SYLLABUS PRESCRIBED FOR TWO YEAR P.G. COURSE IN MASTER OF ENGINEERING (FULL TIME) MECHANICAL- CAD/CAM

SEMESTER-I

1MCC1 COMPUTER AIDED DESIGN

Section-A

Introduction to computer technology, Introduction to CAD systems, Computer Aided Design workstation and peripherals, Graphics input/output devices Design process and CAD models: Computers for design, benefits of CAD ICG: Configuration of graphic workstations, Vector and Raster displays, Geometric modeling and transformations.

Section-B

CAD software: Graphics system and functions of a graphics package, Graphics databases structure and handling, Operating features, wireframe, solid and surface modeling, approaches to solid modeling.Computer aided drafting and documentation: Principles and concepts of automated drafting, drafting packages, Introduction to CADD packages like AutoCAD, SOLIDWORKS, CATIA. Graphics standards like GKS, PHIGS, IGES etc Practical : Five practical based on above syllabus

References:

1) CAD/CAM by Groover and Zimmers
2) Computer Aided Design in Mechanical Engineering by V. Ramamurti
3) CAD by Krishnamoorthy and Rajiv
4) CAD Principles and Applications by Barr, Krimger and Lazaer
5) CAD/CAM Handbook by Teicholz

1MCC2 COMPUTER AIDED MANUFACTURING

Section-A

Numerical control (NC): Fundamentals of NC, merits and demerits of NC, classification of NC systems, basic components of NC systems, instructions, NC tape and coding, control units, features of machine tools and system devices. Computer Numerical Control CNC: Problems in conventional NC, NC controller technology, computer numerical control, designing CNC systems. NC/CNC machine tools: Types and features, DDA integrator, DDA hardware interpolator, software interpolators, reference word interpolator, point to point, straight line and contouring control loops

Section-B

NC/CNC part programming: Introduction, computer-aided part programming (APT), CNC part programming direct numerical control (DNC), Types of DNC Systems. Combined DNC/CNC systems, Adaptive control: ACC and ACO systems, optimization of AC Practical: Five practical based on above syllabus

References:

1) Yoram Koren- Computer control of manufacturing, McGraw Hill.
2) Mikell P. Groover- CAD/CAM-Prentice-Hall of India pvt. Ltd.
3) Kundar T.K., Rao P.N.-Numerical control and computer aided manufacturing; Tata McGraw Hill.
4) D. Kochan- CAM Development in computer integrated manufacturing-Springer Verlag, Berlin

1MCC3 COMPUTER ASSISTED PRODUCTION MANAGEMENT

Section-A

Computer aided process planning: Approaches to CAPP, basic part representation methods, shape producing capabilities, Process economics Computer assisted QC: co-ordinate measuring machines construction and types, automated dimensional gauging and in process gauging Capacity planning: Roll of capacity planning in manufacturing, planning and control systems, hierarchy of capacity planning decisions links to other system modules, capacity planning and control techniques.

Section-B

Just in time: JIT in manufacturing planning and control, leveling the production, pull system introduction, product and process design, JIT applications Computer aided inventory control: Computer aided purchasing procedure, simulation of inventory problems Computer aided materials management: Material requirement planning, computer integrated materials management.

References:

1) Groover M.P.- Automation, Production Systems and CIM.
2) David Bedworth, M.R. Handerson & Philip Wilze- Computer Integrated Design and manufacturing

MANAGEMENT INFORMATION SYSTEMS

Section-A

Objectives and cost benefits of Management Information Systems (MIS). Decision and MIS. A decision environment model, Decision strategies. Characteristics of information: Measurement and amount of Information, Information search, storage and retrieval, Information feed back systems. Planning techniques: Project proposals, reporting and controlling, Determination for information needs and sources, development of conceptual design, development of detailed design, selection of final design, design report, organization for implementation, training of operational personnel, forms and files for data collection, evaluation control and maintenance of information
system.

Section-B

Computer Based Information System, MIS and CBIS family, MIS in total CBIS environment, an MIS model and dimensions of MIS model, an overview of tele-processing system(TPS):Techniques for TPS processing models, MIS and TPS, decision support system : definition : characteristics of DSS difference in DSS and development of DSS and its applications, production of sub-systems : Marketing subsystems, finance sub-systems, personnel sub-system, office automation system : definition, importance, planning and implementation of Automated computer based office communication system.

