumatic circuits, Maintenance and trouble shooting of hydraulic and pneumatic circuits

Unit – IV:

Material handling and Identification Technologies: Automated material handling - Types of equipment and functions, analysis and design of material handling systems. Material Transport systems, Automated guided vehicle systems. Automated storage systems: Automated storage and retrieval systems. Analysis of storage systems. Automatic Data Capture, Bar code technology, other ADC technologies. Shop floor Data Collection systems.

Unit –V :

Manufacturing Systems: Introduction, Manufacturing Cells, Cellular Manufacturing, FMS, Manual Assembly lines. Line Balancing; Transfer lines and analysis of transfer lines without and with buffer storage. Automated Assembly systems. Design for Automated Assembly.

Unit –VI :

Quality Control Systems: Introduction, Statistical Process Control Inspection Principles and Practices, Automated inspection and automated inspection technologies-contact and non contact methods Coordinate measuring machine-machine vision-other optical inspection methods. Non-contact non-optical inspection technologies. Lean Production and Agile Manufacturing.

TEXT BOOKS:

1. Mikell P. Grover, Automation, Production Systems and Computer Integrated Manufacturing, Second Edition, Pearson Education Asia, First Indian Reprint 2001.
2. Antony Espossito, "Fluid power with Applications", Prentice Hall

REFERENCE BOOKS:

1. C. Ray Asfahl, Robots and Manufacturing automation, John Wiley and Sons New York-1992.
2. Earnest C. Fitch, Fluid power and control systems Mc Graw Hill Book Company, 1966.

M.Tech. (CAD/CAM) I Year – II Sem.
122CC14 - FLEXIBLE MANUFACTURING SYSTEMS & CAPP

L	T	P	C
3	1	-	**3**

Unit – I
Introduction to Flexible Manufacturing Systems (FMS): Types of FMS, FMS Components, FMS Planning & Implementation issues, Design issues, FMS Application & Benefits. FMS Computer Control system, Hierarchy of computer control and Supervisory control. Knowledge Based Scheduling,

Unit – II
CAD/CAM Considerations for FMS: FMS Planning, Software for simulation and database of FMS. Specification and selection, trends, application of simulation software, Planning FMS database. Just –In –Time Manufacturing System, Kanbann system and Preventive maintenance.

Unit – III :
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.
Generative CAPP system: Importance. Principle of Generative CAPP system, automation of logical decisions

Unit – IV : Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation, and applications. .
Selection of manufacturing sequence: Significance, alternative-manufacturing processes, reduction of total set-up cost for a particular sequence.

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

Unit – VI :
Computer Aided Inspection and quality control:
Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods. Artificial Intelligence and expert system in Product manufacturing: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

TEXT BOOKS:
1. Jha N.K." Hand Book of Flexible Manufacturing Systems" Academic Press.
2. Automation, Production systems and Computer Integrated Manufacturing System - Mikell PGroover

REFERENCE BOOKS:
1. Computer Design and Manufacturing - Dr. Sadhu Singh.
2. Computer Engineering - David Bedworth
3. Talichi Ohno, Toyota" Production System l3eyond Large Scale Production", Productivity Press India Pvt. Ltd.

M.Tech. (CAD/CAM) I Year – II Sem.

122CC15 - OPTIMUM DESIGN OF MECHANICAL ELEMENTS

L	T	P	C
3	1	-	**3**

Unit – I: Introduction

General characteristics of mechanical systems; adequate and optimum design; principles of optimization; formulation of objective function; design constraints; classification of optimisation problems; considerations in optimization: economic (cost minimisation), geometric (shape example: minimization of surface area for a given volume), material (volume minimisation, mass, weight), strength (stresses; maximization of load carrying capacity), maximization of rigidity (minimization of deflections)

Unit – II: Single Variable Optimisation

Unconstrained optimisation; classification of optimal points; optimality conditions; Direct methods: Bracketing a three-point pattern, Fibonacci's method, Golden section method, Powell's method; Derivative-based methods: Newton's method, Bisection method

