DEPARTMENT OF MECHANICAL ENGINEERING

M TECH. (CAD/CAM)

SCHEME OF INSTRUCTION AND EXAMINATION
(with effect from 2015-16 academic year)

I – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Duration of Exam. (hrs)	Theory /Lab./ Viva	Sess.		
CADM 1.1	Computer Graphics	4	--	4	3	70	30	100	4
CADM 1.2	Integrated Computer Aided Design	4	--	4	3	70	30	100	4
CADM 1.3	CNC & APT Programming	4	--	4	3	70	30	100	4
CADM 1.4	Robotics	4	--	4	3	70	30	100	4
CADM 1.5	Elective Subject 1 A) Advanced Optimization Techniques B) Advanced Numerical Methods C) Advanced Tool Design	4	--	4	3	70	30	100	4
CADM 1.6	A) Design of Hydraulic and Pneumatic Systems B) Advanced Design C) Competitive Manufacturing Systems	4	--	4	3	70	30	100	4
CADM 1.7	CAD lab	--	3	3	Viva-Voce	50	50	100	2
CADM 1.8	Seminar 1		3	3	Viva-Voce	50	50	100	2
Total		**24**	**6**	**30**		**520**	**280**	**800**	**28**

Note : The viva-voce for the labs / seminars shall be held with the course instructor/ faculty member and an external examiner nominated by the university from any academic institution / industry / R & D organization.

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Duration of Exam. (hrs)	Theory /Lab./ Viva	Sess.		
CADM 2.1	Computer Integrated Manufacturing	4	--	4	3	70	30	100	4
CADM 2.2	Mechatronics	4	--	4	3	70	30	100	4
CADM 2.3	Flexible Manufacturing Systems	4	--	4	3	70	30	100	4
CADM 2.4	Vision systems and Image processing	4	--	4	3	70	30	100	4
CADM 2.5	Elective Subject III A) Advanced Finite Element Analysis B) Neural networks and fuzzy techniques C) Concurrent engineering	4	--	4	3	70	30	100	4
CADM 2.6	Elective Subject IV A) Signal Analysis and condition monitoring B) Additive Manufacturing C) Metrology and Non destructive testing	4	--	4	3	70	30	100	4
CADM 2.7	CAM lab	--	3	3	Viva-Voce	50	50	100	2
CADM 2.8	Seminar 1		3	3	Viva-Voce	50	50	100	2
Total		**24**	**6**	**30**		**520**	**280**	**800**	**28**

Note : The viva-voce for the labs / seminars shall be held with the course instructor/ faculty member and an external examiner nominated by the university from any academic institution / industry / R & D organization.

III – SEMESTER

Code No	Course title	Scheme of Examination	Total Marks	Credits
CADM 3.1	Dissertation (Preliminary)	Viva-voce	**100**	**12**

Note : The Dissertation shall be evaluated through Viva–Voce examination by a committee with HOD, Chairman, Board of studies and Research Guide as members. The marks shall be awarded in the ratio of 30,30, and 40 percent by the members respectively.

IV – SEMESTER

Code No	Course title	Scheme of Examination	Total Marks	Credits
CADM 4.1	Dissertation (Final)	Viva-voce	**100**	**12**

Note: The Dissertation shall be evaluated through Defence and Viva–Voce examination by a committee with an External Examiner nominated by University, HOD, Chairman, Board of studies and Research Guide as members. The marks shall be awarded in the ratio of 20, 20, 20, and 40 percent by the members respectively.

CADM 1.1 COMPUTER GRAPHICS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Geometry and line generation: Line segments, Pixels and frame buffers, Bresenham's algorithms: line, circle, ellipse generation.

Graphics primitives: Primitive operations, The display-file interpreter, Display-file structure, Display-file algorithms.

Polygons: Polygons representation, An inside test, Filling polygons, Filling with a pattern.
Transformations: Scaling transformations, Reflection and zooming, Rotation, Homogeneous coordinates and translation, Rotation about an arbitrary point.

Segments: The segment table, Segment creation, Closing a segment, Deleting a segment.
Windowing and clipping: The viewing transformation, Clipping, The clipping of polygons, Generalized clipping.

Three dimensions: 3D geometry, 3D primitives, 3D transformations, Parallel projection, Perspective projection, Isometric projections, Viewing parameters, Special projections.
Hidden surfaces and lines: Back-face removal, Back-face algorithms, The Painter's algorithm, Warnock's algorithm, Franklin algorithm, Hidden-line methods.

Light, color and shading: Point-source illumination, Shading algorithms, Shadows, Color models.

Curves and fractals: Curve generation, Interpolation, B splines, Curved surface patches, Bezier curves, Fractals, Fractal lines, Fractal surfaces.

References:

1. Computer Graphics - A Programming Approach by Steven Harrington, McGraw-Hill International Edition, 1987.
2. Schaum's Outline of Theory and Problems of Computer Graphics by Roy A. Plastock and Gordon Kalley, McGraw-Hill Companies, Inc., 1986.
3. Mathematical Elements for Computer Graphics by David F. Rogersadn Adams.

CADM 1.2 INTEGRATED COMPUTER AIDED DESIGN

Periods per week : 4 | Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. | Credits : 4

Fundamentals of CAD: Introduction, Design process, Application of computer for design, Creating the manufacturing database, Benefits of CAD, Design work station, CAD hardware.

Geometric modeling: Geometric modeling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces, Solid modelers, Feature recognition.

Computer aided drafting: AutoCAD tools, 3D model building using solid primitives and boolean operations, 3D model building using extrusion, Editing tools, Multiple views: Orthogonal, Isometric.

Visual realism: Shading solids, Coloring, Color models, Using interface for shading and coloring.
Graphic aids: Geometric modifiers, Naming scheme, Layers, Grids, Groups, Dragging and rubber banding.

Computer animation: Conventional animation, Computer animation - Entertainment animation, Engineering animation, Animation types, Animation techniques.
Mechanical assembly: Assembly modeling, Part modeling, Mating conditions, Generation of assembling sequences, Precedence diagram, Liaison-sequence analysis.

