First semester

APPLIED MATHEMATICS

(Common to Industrial Automation Engineering/ Industrial Automation and Robotics/ Computer Integrated Manufacturing)

Sub Code	: 18 MCM11	IA Marks	: 40
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objectives:

The main objectives of the course are to enhance the knowledge of various methods in finding the roots of an algebraic, transcendental or simultaneous system of equations and also to evaluate integrals numerically and differentiation of complex functions with a greater accuracy. These concepts occur frequently in their subjects like finite element method and other design application oriented subjects.

Course Content:

MODULE 1

Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model.

Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration. **10 Hour**

MODULE 2

Roots of polynomial-Polynomials in Engineering and Science, Muller's method, Numerical Differentiation and Numerical Integration: Newton – Cotes and Guass Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae**10 Hour**

MODULE 3

System of Linear Algebraic Equations And Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods.

10 Hour

MODULE 4

Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method**10 Hour**

MODULE 5

Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering. Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets **10 hour**

Text Books

1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, Tata Mcgraw Hill, 4th Ed, 2002.
3. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.

1. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
2. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.

1) Model some simple mathematical models of physical Applications.
2) Find the roots of polynomials in Science and Engineering problems.

3) Differentiate and integrate a function for a given set of tabulated data, for Engineering Applications.

AUTOMATION AND COMPUTER INTEGRATED MANUFACTURING

(Common to MAR,IAE,MCM))

Sub Code :	18MCM12	IA Marks :	40
Hrs/ Week:	04	Exam Hour :	03
Total Hrs. :	50	Exam Marks:	60

Course Objectives:

1. T o impart the knowledge of use of computers in the advanced manufacturing for the product development.
2. U nderstand the importance of prototypes, CAD/CAM & CIM.
3. S tudents will get an exposure to types of automated assembly systemsand Computer Process Monitoring.
4. S tudents will come to know about differentmaterialhandlingdevices and its application.
5. T o impart the knowledge of robotics in metal handling and computer aided quality control techniques.

Course Content:

MODULE 1

Production Development Through CIM: Computers in Industrial manufacturing,Product cycle & Production development cycle, Introduction of CAD/CAM & CIM, sequential and concurrent engineering, soft and hard prototyping.**10Hour**

MODULE 2

Computer Integrated Manufacturing and Automation: Fundamentals of CAD/CAM,Computerized Manufacturing planning systems, shop floor control & automatic identification techniques. Computer Network for manufacturing and the future automated factor.

Detroit Type of Automation: Flow lines, DifferentTransfer Mechanisms, workpattern transfer, Different methods.**10Hour**

MODULE 3

Analysis of Automated flow lines: Analysis of transfer lines without storage, with storagebuffer, single stage, Double stage, Multistage with problems, Automated assembly systems, Design for automated assembly, parts feeding devices..

Computer Process Monitoring: Process control methods, direct digital control, supervisorycomputer control, steady state optimal control, on line search strategies, adaptive control.**10 Hour**

MODULE 4

Automated Material Handling and Storage: Material functions, types of material handlingequipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems work in process storage, interfacing handling & storage with manufacturing.**10 Hour**

MODULE 5

Robotics in Material Handling

General considerations in robot material handling – material transfer application – pick &place operations – machine loading & unloading – characte ristics of robot application.

Computer Aided Quality Control: The computer in Q.C, automated inspection principlesand methods, Contact inspection methods, non-contact inspection methods, machine vision system, optical inspection method, sensors, coordinate measuring machine.**10 Hour TEXT BOOKS:**

1. CAD/CAM – Zimmers& Grover, PHI.
2. CAD/CAM/CIM – P. Radhakrishna, New Age Internationa l.

3. M. P. Grover, Automation, Production Systems & Computer Aided manufacturing, Prentice Hall.

REFERENCE BOOKS:

1. CAD/CAM – Zeid, Mc-Graw Hill
2. CAD/Cam, P. N. Rao.
3. Koren.Y "Robotics for Engineering" Mc-Graw Hill.
4. Rooks. B. (ed) "Robert vision & Sensory controls vo l-3 North Holland.

Course Outcome:

At the end of the course students will be able to

1. Get knowledge of shop floor control, Computer Integrated Manufacturing and Automation.
2. Understand the importance of product development through CIM.
3. Get knowledge of Analysis of Automated flow lines andProcess control methods.
4. Adopt appropriate material handling and storage in an automated manufacturing environment.
5. Understand the role of Robotics in Material Handling and computers in quality control for product improvement.

COMPUTER AIDED DESIGN

((Common to MAR,IAE,MCM))

Sub Code	:	18MCM13	*IA Marks*	:	40
Hrs/ Week	:	04	Exam Hour	:	03
Total Hrs.	:	40	Exam Marks	:	60

Course Objectives:

1. T o impart the Applications of computers in Designusing Graphics Software and Database for constructing the Geometry.
2. T o know the Design Transformations andRequirements of Geometric Modeling.
3. T o impart the facilities available for modeling and GraphicsStandardization systems.
4. T o represent curves &surfaces in modeling methods.
5. T o impart the knowledge of RPD modeling.