Constrained optimization: formulation, optimality conditions, necessary and sufficient conditions; design of tensile bar for maximum energy absorption capability per cycle of repeated / variable loading with space and material constraints

Unit – III: Multi-Variable Optimisation

Unconstrained optimisation; problem formulation; optimality conditions; Gradient-based methods: Steepest descent method, Conjugate gradient method, Newton's method, Davidon-Fletcher-Powell (DFP) method, Broyden-Fletcher-Goldfarb-Shanno (BFGS) method; **Constrained optimization**: Problem formulation, Necessary conditions for optimality (equality, inequality and mix of both types of constraints), Sufficient conditions; Design of a 2-bar truss structure of different cross-sections for minimum mass; Minimum weight tubular column design to support a given load without overstressing and buckling

Unit – IV: Nonlinear Programming

Zoutendijk's method of feasible directions; Interior and exterior penalty function methods; optimal design of a practical torsion bar for minimum weight; design of torsion shaft for minimum cost and minimum dynamic torque;

Unit – V: Advanced Optimisation Topics

Geometric Programming technique; dynamic vibration absorbers

Unit – VI: Optimisation of complex mechanical elements

Helical and torsional springs, minimization of structural error in four bar mechanisms for path and function generation

TEXTBOOK:

1. S.S.Rao, "Engineering Optimisation: Theory and Practice", Wiley Eastern Edition
2. Kalyanamoy Deb, "Optimisation for Engineering Design Algorithms and Examples", Prentice Hall of India

REFERENCE BOOKS:

1. Jasbir S. Arora, "Introduction to Optimum Design", McGraw Hill International Edition
2. Ray C. Johnson, "Optimum Design of Mechanical Elements", John Wiley & Sons

M.Tech. (CAD/CAM) I Year – II Sem.
122CC16 - DESIGN FOR MANUFACTURING & ASSEMBLY

L	T	P	C
3	1	-	**3**

Unit – I: Introduction:
Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of design Ling for economical production -creativity in design. Materials: Selection of Materials (or design Developments in Material technology -criteria for material selection - Material selection interrelationship with process selection process selection charts.

Unit – II: **Machining Process:**
Overview of various machining processes - general design rules for machining Dimensional tolerance and surface roughness - Design for machining - Ease - Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.
Metal Casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances -use of solidification simulation in casting design - product design rules for sand casting.

Unit – III: Metal Joining:
Appraisal of various welding processes, Factors in design of weldments - general design guidelines - pre and post treatment of welds - effects of thermal stresses in weld joints - design of brazed joints.
Forging: Design factors for forging - Closed die forging design - parting lines of die5 drop forging die design - general design recommendations.

Unit – IV:Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking. .

Unit – V: Assembly advantages:
Development of the assemble process, choice of-assemble method assemble advantages social effects of automation.
Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free - transfer machine.

Unit – VI: Design of' Manual Assembly:
Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening;' effect of pal1 symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

TEXT BOOKS:
1. Geoffrey Boothroyd, ."Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Engineering Design - Material & Processing Approach - George E. Deiter, McGraw Hill IntI. 2nd Ed. 2000.
REFERENCE BOOKS:
1. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekken, N.Y. 1990.
2. A Delbainbre "Computer Aided Assembly London, 1992.

M.Tech. (CAD/CAM) I Year – II Sem.
122CC17– RAPID PROTOTYPING, TOOLING & MANUFACTURE
(Professional Elective –III)

L	T	P	C
3	1	**-**	**3**

Unit-I Introduction to Rapid Prototyping:
Need for Time Compression in Product Development, History of RP systems, Growth of RP industry, Data formats, RP information workflow, Classification of RP systems, Applications of Advantages & Limitations of RP.