Mechanical tolerancing: Tolerance concepts, Geometric tolerancing, Types of geometric tolerances, Location tolerances, Drafting practices in dimensioning and tolerancing, Tolerance analysis.

Mass property calculations: Geometrical property formulation - Curve length, Cross-sectional area, Surface area, Mass property formulation - Mass, Centroid, Moments of inertia, Property mapping. Properties of composite objects.

References:

1. CAD/CAM Theory and Practice by Ibrahim Zeid.
2. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.
3. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
4. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

CADM 1.3 CNC AND APT PROGRAMMING

Periods per week : 4 | Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. | Credits : 4

Introduction: NC, DNC, CNC, Programmed Automations, Machine control unit, Part program, NC tooling.

NC machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centres, Automatic tool changes (ATC), Turning centres.

Machine control unit & tooling: Functions of MCU, NC actuation systems, Part program to command signal, MCU organization, Computerized numerical control, Transducers for NC machine tools, Tooling for NC machining centres and NC turning machines, Tool presetting.

Manual part programming: Part program instruction formats, Information codes: Preparatory function, Miscellaneous functions, Tool code and tool length offset, Interpolations, Canned cycles. Manual part programming for milling operations, Turning operations, Parametric subroutines.

Computer aided part programming: NC languages: APT, NELAPT, EXAPT, GNC, VNC, Preprocessor, Post processor.

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, complication control commands. Macro subroutines. Part programming preparation for typical examples.

References:
1. Numerical Control and Computer Aided Manufacturing by T.K. Kundra, P.N. Rao and N.K. Tewari, Tata McGraw-Hill Company Limited, New Delhi.
2. Numerical Control of Machine Tools by YoramKoren and Joseph Ben-Uri, Khanna Publishers, Delhi.

CADM 1.4 ROBOTICS

Periods per week : 4 | Examination : 70 ; Sessionals : 30

Examination (Theory): 3hrs. | Credits : 4

Introduction, Transformations and kinematics: Historical development, A sense of mechanisms, Robotic systems, Classification of robots, Position, orientation and location of a rigid body, Mechanics of robot manipulators. Objectives, Homogeneous coordinates, Homogeneous transformations, Coordinate reference frames, Some properties of transformation matrices, Homogeneous transformations and the manipulator: The position of the manipulator in space, Moving the base of the manipulator via transformations, Moving the tool position and orientation.

Position analysis of serial manipulators: Link parameters and link coordinate systems, Denavit-Hartenberg homogeneous transformation matrices, Loop-closure equations, Other coordinate systems, Denavit-Hartenberg method: Position analysis of a planar 3-DOF manipulator: Direct kinematics, Inverse kinematics, Method of successive screw displacements, Wrist centre position.

Position analysis of parallel manipulators: Structure classification of parallel manipulators, Denavit- Hartenberg method versus geometric method, Position analysis of a planar 3RRR parallel manipulator, Geometry, Inverse kinematics and Direct kinematics, Position analysis of a spatial orientation mechanism.

Jacobian analysis of serial manipulators: Differential kinematics of a rigid body, Differential kinematics of serial manipulators, Screw coordinates and screw systems, Manipulator Jacobian matrix.

Trajectory generation: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Geometric problems with Cartesian paths, Path generation at run time, Description of paths, Planning paths using the dynamic model, Collision-free path planning.

Robot Programming: Robot languages: AL, AML, RAIL, RPL, VAL, Demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).

Text Book:

1. Robot Analysis - The Mechanics of Serial and Parallel Manipulators by Lung-Wen Tsai, John Wiley & Sons, Inc.

References:

1. Introduction to Robotics - Mechanics and Control by John J. Craig, Addison-Wesley Longman Inc., 1999.
2. Robotic Engineering - An Integrated Approach by Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall of India Private Limited, 1994.
3. Robotics and Control by Mittal &Nagrath, Tata McGraw Hill Company Ltd.

CADM 1.5 Elective -I
A) ADVANCED OPTIMIZATION TECHNIQUES

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

INTRODUCTION: Statement of an optimization problem, Engineering Applications, Classification of optimization problems

Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P). Complementary geometric programming (C.G.P), Simple applications of G.P

Dynamic programming (D.P): Multistage decision processes. Concepts of sub optimization, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. Continuous D.P, simple applications of D.P

Integer programming (I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Branch-and-bound method.

Stochastic programming (S.P): Basics concepts of probability theory, stochastic linear programming

Unconventional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, A.N.N, Simulated Annealing

References:

1. Operations Research- Principles and Practice, Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research, Hiller and Lieberman, Mc Graw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Goal Programming and Extensions by James P. Ignizio, Lexigton Books.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

References:

1. Operations Research- Principles and Practice, Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research, Hiller and Lieberman, McGraw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Goal Programming and Extensions by James P. Ignizio, Lexigton Books.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

CADM1.5 Elective – I
B) ADVANCED NUMERICAL METHODS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Algebraic equations:Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method.

Ordinary differential equationsRungeKutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

Finite difference method for time dependent partial differential equation parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme- Stability of above schemes.

Finite difference methods for elliptic equations laplace and poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

Finite element method partialdifferential equations – Finite element method - orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

References :

1. SaumyenGuha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.
2. Gupta S.K., "Numerical Methods for Engineers", New Age Publishers, 1995
3. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", Cengage Learning, India Edition, New Delhi, 2009.
4. Jain M. K., Iyengar S. R., Kanchi M. B., Jain , "Computational Methods for Partial Differential Equations", New Age Publishers,1993.
5. Morton K.W. and Mayers D.F., "Numerical solution of partial differential equations", Cambridge University press, Cambridge, 2002.

CADM1.5 Elective – I
C) ADVANCED TOOL DESIGN

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Introduction to tool design Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment

Design of cutting tools Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters

Design of jigs and fixtures Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

Design of press tool dies Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting.

Tool design for CNC machine tools Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

PERIODS REFERENCES:
1. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2004
3. PrakashHiralal Joshi, "Tooling data", Wheeler Publishing, 2000
4. Venkataraman K., "Design of Jigs, Fixtures and Press tools", TMH, 2005
5. Haslehurst M., "Manufacturing Technology", the ELBS, 1978.

