Detailed Syllabus Two year Postgraduate Degree Course (M.Tech.) in Manufacturing Science & Engineering with specialization in *Manufacturing Systems Engineering*

SEMESTER-I

1. **Manufacturing Systems & Automation (3-1-0)**

Module-I

Manufacturing Systems- Components & classifications, Automation in manufacturing systems, principles and strategies, mathematical models, costs. Single-station manufacturing cells. Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration. [10]

Module-II

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines. Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines. [12]

Module-III

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems, automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing. [10]

Module-IV

Group Technology- Part classification & coding, Computer Aided Process Planning (CAPP) - Retrieval & Generative type process planning system. [08]

Text Book(s):

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P. Groover, PHI.

Reference Book(s):

1. Computer Control of Manufacturing Systems- Y. Coren, McGraw Hill.
2. CAD/CAM/CIM- Radhakrishnan & Subramanian, Wiley Eastern.

2. Computer Aided Design & Manufacturing (3-1-0)

Module-I

Fundamentals of CAD: The design process, Application of computer for design, automated drafting, creating manufacturing data base, benefits of CAD, Design workstation- graphic terminal, operator input and output devices, Software of graphic system- graphic package, Data Base Structure, Wireframe Model and Solid Model, Graphics standards Modes of graphics operations, User interface, Software modules, Modeling and Viewing. [10]

Module-II

Geometric Modeling: Mathematical representation of curves, Surfaces and solids- Wire frame models, Entities Analytic curves, Synthetic curves, Manipulation, Surface entities, analytic, Synthetic surfaces, Solid entities, Representation, Manipulations. [10]

Module-III

Geometric Transformation- Transformation of geometric models, Mapping, Inverse transformations, Projections of geometric models, Engineering applications. [06]

Module-IV

Numerical Control: Components of NC system, NC procedure, NC co-ordinate system, motion control, applications, NC part programming-manual part programming, computer assisted part programming, ATP language-macro statements, programming with interactive graphics, NC part programming using CAD/CAM. [08]

Computer control in NC: Problems with conventional NC. Controller Technology, CNC, DNC, Adaptive Control. [06]

Text Book(s):

1. CAD/CAM Theory and Practice- I. Zeid, TMH.
2. CAD/CAM-M.P. Groover & E.W. Zimmers, PHI.

Reference Book(s):

1. CAD/CAM/CIM- Radhakrishnan & Subramanyan, Wiley Eastern.
2. Automation, Production System and CIM- M.P. Groover, PHI.

3. Modeling and Analysis of Manufacturing Systems (3-1-0)

Module-I

Manufacturing system types and principles, Manufacturing models- Physical and mathematical models, model building. Assembly Lines- Introduction and problem formulation, Approaches to assembly line balancing. Transfer Lines and General Serial Systems- Analysis of paced and unpaced lines. [12]

Module-II

Operations Scheduling- Preliminaries of scheduling theory, Single machine models, Parallel machine models, Flow shop and job shop models. [08]

Module-III

Material handling systems- Principles of material handling, Equipment selection, Conveyor analysis, AGV systems. Warehousing: storage and retrieval systems, Warehouse components, ware house design, Warehouse location, Order picking. [12]

Module-IV

Flexible Manufacturing Systems (FMS)- Introduction and system components, FMS planning and control, Flexible assembly system. [08]

Text Book(s):

1. Modeling and Analysis of Manufacturing Systems- R. G. Askin, and C. R. Standridge, John Wiley & Sons.
2. Manufacturing Systems Modeling and Analysis- G. L. Curry and R. M. Feldman, Springer.

Reference Book(s):

1. Manufacturing Systems Engineering- S. Gershwin, Prentice Hall.
2. Factory Physics- M. Spearman and W. Hopp, McGraw Hill.

Elective Subjects (Any two) 2 × (3-1-0)

1. Computer Aided Product Design

Module-I

Integrated Product development process, Concurrent engineering, Work structuring and team Deployment, Product and process systemization - problem, identification and solving methodologies. [08]

Module-II

Product Modeling- Definition of concepts, Fundamental issues, Role of Process chains and product models, Types of product models - model standardization efforts, Types of process chains. [10]

Module-III

Introduction, General Architecture, Distributed computing, Work group computing, PIM – Computational Architecture – Standards, Generic concurrent engineering development environment. [08]

Module-IV

Design for manufacturability – Machining, Casting and metal forming, Optimum design, Design for assembly and disassembly, Probabilistic design concepts - FMEA - QFD - Taguchi Method for design of experiments - Design for product life cycle. [08]

Intelligent Information Systems - Knowledge based product and process models, Applications of soft computing in product development process, advanced database design for integrated manufacturing, Use of STEP standards in CIM. Design for manufacturability - casting, forming, welding and machining. [06]

Text Book(s):

1. Concurrent Engineering Fundamentals Vol II- Biren Prasad, Prentice Hall.
2. Product Design and Development- K.T.Ulrich & S.D.Eppinger, McGraw Hill.