Course Content:

MODULE 1

Introduction to Computer graphics and Database: Computer Aided Design: Definition,Fundamentals of CAD, The Design Process, Computers Applications in Design, Manufacturing Database, Benefits of CAD, Computer Graphics Software and Database: Software configuration of a Graphic system, Functions of a Graphics package, constructing the Geometry.**10Hour**

MODULE 2

TRANSFORMATIONS-Translation, Scaling, Reflection or Mirror, Rotation, Concatenations,Homogeneous Transformation, 3D Transformations-Translation, Scaling, Rotation about, X, Y and Z axes. Mathematics of Projections- Orthographic and Isometric Projections.
GEOMETRIC MODELING: Requirements of Geometric Modeling, Geometric Models,Geometric Construction Methods, Constraint- Based Modeling.**10Hour**

MODULE 3

MODELING FACILITIES AND GRAPHIC STANDARDS: Modeling Facilities-GeometricModeling Features, Editing or Manipulating, Display Control, Drafting, Programming,
GRAPHIC STANDARDS - Standardization in Graphics, Graphical Kernel System (GKS),Other

Graphic Standards-GKS 3D, PHIGS, NAPLPS, Exchange of Modeling Data-IGES, STEP, Drawing Exchange Format (DXF)**10Hour**

MODULE 4

MODELING CURVES &SURFACES: Curve Representation-Line, Circle, Parabola,Hyperbola, Curve Fitting- Interpolation Techniques- Lagrangian Polynomial, B-Splines, Approximate Methods-Method of Least Squares, Polynomial Curve Fitting.

SURFACE REPRESENTATION: Methods-Analytic Surfaces,Surfaces of Revolution,Ruled Surfaces, Synthetic Surfaces- Hermite Cubic Surface, Bezier Surface, Surface Patch, Tabulated Cylinder, Sculptured Surfaces. **10 Hour**

MODULE 5

VIRTUAL AND RAPID PROTOTYPING:Introduction to Virtual modeling, Rapid prototyping,RP data formats and Information workflow, Classifications of RP, Process involving Liquid, discrete particle and solid sheet of standard methods of each, TechnicalCharacteristics of standard methods

10 Hour

TEXT BOOKS:

1. P .N. Rao, CAD/CAM Principles and Applications, 3rd Ed., McGrawHill, Education Pvt Ltd., New Delhi
2. I brahim Zeid&R.Shivasubramanian, CAD/CAM Theory & Practice, 2nd Ed., TMHEducation Pvt Ltd., New Delhi (Chapter 2,)

REFERENCEBOOKS:

1. M .P. Groover and EW Zimmers, CAD/CAM Computer aided DesignandManufacture,Prentice hall, 1984
2. C .B. Besant and E.W.K. Lui, Computer Aided design and Manufacture, Affiliated East West, press India 1988
3. P iegel ,Mathematical Elements for Computer Graphics,

Course Outcome:

At the end of the course students will be able to

1. Configure complete design process.
2. Get knowledge of geometric modeling, Construction of various geometries.
3. Incorporate methods of modeling andusage of GraphicsStandardization systemsfor enhancing productivity in design.
4. Get knowledge of Methods used for Representation of curves and surfaces in modeling.
5. Construct CAD models and RPD models related to mechanical components leading to minimum lead time

AUTOMATION IN MANUFACTURING SYSTEMS

(Common to MAR,IAE,MCM)

Sub Code	: 18MCM14	*IA Marks*	: 40
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objectives:

1. S

tudents will get an exposure to various aspects of production systems and automation in manufacturing, modeling techniques.

2. To understand the mathematical models for production and automation in manufacturing.
3. To understand the control systems in industry and process planning.
4. To know theselection, circuit design and applications of power hydraulic and pneumatic systems.
5. To understand computer aided planning, control and monitoring of production.

Course Content:

MODULE 1

Fundamentals of manufacturing: fundamentals of manufacturing; Production SystemFacilities, Manufacturing support systems, Different types of manufacturing systems, Automation in Production Systems, Automation Principles & Strategies, Manufacturing Operations. **10Hour**

MODULE 2

Mathematical concepts and models: Production concepts and mathematical models cost ofmanufacturing operation, numerical.

Automation and modeling automated manufacturing systems: Basic Elements ofAutomated System, Advanced Automation Functions, Levels of Automation, and Performance**.** Components of automation: sensors actuators and input output device **10Hour**

MODULE 3

Industrial Control and process planning: Industrial Control Systems, Sensors,Actuators, &other Control Systems, Discrete Control using PLC & PLC network, Manufacturing Support Systems, CAPP, Automated CAPP. **10Hour**

MODULE 4

Power Hydraulics & Pneumatics: Concepts features & parameters governing theSelection of various components Necessary for Building the elements, Circuit Design & Analysis. Industrial Application**s** of Fluid power & pneumatic systems, Electro-Hydraulic Servo System. **10Hour**

MODULE 5

PLC: Introduction, Micro PLC, Programming a PLC, Logic Functions, input & outputModules, PLC Processors, PLC Instructors, Timer & counter Instructions, Comparison & data handling instructions.