CADM1.6 Elective – II

A) DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Oil hydraulic systems and hydraulic actuators Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

Control and regulation elements Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

Hydraulic circuits Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

Pneumatic systems and circuits Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

Installation, maintenance and special circuits Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

References :

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 1980.
2. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.
3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.
5. K.ShanmugaSundaram, “Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand& Co Book publishers, New Delhi, 2006 (Reprint 2009).

CADM1.6 Elective – II
B) ADVANCED DESIGN

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Design philosophy: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability

Failure theories: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory. Fatigue failure theories, Fatigue mechanisms, Fatigue failure models, Fatigue failure criteria, Methods to reduce fatigue, Design for fatigue, Modified Goodman Diagram, Gerber method, Soderberg line, Surface failure models. Lubrication, friction and wear

Product Design: Product strategies, Product value, Product planning, product specifications, concept generation, concept selection, concept testing.

Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood, Glass parts.

Economic factors influencing design: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

References:

1. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall.
2. Mechanical Engineering Design by Joseph Shigley and Mischke. Sixth edition, Tata McGraw Hill
3. Machine Design - An Integrated Approach by R.L. Norton, Prentice Hall.
4. Product design and development by Karl T. Ulrich and Steven D. Eppinger. Third edition, Tata McGraw Hill.

CADM 1.6 Elective - II
C) COMPETITIVE MANUFACTURING SYSTEMS

Periods per week : 4 Examination : 70 ; Sessionals : 30

Examination (Theory): 3hrs. Credits : 4

Manufacturing in a competitive environment Automation of manufacturing process - Numerical control - Adaptive control - material handling and movement - Industrial robots - Sensor technology - flexible fixtures - Design for assembly, disassembly and service.

Group technology & flexible manufacturing systems Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer.

Computer software, simulation and database of FMS System issues - Types of software - specification and selection - Trends - Application of simulation - software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

Lean Manufacturing Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system – Total Productive Maintenance – standardized work –Man power reduction – Overall efficiency - Kaizen – Common layouts - Principles of JIT - Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Lean culture.

Just in time Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties – flexible work force - line flow strategy - preventive maintenance - Kanban system - strategic implications - implementation issues - Lean manufacture.

Text books:
1. Groover M.P., " Automation, Production Systems and Computer Integrated Manufacturing ", Third Edition, Prentice-Hall, 2007.
2. Pascal Dennis, “Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, (Second edition), Productivity Press, New York, 2007.

References:
1. Jha, N.K. “Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.
2. Kalpkjian, “Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
3. TaiichiOhno, Toyota, " Production System Beyond Large-Scale production Productivity Press (India) Pvt.Ltd. 1992.

CADM 1.7 CAD LAB

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 2

List of Experiments:

2D and 3D modelling and assembly modelling using modelling packages like AutoCAD, Auto Desk Mechanical desktop, Pro-Engineer, IDEAS.

Linear and non-linear static and dynamic analysis using any FEA package ANSYS / CAEFEM / NASTRAN.

CADM 1.8 SEMINAR -I

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 2

CADM 2.1 COMPUTER INTEGRATED MANUFACTURING

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Introduction: Scope of computer integrated manufacturing, Product cycle, Production automation.

Group technology: Role of group technology in CAD/CAM integration, Methods for developing part families, Classification and coding, Examples of coding systems, Facility design using group technology, Economics of group technology.

Computer aided process planning: Approaches to process planning - Manual, Variant, Generative approach, Process planning systems - CAPP, DCLASS, CMPP, Criteria for selecting a CAPP system, Part feature recognition, Artificial intelligence in process planning.

Integrative manufacturing planning and control: Role of integrative manufacturing in CAD/CAM integration, Over view of production control - Forecasting, Master production schedule, Capacity planning, M.R.P., Order release, Shop-floor control, Quality assurance, Planning and control systems, Cellular manufacturing, JIT manufacturing philosophy.

Computer aided quality control: Terminology in quality control, Contact inspection methods, Noncontact inspection methods, Computer aided testing, Integration of CAQC with CAD/CAM.

Computer integrated manufacturing systems: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, FMS.

References:
1. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.
2. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
3. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R.Henderson, Philip M. Wolfe.
4. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover, Prentice Hall of India Pvt. Ltd.
5. Principles of Computer Integrated Manufacturing by Vajapayee, Prentice Hall of India Pvt. Ltd.

CADM 2.2 MECHATRONICS

Periods per week : 4 Examination : 70 ; Sessionals: 30
Examination (Theory): 3hrs. Credits: 4

Mechatronics system design: Introduction to Mechatronics: What is mechatronics, Integrated design issues in mechatronics, Mechatronics key elements, the mechatronics design process, Advanced approaches in mechatronics.

Modelling and simulation of physical systems: Simulation and block diagrams, Analogies and impedance diagrams, Electrical systems, Mechanical translational systems, Mechanical rotational systems, Electromechanical coupling, Fluid systems.

Sensors and transducers: An introduction to sensors and transducers, Sensors for motion and position measurement, Force, torque and tactile sensors, Flow sensors, Temperature-sensing devices. Actuating devices: Direct current motor, Permanent magnet stepper motor, Fluid power actuation.

Signals, systems and controls: Introduction to signals, systems and controls, System representation, Linearization of nonlinear systems, Time delays.

Real time interfacing: Introduction, Elements of a data acquisition and control system, Overview of the I/O process, Installation of the I/O card and software.

Advanced applications in mechatronics: Sensors for condition monitoring, Mechatronic control in automated manufacturing, Artificial intelligence in mechatronics, Microsensors in mechatronics.

Text Books:

1. Mechatronics System Design by DevdasShetty and Richard A. Kolk, P.W.S. Publishing Company, 2001

References:

1. Mechatronics by W. Bolton, Pearson Education, Asia, II-Edition, 2001
2. Introduction to Mechatronics and Measurement Systems by Michael B. Histand and David G. Alciatore, Tata McGraw Hill Company Ltd.