Reference Book(s):

1. Concurrent Engineering- D.E.Carter, Addison Wesley.
2. Handbook of Product Design for Manufacturing- J.G.Bralla, McGraw Hill.

2. Rapid Prototyping

Module-I

Introduction: Definition of Prototype, Types of prototype, Need for the compression in product development, Survey of applications, Growth of RP industry, Classification of RP systems. Stereolithography Systems: Principle, Process parameter, process details, Data preparation, data files and machine details, Application. [10]

Module-II

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Fusion Deposition Modeling: Principle, Process parameter, Path generation, Applications. [06]

Solid Ground Curing: Principle of operation, Machine details, Applications, Laminated Object Manufacturing: Principle, LOM materials, process details, application. [04]

Module-III

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, object Quadra systems, Laser Engineering Net Shaping (LENS). [04]

Rapid Tooling: Indirect Rapid tooling -Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3D keltool, Direct Rapid Tooling- Direct, AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, ProMetal, Sand casting tooling, Laminate tooling, Soft Tooling vs. Hard tooling. [06]

Module-IV

Software for RP: STL files, Overview of Solid view, magics, mimics, magic communicator, etc. Internet based software, Collaboration tools, Rapid Manufacturing Process Optimization: factors influencing accuracy, data preparation errors, Part building errors, Error in finishing, influence of build orientation. Surface digitizing, surface generation from point cloud, surface modification-data transfer to solid models. [10]

Text Book(s):

1. Stereolithography and other RP& M Technologies- Paul F. Jacobs, Society of Manufacturing Engineers, NY.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling- D.T. Flham and S.S.Dimov, Springer Verlag.

Reference Book(s):

1. Rapid Prototyping: Principles and Applications in Manufacturing- C.C. Kai and L.K.Fai, World Scientific Co.
2. Rapid Prototyping & Manufacturing- Paul F. Jacobs, McGraw-Hill.

3. Design of Hydraulic & Pneumatic Systems

Module-I

Hydraulic Power Generators- Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators- selection, specification and characteristics. Pressure- direction and flow control valves- relief valves, non return and safety valves - actuation systems. [08]

Module-II

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. [12]

Module-III

Pneumatic fundamentals- control elements, position and pressure sensing- logic circuits- switching circuits- fringe conditions modules and integration- sequential circuits- cascade methods- mapping methods- step counter method- compound circuit design- combination circuit design. [12]

Module-IV

Pneumatic equipments - selection of components - design calculations- application- fault finding- hydropneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation- Robotic circuits. [08]

Text Book(s):

1. Fluid power with Applications- Antony Espossito, Prentice Hall.
2. Basic Fluid Power- D. A. Pease and J.J. Pippenger, Prentice Hall.

Reference Book(s):

1. Hydraulic and Pneumatics- A. Parr, Jaico Publishing House.
2. Pneumatic and Hydraulic Systems- W. Bolton, Butterworth - Heineman.

4. Finite Element Analysis in Manufacturing

Module-I

Basics of FEM- Initial value and boundary value problems- weighted residual, Galerkin and Raleigh Ritz methods- Review of Variational calculus- Integration by parts- Basics of variational formulation. Steps in FEA- Discretization, Interpolation, derivation of element characteristic matrix, shape function, assembly and imposition of boundary conditions- Solution and post processing- One dimensional analysis in solid mechanics and heat transfer. [12]

Module-II

Global and Natural co-ordinates- Shape functions for one and two dimensional elements- Three noded triangular and four noded quadrilateral element- Nonlinear analysis- Isoparametric elements- Jacobian matrices and transformations- Basics of two dimensional axi-symmetric analysis. [08]

Module-III

FE analysis of metal casting- Special considerations, latent heat incorporation, gap element- Time stepping procedures- Crank- Nicholson algorithm- Prediction of grain structure- Basic concepts of plasticity- Solid and flow formulation- Small incremental deformation formulation- FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency. [10]

Module-IV

Pre Processing, Mesh generation, element connecting, boundary conditions, input of material and processing characteristics- Solution and post processing- Overview of application packages such as ANSYS and DEFORM- Development of code for one dimensional analysis and validation. [10]

Text Book(s):

1. An Introduction to the Finite Element Method- J.N. Reddy,McGraw-Hill.
2. Finite Element Method in Engineering- S.S. Rao, Pergammon Press.