Unit-II Rapid Prototyping Processes:
Stereo lithography (SL), Selective Laser Sintering (SLS), Fused Deposition Modelling (FDM), Solid Ground Curing (SGC), Laminated Object Manufacturing (LOM); Principle, Process details, Machine details, Advantages, Dis-advantages, Applications.

Unit-III Concept Modelers:
Introduction to concept modeler, Principle and applications of: Thermo Jet Printer, Sander's model market, 3-D printer, Genisys Xs printer, JP System 5, Object Quadra Systems. Softwares for Rapid Prototyping: Overview of Solid view, Magics, Mimics and Magics Communicator, View Expert and 3 Data Expert, 3D view, Velocity2, Rhino, Stl View, Internet based software, Collaboration tools.

Unit-IV Introduction to Rapid Tooling:
Introduction to Tooling, Need for RT, Conventional Tooling methods Vs RT Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy tools, Ceramic tools, Investment Casting, Spin-Casting, Die-Casting, Sand Casting, 3D Keltool process and Fusible Metallic Core. Direct Rapid Tooling: Direct AIM, LOM tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

Unit-V Rapid Manufacturing:
Introduction to RM, Factors influencing Accuracy, data Preparation: Errors due to tessellation, Errors due to Slicing, Part Building: Errors in the SL Process, SLS Process, Part Building Orientation: Orientation Constraints of the SL Process and SLS Process.

Unit-VI CAD/CAM/CNC in relation to Rapid Prototyping:
Reverse Engineering Machines and softwares, advantages and applications.

TEXT BOOKS:
1. Rapid Manufacturing - by D.T. Pham and S.S. Dimov, Springer, 2001
2. “Rapid Prototyping- Principles and Applications”, C. K. Chua, K. S. Leong & C. S. Lim, World Scientific Publication.

REFERENCE BOOKS:
1. Wohlers Report 2000- by Teny Wohlers, Wohlers Associates, 2000.
2. Rapid prototyping - by Amithaba Ghose, Eastern Law house, 1997.
3. Stereolithography and other RP&M Technologies-by Paul F. Jacobs, ASME Press, 1996.
4. Rapid Prototyping & Manufacturing - by Paul F. Jacobs, ASME Press, 1996.

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M.Tech. (CAD/CAM) I Year – II Sem.
122CC18 - COMPUTATIONAL FLUID DYNAMICS
(Professional Elective –III)

L	T	P	C
3	1	**-**	**3**

Unit – I : Introduction:

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

Solution methods: Solution methods of elliptical equations - finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

Unit – II Hyperbolic equations:

Explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

Unit - III : Formulations of incompressible viscous flows:

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

Unit – IV Treatment of compressible flows:

Potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

Unit – V Finite volume method:

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

Unit – VI : Standard variational methods -1:

Linear fluid flow problems, steady state problems, Transient problems.

TEXT BOOK:

1. Computational fluid dynamics, T. J.C' hung, Cambridge University press, 2002.

REFERENCE BOOK:

1. **Text book** of fluid dynamics, **Frank** Choriton, CBS Publishers & distributors, 1985.

M.Tech. (CAD/CAM) I Year – II Sem.
122CC19 - MECHANICAL VIBRATIONS & CONDITION MONITORING
(Professional Elective –III)

L	T	P	C
3	1	**-**	**3**

Unit I: Vibrations of Single Degree of Freedom Systems:
Simple harmonic motion, Free and forced vibrations of damped and undamped systems; Simple harmonic excitation; steady state response forced vibrations; free transverse and torsion vibrations;

Unit II: Vibration of Systems with Two Degrees of Freedom:
Free vibration of spring coupled systems, Two degree freedom of mass coupled system, bending vibrations of two degree of freedom system, Forced vibrations of un damped two degree of freedom system, Forced damped vibrations, Vibration isolation

Unit III: **Vibration of Systems with Multi-degree of Freedom:**
Close coupled system, Far coupled system, mode shapes and modal analysis.
Approximate methods for fundamental frequency: Dunkerley lower bound method, Ray;eigh's upper bound method, Holzer method for close coupled system