CADM 2.3 FLEXIBLE MANUFACTURING SYSTEMS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Introduction: The economic justification of FMS, The basic components of FMS and their integration in the data processing system, The concept of the 'total system'.

Management decisions during FMS project planning, design and implementation: Designing the FMS, Data processing design, FMS project and software documentation.

Artificial intelligence in the design of FMS: LISP, PROLOG, Expert systems, Expert systems in FMS design and control, Integrative aspects of AI languages.

Distributed processing in FMS: Introduction to database management systems (DBMS) and their application in CAD/CAM and FMS, Distributed systems in FMS.

Distributed tool data bases in FMS: The distributed tool data structure with a general purpose tool description facility, Implementation of the FMS tool data base, Application possibilities of the FMS tool data base.

FMS database for clamping devices and fixtures: The FMS clamping device and fixture data base, The analysis and calculation of pallet alignment and work mounting errors, Mating surface description methods for automated design and robotised assembly, Application of industrial robots in FMS, The application of automated guided vehicle (AGV) systems.

Coordinate measuring machines in computer integrated systems: Overview of coordinate measuring machine, Contact and non-contact inspection principles, Part programming coordinate measuring machines, In-cycle gauging.

References:

1. The Design and Operations of FMS by Dr. Paul Ranky, IFS (Publications) Ltd., UK, 1983.
2. Flexible Manufacturing Systems in Practice by Joseph Talavage and Roger G. Hannam, Marcel Dekker Inc., New York.
3. Robotics Technology and Flexible Automation by S.R. Deb, Tata McGraw Hill Company Ltd.

CADM 2.4 VISION SYSTEMS AND IMAGE PROCESSING

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Machine vision - Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications. Image representation - Application of image processing - Image sampling, Digitization and quantization - Image transforms.

Spatial domain techniques - Convolution, Correlation. Frequency domain operations - Fast Fourier transforms, FFT, DFT, Investigation of spectra. Hough transform

Image enhancement, Filtering, Restoration, Histogram equalisation, Segmentation, Region growing.

Image compression - Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification.

References:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.
2 Robot Vision by Prof. Alan Pugh (Editor), IFS Ltd., U.K. 3. Digital Image Processing by A. Rosenfled and A. Kak, Academic Press.
4. The Psychology of Computer Vision by P. Winstan, McGraw-Hill.
5. Algorithms for Graphics and Image Processing by T. Pavidis, Springer Verlag.

CADM2.5Elective – III

A) ADVANCED FINITE ELEMENT ANALYSIS

Periods per week : 4 | Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. | Credits : 4

Introduction, Finite elements of an elastic continuum - displacement approach, generalization of the finite element concept - weighted residuals and variational approaches. Plane stress and plane strain, Axisymmetric stress analysis, 3-D stress analysis.

Element shape functions - Some general families of C continuity, curved, isoparametric elements and numerical integration. Some applications of isoparametric elements in two-and-three dimensional stress analysis.

Bending of thin plates - A C continuity problem. Non-conforming elements, substitute shape functions, reduced integration and similar useful tricks. Lagrangian constraints in energy principles of elasticity, complete field and interface variables (Hybrid method).

Shells as an assembly of elements, axisymmetric shells, semi-analytical finite element processes - Use of orthogonal functions, shells as a special case of 3-D analysis. Steady-state field problems - Heat conduction, electric and magnetic potentials, field flow, etc.

The time domain, semi-descritization of field and dynamic problems and analytical solution procedures. Finite element approximation to initial value - Transient problems.

References:

1. The Finite Element Method by O.C. Zienkiewicz, Tata McGraw Hill Company Ltd.
2. The Finite Element Methods in Engineering by Rao, S.S.
3. Concepts and Applications of Finite Element Analysis by Cook, R.D.
4. Applied Finite Element Analysis by Segerland, L.J.

CADM 2.5 Elective – III
B) NEURAL NETWORKS AND FUZZY TECHNIQUES

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Neural networks and fuzzy systems: Nerual and fuzzy machine intelligence, Fuzzy as multivalence, The dynamical - Systems approach to machine intelligence, Intelligent behaviour as adaptive model - Free estimation.

Neural dynamics-I: Activations and signals, Neurons as functions, Signal monotonicity, Biological activations and signals, Neuron fields, Neuronal dynamical systems, Common signal functions, Pulse-coded signal functions.

Neuronal dynamics-II: Activation models, Neuronal dynamical systems, Additive neuronal dynamics, Additive neuronal feedback, Additive bivalent models, BAM connection matrices, Additive dynamic and the noise - Saturation dilemma, General neuronal Activations: Cohen-Grossberg and multiplicative models. Synaptic Dynamics I: Unsupervised learning, Learning as encoding, change, and quantization, Four unsupervised learning laws, Probability spaces and random processes, Stochastic unsupervised learning and stochastic equilibrium, Signal Hebbian learning, Competitive learning, Differential Hebbian learning, Differential competitive leering.

Synaptic Dynamics II: Supervised learning, Supervised function estimation, Supervised learning as operant conditioning, Supervised learning as stochastic pattern learning with known class memberships, Supervised learning as stochastic approximation, The back propagation algorithm.
Fuzziness Versus: Probability fuzzy sets and systems, Fuzziness in a probabilistic world, Randomness vs. ambiguity: Whether vs. how much, The universe as a fuzzy set, The geometry of fuzzy set, The geometry of fuzzy sets: Sets as points. The fuzzy entropy theorem, Thesubsethood theorem. The entropy-subsethood theorem.

Fuzzy associative memories: Fuzzy systems as between-cube mappings, Fuzzy and neural function estimators, Fuzzy Hebb FAMs, Adaptive FAMs: Product-space clustering in FAM cells. Applications in design and structural analysis.

References:

1. Neural Networks & Fuzzy Systems by Bark Kosko, PHI Published in 1994
2. Neural Network Fundamentals with Graphs, Algorithms and Applications by B.K. Bose, Tata- McGraw Hill.
3. Neural network Design by Hagan, Demuth and Beale, Vikas Publishing House.
4. Fundamentals of Artificial Neural Networks by Mohamad H Hassoum. PHI.
5. Fuzzy Set Theory & its Application by .J. Zimmerman Allied Published Ltd.
6. Algorithms and Applications of Neural Networks in Mechanical Engineering by M. AnandaRao and J. Srinivas, Narosa Publishing House.