Reference Book(s):

1. Metal Forming and the Finite Element Methods- S. Kobayashi, Soo-Ik-Oh and T. Altan, Oxford University Press.
2. The Finite Element Method in Heat Transfer Analysis- R.W. Lewis, K. Morgan, H.R. Thomas and K.N. Seetharaman, JohnWiley.

5. Total Quality Systems & Engineering

Module-I

Principles of Quality Management- Pioneers of TQM, Quality costs, Quality system Customer Orientation, Benchmarking, Re-engineering, Concurrent Engineering. [06]

Leadership- Organizational Structure, Team Building, Information Systems and Documentation, Quality Auditing- ISO 9000- QS 9000. [06]

Module-II

Single Vendor Concept- JIT, Quality Function deployment, Quality Circles, KAIZEN, SGA, POKA-YOKE, Taguchi Methods. [08]

Module-III

Methods and Philosophy of Statistical Process Control, Control Charts for Variables and Attributes, Cumulative sum and exponentially weighted moving average control charts, Others SPC Techniques- Process Capability Analysis- Six sigma accuracy. [10]

Module-IV

Acceptance Sampling Problem, Single Sampling Plans for attributes, Double, multiple and sequential sampling, Military standards, The Dodge-Roming sampling plans. [10]

Text Book(s):

1. Total Quality Management for Engineers- M. Zairi, Woodhead Publishing.
2. Introduction to Statistical Quality Control- D.C. Montgomery, John Wiley and Sons.

Reference Book(s):

1. ISO 9000- A Manual for Total Quality Management- S. Dalela and Saurabh, S.Chand and Company Ltd.
2. Statistical Quality Control- E.L. Grant and Leavensworth, McGraw-Hill.

6. Micro-Electro-Mechanical Systems

Module-I

Introduction to MEMS technology**:** Introduction to MEMS and motivation, Basic definitions, Scaling in Micro domain: How small is different- some natural examples, Scaling laws in electrostatic, electromagnetic, rigidity of structures, heating & cooling, Fluid viscosity and fluid interfaces, etc. Scaling in overall system performance considering multiple physical domains. [08]

Module-II

MEMS Materials: Mechanical and other properties of materials used in MEMS Microfabrication / Micromachining: Overview of microfabrication, Review of microelectronics fabrication processes like photolithography, deposition, doping, etching, structural and sacrificial materials, other lithography methods,. MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods. [08]

Module-III

Transduction Principles: Transduction principles in microdomain. MEMS Modeling: Basic modeling elements in electrical, mechanical, thermal and fluid systems, analogy between 2nd order mechanical and electrical systems. Modeling elastic, electrostatic, electromagnetic systems. [10]

Module-IV

Radio Frequency (RF) MEMS: Introduction, Review of RF-based communication systems, RF – MEMS like MEMS inductors, varactors, tuners, filters, resonators, phase shifters, switches. Optical MEMS: Preview, passive optical components like lenses and mirrors, actuators for active optical MEMS.

Nanotechnology and MEMS: Relation between micro and nanotechnologies. Need and issues in handling nano products with the help of MEMS. [14]

Text Book(s):

1. MEMS and Microsystems Design and Manufacture**-** Tai, Ran Hsu, TMH.
2. Foundations of MEMS**-** Chang Liu, Pearson International Edition.

Reference Book(s):

1. MEMS**-** N. P. Mahalik, TMH.
2. Fundamentals of Microfabrication**-** Madou, CRC Press.

SEMESTER-II

1. **Laser Processing of Materials (3-1-0)**

Module-I

Laser Systems- Laser beam characteristics, laser principles, High power lasers for materials applications, Principles and working of CO2, Nd:YAG and Excimer laser, Optics for irradiation. [08]

Module-II

Thermal process in Interaction zones- Laser Materials processing parameters, Conduction and convection, Analytical models in one dimensional heat flow, Depth of irradiation with respect to energy density, Reflectivity of material with respect to wave length, Rate of heating, cooling and temperature gradient. [12]