Unit IV: Experimental methods in vibration analysis:
Vibration instruments: exciters, transducers, analysers, measurement devices: vibrometers, velocity meters and accelerometers; Signal analysis techniques: time domain analysis, frequency domain analysis, amplitude and power spectra, coherence, auto and cross correlations, amplitude and frequency modulations; Tests for free and forced vibrations

Unit V: Condition Monitoring of Systems:
Introduction to Vibration and Condition Monitoring; Failure types, investigation and occurrences; Machinery Signatures and analysis; Wear and lubricant / contaminant monitoring and analysis; Introduction to Active Control of Structures

Unit VI: Case studies:
Vehicle dynamics, vehicle subjected to random vibrations (for example an uneven road), Introduction to nonlinear and random vibrations, Vibrations in turbines;

TEXTBOOK:
1. "Introductory Course on Theory and Practice of Mechanical Vibrations", J.S.Rao, K.Gupta, Revised second edition, New Age International Publishers
2. "Theory of Vibration with Applications", William T. Thomson, Marie Dillon Dahleh, Pearson Low Price Edition
3. "Condition Monitoring and Condition Based Maintenance", Dr. Prabhu, Teacher Training Institute, Bhopal

REFERENCE BOOKS:
1. "Mechanical Vibration and Shock Measurements", J.T.Broch, Bruel and Kjae Publication
2. "Mechanical Fault Diagnosis and Condition Monitoring", R.A.Collacott, Chapman and Hall Publishers
3. "Applications of Random Vibrations", N. C. Nigam, S. Narayanan, Narosa Publishers

M.Tech. (CAD/CAM) I Year – II Sem.
122CC20 – PRODUCTION AND OPERATION MANAGEMENT
(Professional Elective –III)

L	T	P	C
3	1	-	**3**

Unit-I: Operation Management-Definition-Objectives-Types of production systems-historical development of operation management-Current issues in operation management.
Product design- Requirements of good product design-product development-approaches-concepts in product development-standardization-simplification-Speed to market-Introduction to concurrent engineering.
Introduction to SAAP.

Unit-II: value engineering-objective-types of values-function & cost –product life cycle-steps in value engineering-methodology in value engineers-FAST Diagram-Matrix Method.
Location –Facility location and layout-Factors considerations in Plant location-Comparative Study of rural and urban sites-Methods of selection plant layout-objective of good layout – Principles – Types of layout line balancing.

Unit-III: Aggregate Planning-definition-Different Strategies-Various model of Aggregate Planning-Transporation and graphical models.

Unit-IV: Scheduling – Policies-Types of scheduling –Forward and Backward Scheduling – Grant Charts –Flow shop Scheduling- n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of balance.

Unit-V: Project Management-Programming Evaluation Review Techniques (PERT) – three times estimation-critical path-probability of completion of project-critical path method-crashing of simple nature.

Unit-VI: Advance inventory control systems-Material Requirement-Terminology-types of demands-inputs to MRP-techniques of MRP-Lot sizing methods-benefits and drawbacks of MRP-Manufacturing Resources Planning (MRP-II), Pull systems-Vs Push system-Just in time (JIT) Philosophy Kanban System-Calculation of number of Kanbans Requirements for implementation JIT-JIT Produciton process-benefits of JIT.

TEXT BOOKS:
1. “Production and Operations Management” by chary.
2. “Production and Operation Management” by Panner Selvam
3. “Production and Operation Analysis” by Nahima

REFERENCE BOOKS:
1. “Operations Management” by E.S.Buffs
2. “Operations Management “Theory and Problems: by Joseph G.Monks.
3. “Production Systems Managemnet” by James I.Riggs
4. “Operations Mangement” by chase

M.Tech. (CAD/CAM) I Year – II Sem.
122MB01 - ENTREPRENEURSHIP AND INNOVATION
(Open Elective)

L	T	P	C
3	1	-	**3**

Unit – I:

Nature of Entrepreneurship; Characteristics, Qualities and skills of an Entrepreneur, functions of entrepreneur, Entrepreneur scenario in India and Abroad. Forms of Entrepreneurship: Small Business, Importance in Indian Economy, Types of ownership, sole trading, partnership, Joint Stock Company and other forms. First-Mover disadvantages, Risk Reduction strategies, Market scope strategy, Imitation strategies, and Managing Newness.