CADM 2.5 Elective – III
C) CONCURRENT ENGINEERING

Periods per week : 4 — Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. — Credits : 4

Introduction: Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.

Strategic approach and technical aspects of product design: Steps in the strategic approach to product design - Comparison to other product design methods - Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.

Basic issues in manufacturing system design: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.

Assembly workstation design: Strategic issues - Technical issues analysis.

Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.

Case studies: Automobile air conditioning module - Robot assembly of automobile rear axles.

Reference:

1. Concurrent Design of Product and Processes by James L. Nevins and Daniel E. Whitney, McGraw-Hill Publishing Company, 1989.

CADM 2.6 Elective - IV

A) SIGNAL ANALYSIS AND CONDITION MONITORING

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Introduction: Basic concepts. Fourier analysis.Bandwidth. Signal types. Convolution.

Signal analysis: Filter response time. Detectors.Recorders.Analog analyzer types.

Practical analysis of stationary signals: Stepped filter analysis. Swept filter analysis. High speed analysis.Real-time analysis.

Practical analysis of continuous non-stationary signals: Choice of window type. Choice of window length.Choice of incremental step.Practical details.Scaling of the results.

Practical analysis of transients: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth).Analysis by repeated playback (variable bandwidth).

Condition monitoring in real systems: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan.Sugar centrifugal.Cooling tower fan.Air separator.Preheater fan.Field balancing of rotors.ISO standards on vibrations.

References:

1. Condition Monitoring of Mechanical Systems by Kolacat.
2. Frequency Analysis by R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory by V. Ramamurti, Narosa Publishing House.

CADM 2.6 Elective - IV
B) ADDITIVE MANUFACTURING

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Introduction: Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.

Reverse engineering and cad modeling: Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

Liquid based and solid based additive manufacturing systems: Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Powder based additive manufacturing systems: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

Other additive manufacturing systems: Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

References:

1. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
3. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2011.
5. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
6. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

CADM 2.6 Elective - IV

C) METROLOGY AND NON DESTRUCTIVE TESTING

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 4

Measuring machines Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Image shearing microscope - Use of computers - Machine vision technology - Microprocessors in metrology.

Statistical Quality Control Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.

Liquid penetrant and magnetic particle tests Characteristics of liquid Penetrants - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications - Advantages and limitations.
RADIO GRAPHY Sources of ray-x-ray production - properties of d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

Ultrasonic and acoustic emission techniquesProduction of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.

References:
1. JAIN, R.K. “Engineering Metrology ", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, " Non Destructive Testing ", Mac Millan, 1988.
3. American Society for Metals, “Metals Hand Book ", Vol. II, 1976.
4. Progress in Acoustic Emission, “Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.

CADM 2.7 CAM LAB

Periods per week : 3 | Examination: 50 Sessionals : 50

Credits : 2

Manual and computer assisted part programming exercises on CNC machine tools.

Surface generation, Tool selection, NC code generation and Tool path simulation for turning and milling operations using CAM packages like CATIA, Gibbs CAM, Master CAM.

Robot programming off-line and on-line.

CADM1.1

M.Tech.DEGREE EXAMINATION

MECHANICAL ENGINEERING

CAD/CAM

FIRST SEMESTER

COMPUTER GRAPHICS

(Effective from the Admitted Batch of 2015-2016)

MODEL PAPER

Time : 3Hrs. Max. Marks: 70

Answer any FIVE questions.

All questions carry equal marks.

1. a) Explain the Bresenham's algorithm for generating a circle and discuss about its advantages.
b) Explain about the graphic primitives for display-file structure.

2. a) Explain an algorithm for filling a polygon with a pattern.
b) Develop a combined transformation matrix to reflect the given object about a line passing through the point (x_p, y_p) and having a slope lm.

3. a) Explain the procedure for creating and closing a segment.
b) Explain about the generalized clipping.

4. a) Derive the combined transformation matrix to rotate the given 3-D object about an axis passing through the points (x_a, y_a, z_a) and (x_b, y_b, z_b).
b) Explain transformation for perspective projection.

5. a) Explain the Painter's algorithm with a suitable example.
b) Explain about any one shading algorithm.

6. a) Given the algorithm to generate the Bezier curve for the four given points.
b) What is fractal? How thy are useful in generating lines and surfaces?

7. a) Write short note on 3-D homogeneous transformations.
b) Explain the procedure to represent a surface patch in a CAD model.

8. Write short notes on:
a) Pixels and frame buffers.
b) Inside test.
c) Scaling transformation.
d) Curve fitting and curve fairing technique.

CADM1.2

M.Tech.DEGREE EXAMINATION

MECHANICAL ENGINEERING

CAD/CAM

FIRST SEMESTER

INTEGRATED COMPUTER AIDEDE DESIGN

(Effective from the Admitted Batch of 2015-2016)

MODEL PAPER

Time : 3Hrs. Max. Marks: 70

Answer any FIVE questions.

All questions carry equal marks.

1. a) What is CAD and what are its applications and benefits?
b) What are the hardware requirements of a Design workstation? Explain.

2. a) What is geometric modeling? Compare and contrast the various modeling techniques.
b) How are solid modelers categorized? Explain the generic architecture of any solid modeler. Name some popular solid modelers.
c) Create the CSG model of the solid shown in the figure 1.

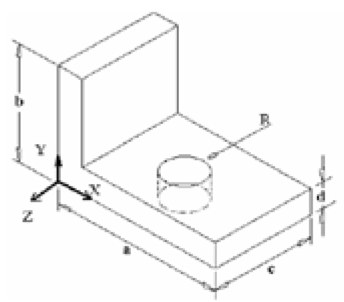


Fig.1.

3. a) What is shading? How is the shading of CSG model achieved? Explain any one shading algorithm for solids.
b) What do you understand by the term geometric modifier? Explain. Give some examples where layering concepts are useful.