Module-III

Laser Metallurgy- Laser surface treatment, Transformation hardening, Rapid quenching, Methods to obtain desired penetration depths, Laser surface alloying, Laser surface cladding, Shock hardening, Advantages of laser surface treatment. [10]

Module-IV

Laser Cutting and Drilling- Laser instrumentation for cutting and drilling, cut quality and process characteristics, methods of cutting. Laser Welding- Process mechanisms (Key hole and Plasmas), operating characteristics, process variations, imperfections. [10]

Text Book(s):

1. Opto electronics – An introduction- W. J. Hawkes, Prentice Hall of India.
2. Laser Processing of Engineering Materials- J.C. Ion,Butter Worth-Heinemann.

Reference Book(s):

1. Laser Materials Processing- W.M. Steen, Springer Verlag.
2. High power laser applications- J.F.Reddy, Academic Press.

2. Discrete System Simulation (3-1-0)

Module-I

Systems, modeling, general systems theory, concept of simulation, simulation as a decision making tool, types of simulation. Pseudo random numbers, methods of generating random variates, discrete and continuous distributions, testing of random numbers. [08]

Module-II

Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation. [08]

Module-III

Comparison and selection of simulation languages, study of any one simulation language. [10]

Module-IV

Development of simulation models using the simulation language studied for systems like, queuing systems, production systems, Inventory systems, maintenance and replacement systems, investment analysis and network. [14]

Text Book(s):

1. Discrete event system simulation- J. Banks, J.S. Carson, B.L. Nelson, D.M. Nicol, PHI.
2. Simulation using GPSS- T.J. Schriber, John Wiley.

Reference Book(s):

1. Simulation Techniques for Discrete Event Systems- I.Mitrani, Cambridge University Press.
2. Simulation Modeling and Analysis- A.M. Law, McGraw Hill India.

3. Robotics and Robot applications (3-1-0)

Module-I

Robot Fundamentals: Definitions, History of robots, Laws of Robotics, Robot Specification, Anatomy of a Robot, Robot classifications, Function line diagram representation of robot arms, common types of arms, Robot end effectors- Types, Tools as end effectors, Considerations in gripper selection and design. [06]

Manipulator Kinematics: Homogeneous coordinate transformation, matrix representations of coordinate transformation, D-H representation of kinematics linkages, Forward and Inverse Kinematics of manipulators, Euler's angle and fixed rotation for specifying position and orientation. [08]

Module-II

Robotics Dynamics: Velocity Kinematics, Acceleration of rigid body, Lagrange-Euler Formulation, Newton–Euler's formulation. [04]

Trajectory Planning: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, 4-3-4 & trapezoidal velocity strategy for robots. [04]

Module-III

Robot Actuators and Sensors: Internal and external sensors, Position- potentiometric, Optical sensors, Encoders - absolute, incremental, Touch and slip sensors, Velocity and acceleration sensors, Proximity sensors, Force and torque sensors. Actuators- Hydraulic, Pneumatic and Electrical, Comparison of actuating systems and their relative merits and demerits. [08]

Module-IV

Robot Programming: Methods of robot programming- Textual and Leadthrough, WAIT, SIGNAL and DELAY commands, Capabilities and limitations of leadthrough programming, Robot language structure, Motion, sensor and end effectors commands, Programming examples. [06]

Robot application in Manufacturing- Material Transfer- Material handling, loading and unloading, Processing - spot and continuous arc welding and spray painting, Assembly and Inspection. [04]

Text Book(s):

1. Industrial Robotics- Groover M P et al, Pearson Education.
2. Robotics and Control- Mittal R K & Nagrath I J, TMH.

Reference Book(s):

1. Robotics Technology and Flexible Automation- S.R.Deb, TMH.
2. Robotic Engineering- Richard D. Klafter, PHI.

Elective Subjects (Any two) 2 × (3-1-0)

1. Diagnostic Techniques

Module-I

Defect generation- types of failures, Defects reporting and recording, Defect analysis, Failure analysis, Equipment downtime analysis, Breakdown analysis- FTA, FMEA, FMECA.