Unit – II:

Aspects of Promotion: Generation of new entry opportunity, SWOT Analysis, Technological Competitiveness, legal regulatory systems, patents and trademarks, Intellectual Property Rights- Project Planning and Feasibility Studies- Major steps in product development.

Unit – III: Management Of Small Business:

Pre feasibility study - Ownership - budgeting - project profile preparation - Feasibility Report preparation - Evaluation Criteria- Market and channel selection- Product launching - Monitoring and Evaluation of Business- Effective Management of Small business.

Unit – IV: Support Systems For Entrepreneurs:

Institutional Support, Training institution, Financial Institutions and Aspects: Sources of raising Capital, Debt-Equity, Financing by Commercial Banks, Government Grants and Subsidies, Entrepreneurship Promotion Schemes of Department of Industries (DIC), KVIC, SIDBI, NABARD, NSIC, APSFC, IFCI and IDBI. New Financial Instruments. Research and Development – Marketing and legal aspects, Taxation benefits, Global aspects of Entrepreneurship.

Unit – V: Introduction To Innovation:

Meaning of innovation, sources of innovative opportunity, 7 sources of innovative opportunity, Principles of innovation, the enablers of innovation, business insights, insights for innovation, technical architecture for innovation, focus on the essence of innovation.

Unit – VI: Process And Strategies For Innovation:

Process of innovation, the need for a conceptual approach, Factors contributing to successful technological innovation, Strategies that aim at innovation, impediments to value creation and innovation.

TEXT BOOKS:

1. Robert D Hisrich, Michael P Peters, Dean A Shepherd: Entrepreneurship, TMH, 2009
2. Bholanath Dutta: Entrepreneurship – Text and cases, Excel, 2009.

REFERENCE BOOKS:

1. Vasanth Desai: Entrepreneurship, HPH, 2009

2. H. Nandan: Fundamentals of Entrepreneurship, PHI, 2009.

3. Barringer: Entrepreneurship, Pearson,2009.

4. Peter Drucker (1993), “Innovation and Entrepreneurship”, Hyper Business Book.

5. C.K. Prahalad, M.S. Krishnan, The new age of Innovation – TATA McGRAW-HILL Edition 2008.

M.Tech. (CAD/CAM) I Year – II Sem.
122MB56 - BANKING OPERATIONS, INSURANCE AND RISK MANAGEMENT
(Open Elective)

L	T	P	C
3	1	**-**	**3**

Unit – I: Introduction To Banking Business:

Banking Sectors- Retail, Corporate, Rural, and International; Non-banking financial intermediaries; Types of advances and deposits in a bank, New Dimensions and Products. - Credit, Debit and Smart Cards, and e-Banking Structure of the Indian Banking System's. Commercial Banks – Public and Private Sector and Foreign Banks. Cooperative Banks.

Unit – II: Banking Reforms and Regulation:

Banking Regulation Act, 1949, Reserve Bank of India Act 1934, and Reserve Bank's Instruments of Credit Control. Deficiencies in Indian Banking including Problems Accounts and Non-Performing Assets, Banking Sector Reforms.

Unit – III: Insurance:

Need for and importance of insurance, branches of insurance (life and general insurance) policy and procedure.

Unit – IV: Insurance Business Environment:

Mathematical basis of life insurance, reinsurance coverage, regulatory and legal frame work governing the insurance, business and economics of insurance, need for changing mindset; Latest trends.