4. a) What is animation? Compare and contrast the conventional animation and computer animation. Write a brief note on animation techniques.
b) Explain the procedure involved in animating a four bar linkage.

5. a) Generate the assembly tree and the precedence diagram for the assembly shown in the figure 2. Count the number of all possible assembly sequences to create the assembly.

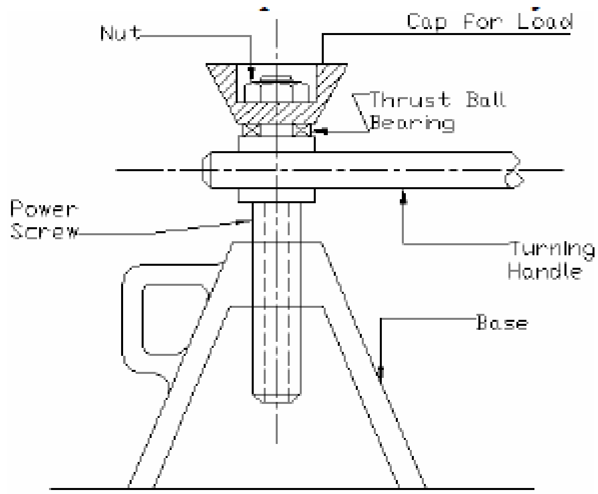


Fig. 2.

b) What are the various techniques to generate all assembly sequences for a mechanical component? Explain Liaison sequence analysis.

6. a) What is geometric tolerancing? What are the types of geometric tolerances? How is it different from conventional tolerancing? Give a list of ANSI symbols for geometric tolerances?

b) Fig.3 shows a part design with assigned tolerances. Use the arithmetic method to calculate the tolerance information for the axial dimension F of the outside surface shown.

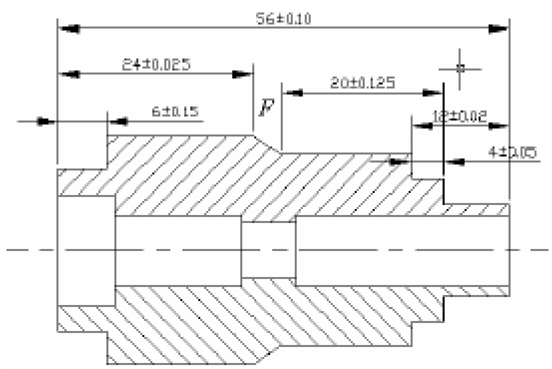


Fig. 3

7. a) Derive the principal moments of inertia of an object given its moments about a coordinate system.

b) The geometry of an object is given in the following figure. Calculate the mass properties of the object assuming a density of 801.2 N/m^3.

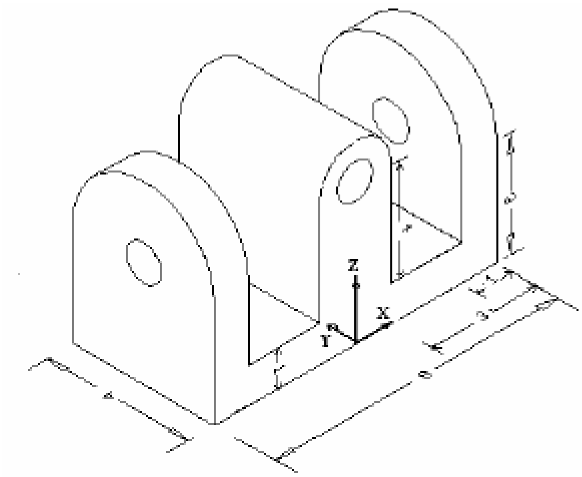


Fig. 4

8. Write short notes on any FOUR of the following:
a) Rubber banding and dragging
b) Rendering a 3-D solid model
c) Boolean operations, extrusion with AutoCAD
d) Tolerance analysis
e) Properties of composite objects

CADM1.3
M.Tech.DEGREE EXAMINATION
MECHANICAL ENGINEERING
CAD/CAM
FIRST SEMESTER
CNC & APT PROGRAMMING
(Effective from the Admitted Batch of 2015-2016)
MODEL PAPER

Time : 3Hrs. Max. Marks: 70

Answer any FIVE questions.
All questions carry equal marks.

1. a) What is NC? What are the major advantages of CNC machine tool compared to its conventional counter part?
   b) How do you designate the coordinate axes for a CNC lathe? Show them diagrammatically on a rough sketch of a lathe.
2. a) How BCD system differs from Binary system? Explain how the eight track tape coding is specified in ISO and EIA.
   b) Explain important features of a CNC machining centre.
3. a) What is the function of a Transducer in CNC? Explain any one type of a Transducer.
   b) Explain the function of MCU and explain its organization to perform its functions.
4. Prepare manual part program for machining the component with 4 holes of 10 mm diameter on 60 mm p.c.d. as shown in Fig.1 using ISO code. Do not use G41 or G42.

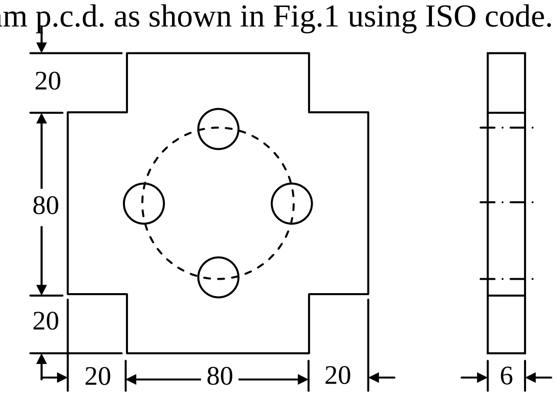


Fig.1

5. Prepare manual part programming for turning the component shown in Fig.2 on CNC lathe using ISO code. Assume the tool tip radius is 2 mm.