Planned and unplanned maintenance- Breakdown maintenance, Corrective maintenance, Opportunistic maintenance, Routine maintenance, Preventive maintenance, Predictive maintenance. [10]

Module-II

Condition based maintenance system- Design out maintenance-selection of maintenance system. Codification and Cataloguing-Instruction manual and operating manual, Maintenance manual and Departmental manual, Maintenance time standard, Maintenance work order and work permit, job monitoring- Feedback and control, Maintenance records and documentation. [10]

Module-III

Selection and scope of computerization- Equipment classification, Codification of breakdown, material and facilities, Job sequencing, Material management module, Captive Engineering module. [08]

Module-IV

Condition monitoring techniques, Visual monitoring, Temperature monitoring, Vibration monitoring, Lubricant monitoring, Cracks monitoring, Thickness monitoring, Noise and sound monitoring, Condition monitoring of hydraulic system.

Machine diagnostics-Objectives, Monitoring strategies, Examples of monitoring and Diagnosis, Control structures for machine diagnosis. [12]

Text Book(s):

1. Industrial Maintenance Management- S. K. SRIVASTAVA, S.Chand & Company Ltd.
2. Handbook of Machine Tools- Vol. 3- M. Weck and H.Bibring, John Wiley &Sons.

2. Manufacturing Information Systems

Module-I

Introduction: The evolution of order policies, from MRP to MRP II, Role of Production Organization, Operations Control. Database: Terminologies, Entities and attributes, Data models, schema and subschema, Data Independence, ER Diagram, Trends in database. [6]

Module-II

Designing Database: Hierarchical model, Network approach, Relational Data model -concepts, principles, keys, relational operations - functional dependence -Normalisation, types - Query languages. [12]

Module-III

Manufacturing Considerations: The product and its structure, Inventory and process flow, Shop floor control - Data structure and procedure - various model - the order scheduling module, input/output analysis module the stock status database, the complete IOM database. [09]

Module-IV

Information System for Manufacturing: Parts oriented production information system - concepts and structure -computerised production scheduling, online production control systems, Computer based production management system, computerised manufacturing information system - case study. [09]

Text Book(s):

1. Manufacturing Information Systems- L.G. Sartori, Addison-Wesley Publishing Company.
2. An Introduction to Database Systems- C.J. Date.C.J., Narosa Publishing House.

Reference Book(s):

1. Material Requirements Planning- G. Orlicky, McGraw-Hill.
2. Knowledge based Manufacturing Management- R. Kerr. Addison-Wesley.

3. Mechatronics (3-1-0)

Module-I

Introduction: Introduction to Mechatronics: Mechatronic system, measurement systems, control systems and response of systems, Open and Closed loop System, Transfer Function, Sequential Controller, Microprocessor based controller. Basic System models: Mathematical models, Introduction to Mechanical, Electrical, Fluid and Thermal systems, Rotational and Transnational systems, Electro-Mechanical, Hydraulic- Mechanical systems. [10]

Module-II

Sensors and transducer: Desirable features, Displacement, position and proximity sensors, Velocity, motion and Force sensors, Time of flight sensors, Binary force sensor, temperature and Pressure measurement, Sensor selection.

Actuation Systems: Actuation Systems, Pneumatic and Hydraulic systems, Directional control valves, Rotary actuator, Mechanical actuation systems- Mechanical Systems, Electrical Actuation Systems- Electrical Systems, Relays and Solenoids, DC brushed motors, DC brushless motors, DC servo motors, Stepper Motors. Drive selection. [12]

Module-III

Microcontrollers: 8051 Microcontroller, Microprocessor structure, Digital Interfacing, Analog Interfacing, Applications Programming- Assembly/ C (LED Blinking, Controlling a stepper motor). Interfacing: Interfacing microcontrollers with general purpose three-state transistors, interfacing relays, Interfacing solenoids, Interfacing stepper motor, Interfacing with sensors, Interfacing with RS 232 and RS485. [10]

Module-III

Programmable Logic Controllers: Basic Structure, Programming- Ladder diagram, Timers, Internal Relays and Counters Shift Registers, Master and Jump Controls, Data Handling, Analog input / output, PLC Selection, Application. [08]

Text Book(s):

1. Mechatronics- W Bolton, Pearson Education.
2. Mechatronics Principles and Applications- G.C.Onwubolu, Elsevier Butterworth-Heinemann.

Reference Book(s):

1. Mechatronics Source Book- Newton C Braga, Thomson Publications.
2. Introduction to Mechatronics and Measurement Systems- D.G.Alciatore and M.B.Histand, McGraw Hill.

4. Computer Integrated Manufacturing (3-0-0)

Module-I

Introduction: The meaning and origin of CIM, The changing manufacturing and management scenario, External communication, Islands of automation and software.