References:

1) Essentials of MIS by K.C. Laudon, J.P. Laudon; PH
2) Strategic Management and MIS: An Integrated Approach by W. Robson;Pitman Pub.
3) Information systems for Managers by G.W.Reynolds; West Pub.
4) IT for Management by Turban E and McLean E; John Wiley Pub.
5) Foundations of Information systems by Zwass V; Irwin/ McGraw Hill

1MCC 5 ELECTIVE-I

4. OPTIMIZATION TECHNIQUES

Section-A

Classical Optimization Techniques: Single-variable and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers Method, Kuhn-Tucker Condition Single-variable Optimization Techniques: Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden-section Method, Quadratic Interpolation Method, Newton Method, Quasi-Newton Method, Secant Method Multi-variable Optimization Techniques: Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method, Conjugate Direction Method, Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon- Fletcher-Powell Method

Section-B

Constrained Optimization Techniques: Interior Penalty Function Method, Exterior Penalty function Method. Genetic Algorithm, Simulated Annealing, Artificial Neural Networks. Theory of Constraints: Introduction to TOC, Optimized Production Technology (OPT), Nine principles of OPT, Five Focusing Steps (The 5FS) of TOC, Capacity Constrained Resources and the Time Buffer, Modeling the Time Buffer, Modeling Return-On-Investment (ROI) in TOC, Comparison of TOC and Local Optimization Approaches

References:

1. Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India.
2. Dennis J Jr, Schnabel R (1996). Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Society for Industrial and Applied Mathematics.
3. Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers
4. Ravindran A, Ragsdell K and Reklaitis G (2006). Engineering Optimization: Methods and Applications, 2nd edition, John Wiley and Sons Inc.
5. Goldratt, E. M. and Cox, J. (2004). The Goal: A Process of Ongoing Improvement. 3rd Edition, North River Press. ISBN-10: 0884271781, ISBN-13: 978-0884271789
6. Dettmer, H. William (1997). Goldratt's Theory of Constraints: A Systems Approach to Continuous Improvement, American Society for Quality. ISBN 0873893700, 9780873893701

1MCC 5 ELECTIVE-I

5. DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT

Section-A

Introduction: General design principles for manufacturability, Strength and mechanical factors, Mechanism selection, Evaluation method, Process capability, Feature tolerances, Geometric tolerances, Assembly limits - Datum features, Tolerance stacks. Factors influencing form design: Working principle, Material, Manufacture, Design, Possible solutions, Materials choice, Influence of materials on form design , Form design of welded members, Forgings and castings.

Component design-machining consideration : Design features to facilitate machining, Drills, Milling cutters, keyways, Doweling procedures, Counter sunk screws, Reduction of machined area, Simplification by separation, Simplification by amalgamation, Design for machineability, Design for economy, Design for clampability, Design for accessibility, Design for assembly.

Section-B

Component design - casting consideration: Redesign of castings based on parting line considerations, Minimizing core requirements, machined holes, Redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, Group technology, Computer Applications for DFMA. Design for the environment: Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Applications, Lifecycle assessment: Basic method, AT&T's environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for disassembly: Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.

BOOKS RECOMMENDED:

1. Bralla, "Design for Manufacture handbook ", McGraw hill, 1999. 2. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker, 1994.

3. Dixon, John. R, and Corroda Poli, "Engineering Design and Design for Manufacture and Structural approach", Field Stone Publisher, USA, 1995.

4. Fixel, J. "Design for the Environment", McGraw Hill., 1996.5. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, 2004.

SEMESTER-II

2MCC1 FINITE ELEMENT ANALYSIS

Section-A

Introduction: Discretization, going from part to whole approach, Conventional Numerical methods- finite difference method , method of least squares Ritz method, boundary value problems, displacement method, the equilibrium method, the mix method of solid mechanics, Finite element formulation, variational methods. Finite Elements- types: triangular, rectangular, quadrilateral, sector curved, isoparametric elements General procedure of FEM: Discretization, element shapes, interpolation functions, shape functions, element stiffness matrix, global stiffness matrix, application of boundary conditions, solutions.