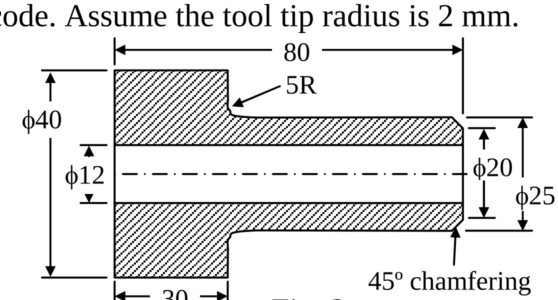


Fig. 2

6. a) Give any six circle definitions in APT geometry.

b) Write APT geometry to define lines and circles shown in Fig.3.

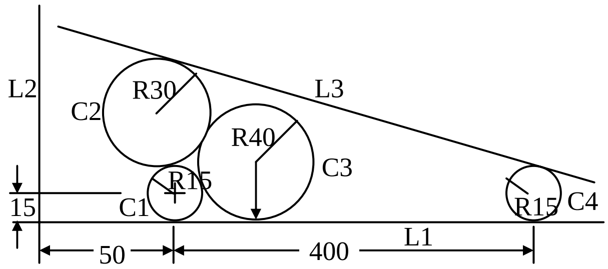


Fig. 3

7. Prepare NC program in APT for machining the contour shown in Fig.4 with two passes one with rough-cut and other with finish cut.

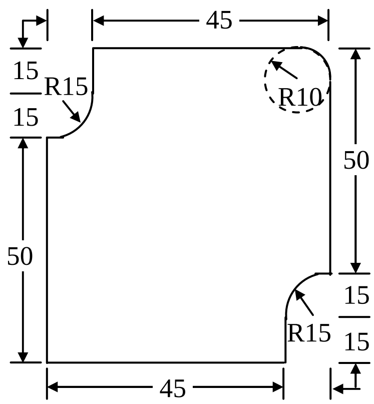


Fig. 4

8. Write short notes on any FOUR of the following:

i) Servo system
ii) Presenting tools
iii) Tab sequential format
iv) MATRIX definition in APT
v) INTOL and OUTTOL commands
vi) Post processor

CADM1.4
M.Tech.DEGREE EXAMINATION
MECHANICAL ENGINEERING
CAD/CAM
FIRST SEMESTER
ROBOTICS
(Effective from the Admitted Batch of 2015-2016)
MODEL PAPER

Time : 3Hrs. Max. Marks: 70

Answer any FIVE questions.
All questions carry equal marks.

1. a) Write about the historical development of Robot manipulators.
   b) Write about the classification of Robots.
2. a) Explain the different ways by which the orientation of a rigid body can be described with respect to the fixed frame.
   b) What is the resultant rotation matrix for a rotation of 60º about the fixed X-axis, followed by a rotation of 45º about the Y-axis, followed by rotation of 30º about the Z-axis. For the above rotations find the direction of the screw axis and angle of rotation.
3. Figure-1 shows the schematic diagram of the Scorbot robot. In the diagram, the second, third and fourth joint axes are parallel to one another and point into the paper at points A, B, and P respectively. The first joint axis points up vertically, and the fifth joint axis intersects the fourth perpendicularly. The D-H parameters are as given under. Find the overall transformation matrix for the robot.

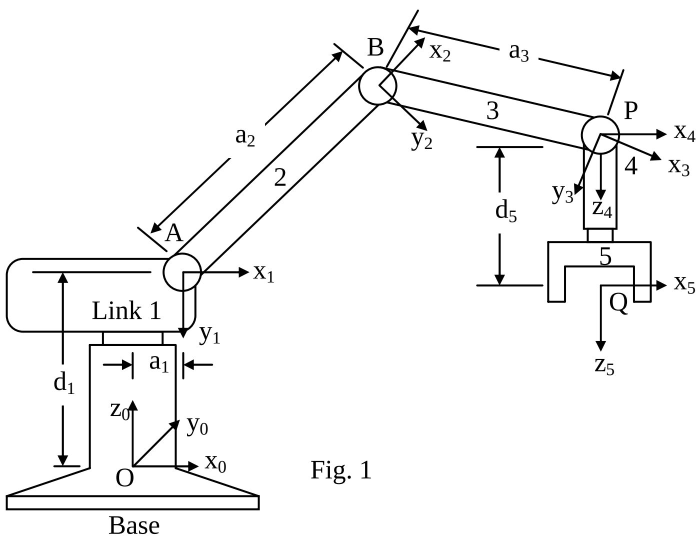


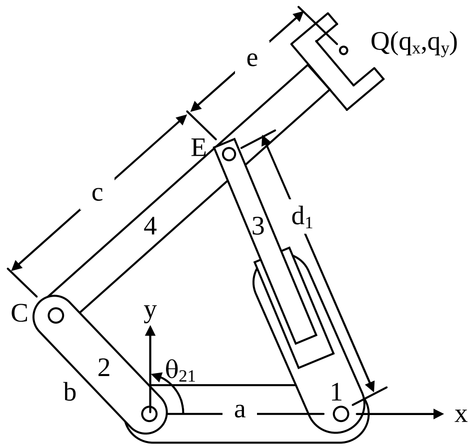
Fig. 1

D-H parameters of a Scorbot robot

Joint i	α_i	a_i	d	θ_i
1	$-\pi/2$	$a_1 = 10$	$d_1 = 5$	$\theta_1 = 30$
2	0	$a_2 = 15$	$d_2 = 0$	$\theta_2 = 45$
3	0	$a_3 = 20$	$d_3 = 0$	$\theta_3 = 60$
4	$-\pi/2$	$a_4 = 0$	$d_4 = 0$	$\theta_4 = 50$
5	0	$a_5 = 0$	$d_5 = 5$	$\theta_5 = 70$

4. a) How do you classify parallel manipulators?
   b) Figure-2 shows the schematic diagram of planar 2-d.o.f. five-bar manipulator that is constructed with one

prismatic and four revolute joints. Find the end effector position **q** as function of the two input joint variables, d_1 and θ_2.



5. a) What is a Jacobian?
   b) Derive the conventional Jacobian of a planar 2-d.o.f. manipulator shown in Figure-3.