Unit – V: Risk Analysis:

Firm risk and Market risk: Portfolio related Risk measure, Mean variance and portfolio construction. Port folio theory and capital Budgeting CAPM.Risk Management: Option valuation; Derivatives: managing financial Risk Options and option contracts; credit risk management; introduction, risks and credit risk management.

Unit – VI: Risk And Return:

Return and Risk, measuring internal risk, measuring Historical return and measuring historical risk measuring expected return and risk .Derivatives and Risk Management: Risk management Forwards and Futures, options; Interest rates and currency swaps

TEXT BOOKS :

1. Varshney, P.N., Banking Law and Practice, Sultan Chand & Sons, New Delhi.
2. General principles of Insurance - Harding and Evanly
3. Investment Analysis and Port folio Management: Prasanna Chandra 2/e

REFERENCE BOOKS :

1. Read, E. W., Commercial Bank Management, Harper and Row Publishers, New York
2. Lectures on Banking Law - Gilbert J.N.
3. Dr. Shrikrishna Laxman Karve, Principles of Life Insurnace, Himalaya publishing house.
4. P.K. Gupta, Principles and practice of non life insurance, Himalaya publishing house

M.Tech. (CAD/CAM) I Year – II Sem.

122BT37 - CULTURE, VALUES, PROFESSIONAL ETHICS & INTELLECTUAL PROPERTY RIGHTS

(Open Elective)

L	T	P	C
3	1	**-**	**3**

A: Indian Culture- Ancient Wisdom:

Unit – I

Purpose of Education – Indian Perspective, Civilization and Culture, Wisdom of selflessness and sacrifice, ancient wisdom on good governance and Happy life, bunch of thoughts and contribution of ancient to modern sages/ monks on Indian culture, need for interfaith understanding, cultural unity of India, what sages, seers said about knowledge devotion, meditation and happiness in life.

Unit – II

What is modernity, relevance of yogic and spiritual practices for intellect-mind-body harmony. Science and religion, concentration and meditation, peace of mind, Hinduism in view of Mahatma Gandhi, Role of expanse of Technology in Third Millennium. Indian literature and cultural identity, Teacher- Student relationship. Need for balance and harmonious growth in all stages of life. Development into holistic professional.

B: Human Values and Value Education

Unit – III

Human Values – Rules of Behaviour, Distinguishing and Defining 'Human' Values Truth Love and Caring, Peace, Responsibility, Justice, Human Values Applied in Practice, Values and Psychic Health, The Hierarchy of Human Values, Values of Nature, The Values of Personhood (Personality), **Values of the Person,** The Value of Truth, The Value of the Good, The Value of Beauty, Moral Values, The Value of Happiness, The need for Human Value, **Value Education**, Need of Value Education, Basic Guidelines for Value Education, Content of Value Education, Process of Value Education.

C: Human Values and Ethics

Unit – IV

Morals, Ethics, Concept of Values, Characteristics of Values, Types of Values, Principles of values, Core Values.

Ethics, Morality, Law, Characteristics of an Ethical Person, Professional Ethics, Professional Responsibility, Codes of Practice, Things to Do, Things to Not Do, Ethical Behaviour, Marketing Ethics, Specific Issues in Marketing Ethics, Special Ethical Issues in Marketing to Children, Unfair or Deceptive Marketing Practices, The use of Ethics as a Marketing Tactic, General Guidelines of Marketing, Ethics in Finance Professional, Ethical Violations, Ethical Codes for Financial Professionals, Ethics in Computer Profession, Some Questions in Computer Ethics, Ethical Standards, Ethics in Engineering, Current Codes of Ethics, General Principles, Ethical Issues, Ethics, General Business Ethics, Theoretical Issues in Business Ethics, Business Ethics, Religious Views on Business Ethics, Importance of Ethics in Business, Ethics in Advertising, Work Ethics, Criticisms of Work Ethic Concept, Working with Ethics.