Section-B

FEA of 2-D single variable problems, application of Heat transfer, fulid mechanics, solid mechanisms, plane elasticity, analysis of structural vibrations

Applications: Free vibration of thin plates, cylindrical shells, transient heat conduction, torsion of prismatic shafts, motion of fluid in flexible container, flow of ideal fluids, viscous fluids, sheep structures.

Softwares in FEM: Introduction and study of FEM packages like ASKA, SAP, NASTRAN, ANSYS, COSMOS, NISA, ANIDA

Practical: Five practical based on above syllabus

References:

1) Introduction to Finite Element Methods by C.S. Desai & J.F. Abel.

2) Concept and application of Finite element analysis by Robert Cook.

3) Finite element analysis by C.S. Krishnamoorthy.

4) Finite element methods by J.N. Reddy.

2MCC2 SIMULATION THEORY AND APPLICATIONS

Section-A

System models and studies: Concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modeling, types of models, principles used in modeling, subsystems, types of system studies.

System simulation: The techniques of simulation, Monte Carlo method, comparison of simulation and analytical methods, Analog computers and methods, hybrid computer, simulators, continuous system simulation languages, system dynamics, growth models, logistic curves, multi-segment models, probability concepts in simulation, system simulation, events, representation of time, arrival pattern.

Section-B

Analysis of simulation output : Estimation method, simulation run statistics, replications of runs, elimination of initial bias, batch means, regenerative techniques, time series analysis, spectral analysis, auto regression. Applications of simulation in manufacturing

Practical : Five practical based on above syllabus

References:

1) Geoffrey Gordon- System Simulation
2) Narsingh Deo- System Simulation with Digital Computers.
3) Naylor T.H. et. Al.- Computer Simulation Techniques.
4) Gottfried B.S- Elements of Stochastic Process Simulation

2MCC3 ROBOTICS AND ROBOT APPLICATIONS

Section-A

Introduction: Definition, need, robot classification, terminology and systems, benefits and limitations. Robot system: Robot physical configuration, basic robot motions, end effectors work cell control and interlocks. Robot sensors: Vision tactile and proximity, voice, robot control, kinetics and necessary control systems.

Section-B

Robot applications: General considerations and problems, material transfer, machine loading, welding, spray coating, processing operations, assembly, inspection, robo in FMS and automation. Robot arm kinematics: Homogenous transformation matrix.

References:

1) Handbook of Industrial robotics.
2) Aures R.U. & Miller S.M.- Robotics applications and social implications.
3) Tanner W.R. – Industrial Robots Vol.-1 & Vol.-2.
4) Groover M.P. and Zimmer E.W.- Computer Aided Design and Manufacturing

2MCC4 INDUSTRIAL PRODUCT DESIGN

Section-A

An approach to industrial design, Technical requirements, Ergonomic requirements, Aesthetic requirements. Ergonomic and industrial design Man- Machine relationship, Anthrometric data, Ergonomical design aspects of M/c tools testing M/cs, Instruments, automobile process equipment, etc.

Aesthetic concepts: Concepts of unity, concept of order with variety, concept of purpose, style and environment, Aesthetic continuity, proportions, rhythm, radiance.

Section-B

Design for Producibility, design for Assembly & Disassembly, Design for Maintenance
Computer aided Product Design

Industrial Design in Graphics: general design situations, Specifying design requirements, rating the importance of Industrial Design. Design & development for Generative Manufacturing Processes. Product Patenting.

References:

1) Industrial Design for Engineers by W.H. Mayali.
2) Design Engineering by John Diwan .
3) Problems of Product Design development by C.Hearn Bucle Pergaman Press.
4) Product Design & Manufacture by John Lindbeck , Prentice Hall International.
5) Integrated Product & Process Design by Edward Magrab, RC Press.

2MCC5 ELECTIVE-II

1. FLEXIBLE MANUFACTURING SYSTEMS

Section-A

FMS an overview: types and configuration, concept, types of flexibility and performance measures, functions of FMS, FMS host and area controller function distribution. Development and implementation of FMS: Planning phases, integration, system configuration, FMS layout, FMS project development steps.

Section-B

Automated material handling and storage: Functions- types- analysis of material handling equipments design on conveyors and AGV systems.

Automated Storages: Storage system performance- AS/RS- carousal storage system- WIP storage system- interfacing handling, storage with manufacturing.