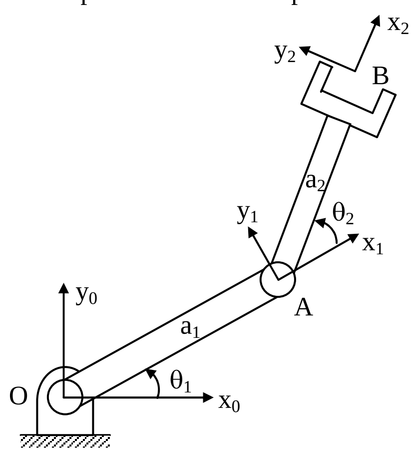


Fig. 3

6. a) A single-link robot with a rotary joint is motionless at $\theta = 15^\circ$. It is desired to move the joint in a smooth manner to $\theta = 75^\circ$ in 3 seconds. Find the coefficients of a cubic which accomplishes this motion and brings the manipulator to rest at the goal. Plot the position, velocity, and acceleration of the joint as a function of time.
   b) What is collision-free path planning?
7. Write about any Robot Language providing a sampling of the important features and statements.
8. Write short notes on any THREE of the following:
   a) Homogeneous Transformation Matrix.
   b) Method of successive crew displacements.
   c) Planning paths using the dynamic model.
   d) Demonstration of points in space.

CADM1.5ELECTIVE -I

M. Tech.DEGREE EXAMINATION

MECHANICAL ENGINEERING

CAD/CAM

FIRST SEMESTER

ADVANCED OPTIMZATION TECHNIQUES

Common with Industrial Engineering

(Effective from the Admitted Batch of 2015-2016)

MODEL PAPER

Time : 3Hrs. Max. Marks: 70

Answer any FIVE questions.

All questions carry equal marks.

1. a) What is arithmetic – geometric inequality?

   b) Minimize the following function:

   $$f(X) = \frac{1}{2}x_1^2 + x_2 + \frac{2}{3}x_1^{-1}x_2^{-1}$$

2. a) Explain the problem of Dimensionality in Dynamic programming.

   b) Maximize $f(x_1, x_2) = 50x_1 + 100x_2$

   Subjected to

   $$10x_1 + 5x_2 \leq 2500$$
   $$4x_1 + 10x_2 \leq 2000$$
   $$x_1 + 1.5x_2 \leq 450$$
   $$x_1 \geq 0, \qquad x_2 \geq 0$$

3. Solve the following problem using Bala's method.

   Minimize $f = 3x_1 + 2x_2 + x_3 + x_4$

   Subjected to

   $$x_2x_3 + x_4 \leq 1$$
   $$2x_1 + x_2x_3 + x_4 \geq 3$$
   $$x_i = 0 \, or 1, \; i = 1,2,3,4.$$

4. A contractor plans to use four tractors to work on a project in a remote area. The probability of a tractor functioning for a year without a breakdown is known to be 82%. If X denotes the number of tractors operating at the end of a year, determine the probability mass and distribution function of X and also find the expected value and the standard deviation of the number of tractors operating at the end of one year.

5. Find the minimum of

   $$f_1 = x_1^2 + x_2^2$$
   $$f_2 = (x_1 - 2)^2 + x_2^2$$

   Subject to

   $$x_1 - x_2 - 1 \leq 0$$

6. a) Construct the objective function to be used in GAs for a minimization problem with mixed equality and inequality constraints.

   b) Consider the following two strings denoting the vector X_1 and X_2

   X_1: {1 0 0 0 1 0 1 1 0 1}

   X_2: { 0 1 1 1 1 1 0 1 1 0}

   Find the result of crossover at location 2. Also, determine the decimal value of the variable before and after crossover if each string denotes a vector of two variables.

7. a) What is a sigmoid function? How it is affected by weighted sum of inputs, explain.

   b) How is a neuron modeled in neural network-based model, explain with one example.

8. Explain any Three of the following.
   a) Simulated Annealing Algorithm
   b) Continuous Dynamic programming
   c) Branch – and - Bound method
   d) Complementary Geometric programming

CADM1.6ELECTIVE -II

M. Tech.DEGREE EXAMINATION

MECHANICAL ENGINEERING

CAD/CAM

FIRST SEMESTER

ADVANCED DESIGN

(Effective from the Admitted Batch of 2015-2016)

MODEL PAPER

Time : 3Hrs. Max. Marks: 70

Answer any FIVE questions.

All questions carry equal marks.

1. a) What is need analysis?
   b) Explain different design specifications with suitable examples.
2. a) Explain different stages of product life cycle. Illustrate with a suitable example.
   b) Briefly enumerate the advantages of standardization.
3. a) Explain Von Mises stress.
   b) For the bicycle pedal arm assembly as shown in Fig.1 with rider applied force of 1500 N at the pedal, determine the Von Mises stress in the 15 mm dia pedal arm. The pedal attaches to the arm with a 12 mm thread. Find the Von Mises stress in the screw. Find the safety factor against static failure if the material has S_y = 350 MPa.

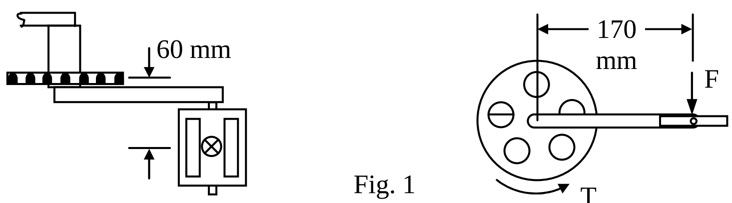


Fig. 1

4. a) Explain the mechanism of fatigue failure.
   b) Explain various factors affecting fatigue life of a component.
5. a) Explain the design considerations for casting process with examples.
   b) Briefly explain design process for non-metallic parts.
6. a) Explain the conventional breakeven chart.
   b) What is manufacturability? Describe its significance in design for manufacturing.
7. a) What is creativity?
   b) Explain the various creative techniques.
8. Write any FOUR of the following:
   a) Shigley model of design.
   b) Fracture mechanics theory of failures.
   c) Stress concentration factors.
   d) Design for reliability.
   e) Material selection concepts.