D: Intellectual Property Rights (IPR)

Unit – V

Invention and Creativity, Basic Types of Property, Need for Protection of IPR, IP Types – Industrial Property (Patents, Trade Marks, Trade Secrets, Industrial Designs and Integrated Circuits), Copyrights and Related Rights, Geographical Indications.

Unit – VI

WIPO Mission and Activities, GATT & Trips. Patent search, Patent drafting. National and International conventions, Patent Cooperation Treaty (PCT), Case Studies on IP.

TEXT BOOKS:

1. I.V. Chalapati Rao "Ancient Wisdom, Modern Insights" - Sri Yabaluri Raghavaiah Memorial Trust
2. Smriti Srivastava "Human Values and Professional Ethics" – S.K. Kataria & Sons.
3. Anitha Rao R & Bhanoji Rao "Intellectual Property Rights- A Primer", Eastern Book Company, 2008.

REFERENCE BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V.S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/Prentice Hall, New Jersey, 2004 (Indian Print)

M.Tech. (CAD/CAM) I Year – II Sem.
122IT03 - DATA BASE MANAGEMENT SYSTEMS
(Open Elective)

L	T	P	C
3	1	**-**	**3**

UNIT I :
Data base System Applications, data base System VS file System – View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor, History of Data base Systems. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.

UNIT II :
Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.
Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

UNIT III :
Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.

UNIT IV :
Schema refinement – Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

UNIT V :
Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation-Based Protocols – Multiple Granularity, Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

UNIT VI :
Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing – Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure.

TEXT BOOKS :

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

REFERENCES :

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. Introduction to Database Systems, C.J.Date Pearson Education

M.Tech. (CAD/CAM) I Year – II Sem.
122CC73 - COMPUTER AIDED ANALYSIS AND ROBOTICS LAB

L	T	P	C
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Computer Aided Analysis:

The following exercises shall be given to the students on CAE Software such as ANSYS, NASTRAN, CFX etc.

1. Static analysis of 2D/3D truss using FEA Software ANSYS /NASTRAN)
2. Structural static analysis of beams with distributed load using FEA Software(ANSYS/ NASTRAN)
3. Structural static Analysis of corner bracket using ANSYS / NASTRAN
4. Structural Dynamic Analysis of cantilever using ANSYS/ NASTRAN
5. Transient Dynamic Analysis of Beam Structures using ANSYS/NASTRAN
6. Thermal Analysis of composite slab using ANSYS/NASTRAN
7. Structural and Thermal Analysis bracket using ANSYS
8. Buckling Analysis of composite structures using ANSYS/NASTRAN
9. Analysis of pressure vassals using ANSYS/NASTRAN
10. Eigenvalues Analysis of composite beams /shells
11. CFD Analysis of Flow Passages- pipe flow
12. CFD Analysis of Flow Passages- nozzle flow

Robotics Lab:

Practice in Robot programming and its languages.: Robotic simulation using software, Robot path control, preparation of various reports and route sheets, Simulation of manufacturing system using CAM software, controller operating system commands.

1. **Exercise on Pick and Place Tasks**: Recording Pick and Place positions, Performing Pick and Place Movements, Writing a Pick and Place Program, Running the Program Line by Line and Running the Program continuously.
2. **Exercise on Inputs, outputs**: Digital inputs and outputs, programming with inputs, micro switch proximity switch, inductive proximity sensor, capacitive proximity sensor and optical proximity sensor, digital relay outputs, manual control of the outputs, writing a program to control outputs, integrating inputs and outputs.
3. **Exercise on Joint & XYZ Coordinate systems, point to point control, linear interpolation and circular interpolation:** Joint Coordinates, XYZ Coordinates, Point to Point control and continuous path control, linear and circular interpolation.
4. **PLC Programming through ladder logic**
5. **Demos on P- Simulators**
6. **Demos on H-Simulator**

M.Tech. (CAD/CAM) I Year – II Sem.
122CC74 –TECHNICAL SEMINAR
(INDEPENDENT REVIEW PAPER)

L	T	P	C
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There shall be two seminar presentations during I year I semester and I year II Semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.