Dedicated and open systems, Manufacturing automation protocol, Product related activities of a company, Marketing engineering, Production planning, Plant operations, Physical distribution, Business and financial management. [08]

Module-II

Group Technology: History of group technology, Role of GT in CAD/CAM integration, Part families - classification and coding, DCLASS, MICLASS and OPITZ coding systems, Facility design using GT, Benefits of GT, Cellular manufacturing.

Computer Aided Process planning: Role of process planning in CAD/CAM integration, Approaches to computer aided process planning- Variant approach and Generative approaches, CAPP and CMPP process planning systems. [08]

Module-III

Shop Floor Control and FMS: Shop floor control-phases, Factory data collection system, Automatic identification methods- Bar code technology, Automated data collection system, FMS-components of FMS - types -FMS workstation, Material handling and storage systems, FMS layout, Computer control systems-application and benefits.

CIM Implementation: CIM and company strategy, System modeling tools-IDEF models, Activity cycle diagram, CIM open system architecture (CIMOSA), Manufacturing enterprise wheel, CIM architecture, Product data management, CIM implementation software. [12]

Module-IV

Data Communication: Communication fundamentals, Local area networks, Topology, LAN implementations, Network management and installations.

Open System and: Open systems, Open system inter connection, Manufacturing automations protocol and technical office protocol (MAP /TOP).

Database for CIM: Development of databases, Database terminology, Architecture of database systems, Data modeling and data associations, Relational data bases, Database operators, Advantages of data base. [12]

Text Book(s):

1. Computer Integrated Manufacturing System- Y. Koren, McGraw-Hill.
2. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.

Reference Book(s):

1. CAD/CAM/CIM- P. Radhakrishnan, S. Subramanyan and V. Raju- New Age International (P) Ltd.
2. Computer Integrated Manufacturing- Paul G. Ranky, Prentice Hall International.

5. Concurrent Engineering

Module-I

Introduction: Extensive definition of CE - CE design methodologies, Organizing for CE, CE tool box collaborative product development. Use of Information Technology: IT support, Solid modeling, Product data management, Collaborative product commerce, Artificial Intelligence - Expert systems - Software hardware co-design. [12]

Module-II

Design Stage: Life-cycle design of products, Opportunity for manufacturing enterprises, Modality of Concurrent Engineering Design, Automated analysis idealization control, Concurrent engineering in optimal structural design - Real time constraints. [08]

Module-III

Manufacturing Concepts and Analysis: Manufacturing competitiveness, Checking the design process, Conceptual design mechanism- Qualitative Physical approach, An intelligent design for manufacturing system, JIT system, Low inventory, Modular, Modeling and reasoning for computer based assembly planning, Design of Automated manufacturing. [10]

Module-IV

Project Management: Life Cycle semi realization, Design for economics, Evaluation of design for manufacturing cost, Concurrent mechanical design, Decomposition in concurrent design, Negotiation in concurrent engineering design studies, Product realization taxonomy, Plan for Project Management on new product development, Bottleneck technology development. [10]

Text Book(s):

1. Concurrent Engineering Fundamentals: Integrated Product Development- Prasad, Prentice Hall.
2. Concurrent Engineering: Automation Tools and Technology- Andrew Kusaik, Wiley.

Reference Book(s):

1. Integrated Product Development- Anderson MM and Hein, L. Berlin, Springer Verlag.
2. Successful Implementation of Concurrent Product and Process- Sammy G Sinha, Wiley.

6. Image Processing in Manufacturing

Module-I

Image representation and nomenclature, Relationship of image processing and computer vision, Digital image fundamentals, Geometric model for imaging and applications- Imaging requirements. [08]

Module-II

Image transformers-Sampling, Enhancement, Restoration and conversions, Segmentation, Thresholding representation and description. [10]

Module-III

Processing binary images- Image measurements, Multilevel image analysis, Higher dimensional modeling, Image based knowledge manipulation. [10]

Module-IV

2D/3D Image acquisition, 3D image Visualisation, Imaging surfaces, Image processing system components.

Study of surface finish - Sorting and counting of objects, Tool Wear measurement, measurement technique, Robot application. [12]

Text Book(s):

1. The Image Processing Hand Book- J.C. Russ, CRC Press/IEEE Press.
2. Digital Image Processing and Computer Vision- R. J. Schalkoff, John Wiley & Sons.

Reference Book(s):

1. Digital Image Processing- R. C. Gonzalez & R. E. Woods, Addison Wesley.
2. Introduction to machine vision- R. C. John, Tata McGraw Hill.