Modeling and Analysis of FMS: Analytical, heuristic, queuing, simulation and petrinet modeling techniques- scope, applicability and limitations

References:

1) Groover M.P.- Automation, Production Systems and CIM.
2) Ranky P.G.- The Design and Operation of FMS.
3) Parrish D.J.- Flexible Manufacturing.

2MCC5 ELECTIVE-II

2. VIRTUAL MANUFACTURING

Section-A

Virtual reality in engineering, rapid prototyping and near net shape manufacturing, visualization, environment construction technologies, modeling technologies, metamodeling, integrated infrastructure and architecture, simulation, integration of ligacy data, manufacturing characterization, verification, validation and measurement, work flow, cross functional treads.

Section-B

Design centered and production centered VM, CAD data translation, manufacturing resource models for distributed manufacturing, design of production systems, Virtual manufacturing over INTERNET, IMACS (interactive manufacturability analysis and critiquing system), optimal selection of partner in Agile Manufacturing, Virtual reality modeling languages.

References:

1) Considine D.M. and Considine G.D. – Standard Handbook of Industrial Automation.
2) Kusiak A.- Intelligent Manufacturing Systems.
3) Fundamentals of Industrial Automation by Turgan.

2MCC 5 ELECTIVE-II

3. INDUSTRIAL AUTOMATION

Section-A

Introduction to Industrial Automation: Automation in production systems, Opportunities of automation and computerization in a production system, Automated manufacturing systems, Computerized manufacturing support systems, reasons for automating, automation principles and strategies, basic elements of an automated system, advanced automation functions, levels of automation. Industrial Control Systems**:** Process industries, discrete manufacturing industries, continuous and discrete control, computer process control and the forms of computer process control, sensors, actuators and other control system components. Automated Manufacturing Systems**:** Fundamentals of automated production lines, applications of automated production lines, transfer lines, automated assembly systems.

Section-B

Modelling and Simulation for Plant Automation: Need of system modeling, uses of system simulation, mathematical modeling of a plant, model evaluation and improvement, modern tools for modeling and simulation of systems, applications. Industrial Control Applications: Introduction, cement plant, thermal power plant, water treatment plant, irrigation canal management, steel plant, etc. Intelligent Controllers: Introduction, model based controllers, predictive control, artificial intelligence based systems, expert controller, fuzzy logic system, fuzzy controller, fuzzy logic tools, artificial neural networks, neural controllers, VLSI implementation of neural networks, neuro-fuzzy control systems.

Books :

1. Automation, Production Systems and Computer-Integrated Manufacturing, by M. P. Groover, Pearson Education Pub.
2. Computer-Based Industrial Control, by Krishna Kant, Prentice Hall of India.

2MCC 5 ELECTIVE-II

4. RAPID PROTOTYPING AND TOOLING

Section-A

Introduction: Need for time compression in product development, Product development conceptual design, Development, Detail design, Prototype, Tooling, Applications of RP. Stereolithography systems: Principle, Process parameters, Process details, Machine details, Applications. Laser sintering systems: Principle, Process parameters, Process details, Machine details, Applications. Fusion deposition modeling: Principle, Process parameters, Process details, Machine details, Applications.

Section-B

Laminated object manufacturing: Principle, Process parameters, process details, Machine details, Applications. Laser engineering net shaping (lens): Ballistic Particle Manufacturing (BPM), 3D printing. Principle, Introduction to rapid tooling, Direct and indirect method, Commercial softwares for RP, STL file generation. Rapid tooling techniques- vacuum casting, DMLS, etc. Introduction to reverse engineering.

BOOKS RECOMMENDED:

1. Pham, D.T. & Dimov.S.S., "Rapid manufacturing", Springer -Verlag, London, 2001.
2. Terry wohlers, "Wohlers Report 2007", Wohlers Associates, USA,2007.
3. Ghosh A., "Rapid Protopyping: A Brief Introduction", Affiliated East West,
4. Kenneth G. Cooper, "Rapid Prototyping Technology: Selection and Application", CRC Press, 2001.
5. Chua Chee Kai, Leong Kah Fai, Lim Chu -Sing, "Rapid Prototyping: Principles and Applications", World Scientific, 2003.

SEMESTER-III

3MCCS Seminar

Project

SEMESTER-IV

4MCCP Project (Dissertation and viva-voce)