In the First semester the report must be in the form of the review paper with a format used by IEEE / ASME etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 10 marks
- Final Report : 10 marks
- Presentation : 30 marks

M.Tech. (CAD/CAM) II Year – I Sem.

122CC75 - COMPREHENSIVE VIVA-VOCE

L	T	P	C
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There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the students' understanding in various subjects he/she studied during the M.Tech course of study. The Comprehensive Viva-Voce is valued for 50 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce. A candidate has to secure a minimum of 50% to be declared successful.

M.Tech. (CAD/CAM) II Year – I Sem.
122CC76 - PROJECT SEMINAR-I

L	T	P	C
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In II year I semester, a project seminar shall be conducted for 50 marks and for 2 credits (there is no external evaluation). The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 20 marks and the end semester seminar evaluation shall carry 30 marks. The report for the mid-semester project seminar will carry 5 marks and remaining marks shall be for presentation and discussion. The report for end semester project seminar shall be for 10 marks and the remaining marks shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

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M.Tech. (CAD/CAM) II Year – I Sem.
122CC77 - PROJECT WORK (PART- I)

L	T	P	C
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Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Project Review Committee.

A Project Review Committee (PRC) shall be constituted comprising of Heads of all the Departments which are offering the M.Tech programs and three other senior faculty members concerned with the M.Tech. programme.

Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the previous semesters and after obtaining the approval of the PRC.

After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the PRC for its approval. Only after obtaining the approval of PRC the student can initiate the Project work. This process is to be completed within four weeks of commencement of II year I semester.

The student shall submit a project report at the end of II year I semester, and the same shall be evaluated at the end of that semester by the PRC as SATISFACTORY or UNSATISFACTORY. In the case of unsatisfactory declaration, the student shall re-submit the Project report after carrying out the necessary modifications / additions in the Project work, within the specified time as suggested by the PRC.

M.Tech. (CAD/CAM) II Year – II Sem.
122CC78 - PROJECT SEMINAR-II

L	T	P	C
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A project seminar shall be conducted for 50 marks and for 2 credits (there is no external evaluation). The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 20 marks and the end semester seminar evaluation shall carry 30 marks. The report for the mid-semester project seminar will carry 5 marks and remaining marks shall be for presentation and discussion. The report for end semester project seminar shall be for 10 marks and the remaining marks shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

M.Tech. (CAD/CAM) II Year – II Sem.
122CC79 - PROJECT WORK AND DISSERTATION

L	T	P	C
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A candidate is permitted to submit Project Dissertation only after successful completion of PG subjects (theory and practical), seminars, Comprehensive viva-voce, PG Project Part–I, and after the approval of PRC, not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and shall make an oral presentation before the PRC. Along with the draft thesis the candidate shall submit draft copy of a paper in standard format fit for publication in Journal / Conference, based on the project thesis, to the Head of the Department with due recommendation of the supervisor.

- Five copies of the Project Dissertation certified by the Supervisor and Head of the Department shall be submitted to the College.

- The dissertation shall be adjudicated by one examiner selected by the College. For this, Head of Department shall submit a panel of 3 examiners, who are eminent in that field, with the help of the PRC. The Chief Superintendent of the college in consultation with the college academic committee shall nominate the examiner.

- If the report of the examiner is not favorable, the candidate shall revise and resubmit the Dissertation, in the time frame as prescribed by PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.

- If the report of the examiner is favorable, viva-voce examination shall be conducted by a Board consisting of the Head of the Department, Supervisor and the Examiner who adjudicated the Dissertation. The Board shall jointly report the student's performance in the project work as – (a) Excellent, or (b) Good, or (c) Satisfactory, or (d) Unsatisfactory, as the case may be. In case, the student fails in the viva-voce examination, or gets the Unsatisfactory grade, he can re-appear only once for the viva-voce examination, as per the recommendations of the Board. If he fails at the second viva-voce examination, the candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.