Computer Aided Planning and Control and Computer Monitoring

Production Planning and control cost planning and control inventory management material requirements planning (MRP) shop floor control. Types of productionMonitoring systems.

10Hour

TEXT BOOKS

1. Performance modeling of automated Manufacturing Systems - Viswanandham, PHI.
2. Fluid Power System - Goodwin, McGraw Hill Press Limited, 1976.
3. Principles & Applications - Webb, PLC McMillan 1992.

REFERENCE BOOKS:

1. Principles of CIM - Vajpayee, PHI.
2. Automation Production Systems & CIM - Mikell P Grover, Pearson Education, Asia
3. Fluid Power with Applications - Anthony Esposito, Prentice Hall, 1997.
4. Mechatronics - W, Bolton, Longman, Adderson Wesley.

Course Outcome:

At the end of the course students will be able to

1. Students will get an insight of automation in manufacturing and modeling techniques.
2. Students will be able to demonstrate knowledge of their understanding of mathematical models

for production and automation in manufacturing.

3. Students will gain the knowledge of process planning and industrial control systems.
4. Students will gain the applications of power hydraulic and pneumatic systems.
5. Studentswill gain the knowledge about process planning, control and monitoring and its types.

Professional Elective-I

RAPID PROTOTYPING

(Common to MAR,IAE,MCM)

Sub Code	: 18MCM15	*IA Marks*	: 40
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objective

1. The course enables insight into rapid prototypingandStereo lithography Systems.
2. To impart the knowledge of principle and applications of Selective Laser Sintering.
3. Students will gain the knowledge about solid ground curing and concepts modelers in Rapid Prototyping.
4. To impart the knowledge of direct and indirect Rapid tooling.
5. Students will learn different software techniques used for RPApplication of Rapid Prototyping

Course Content:

MODULE 1

Introduction: Definition of Prototype, Types of prototype, Need for the compression inproduct development, History of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.

Stereo lithography Systems: Principle, Process parameter, process details, Datapreparation, data files and machine details. **10 Hour**

MODULE 2

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.

Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications. **10 Hour**

MODULE 3

Solid Ground Curing: Principle of operation, Machine details, Applications, LaminatedObject Manufacturing: Principle, of operation, LOM materials.

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer,GenisysXs printer HP system 5, object Quadra systems. **10Hour**

MODULE 4

Rapid Tooling : Indirect Rapid tooling -Silicon rubber tooling—Alum inum filled epoxy toolingSpray metal tooling ,Cast kirksite ,3D keltool ,etc .Direct Rapid Tooling — Direct, AIM, Quick cast process, Copper polyamide, Rapid Tool, DMLS. **10Hour**

MODULE5

Software for Rp: Stl files, Overview of Solid view, magics, imics, magic communicator, etc.Internet based software, Collaboration tools

Application of Rapid Prototyping and Technology:-Functional models, pattern forinvestment and Vacuum casting, medical models, Art models, Engineering analysis models. **10Hour**

Text Books:

1. Paul F. Jacobs: " Stereo 1ithography and other RP & M Technologies"-SME NY, 1996.
2. Flham D.T &Dinjoy S.S " Rapid Manufacturing"- Verlo g London 2001.

Reference Books:

1. Terry Wohler's "Wohler's Report 2000 "- Wohler's As sociation 2000

2. Hari Prasad, K S Badarinarayan, “Rapid Prototyping and Tooling”, published by SIP-Pageturners, 2013
3.

Course Outcomes:
At the end of the course students will be able to

1. Students will get the knowledge ofStereo lithography Systems in rapid prototyping.
2. Student can assess and implement RP techniques for Selective Laser Sinteringand other applications leading to better ROI for the company that uses RP machine.
3. Students will implement the knowledge of solid ground curing and concepts modelers in Rapid Prototyping.
4. Students will get the knowledge about tooling in RP.
5. Will learn the knowledge about software which is used in RP.

Manufacturing Engineering Lab 1

Sub Code : 18MAR16	IA Marks :40
Hrs/ Week : 4	Exam Hour : 03
Total Hrs: 84	Exam Marks :60

Note:

The focus is on experimental investigations on one or more topics identified below.
Physical experiments as well as numerical experiments are welcome.

Each student must prepare and submit a comprehensive report on the problems Investigated and give a presentation on the same for internal evaluation. Any one of the exercises done from the following list has to be asked in the Examination for evaluation. Parametric studies and correlation studies are implied.

1. Optimizing machining time to produce mild steel components on a CNC turning Centre.
2. Characterize surface roughness of High carbon steel using a grinding machine.
3. To determine power required to machine a chosen component and evaluate suitability of the machine to manufacture the same.
4. To compare surface characteristics produced by conventional and CNC turning machines.
5. To Estimate the accuracy of taper produced on a shaft by grinding.
6. To measure cutting forces during machining of High carbon steel and optimize machining parameters.
7. To optimize a single point cutting tool for machining HC steel and to arrive at parameters like rake angle, relief angle, and nose radius etc.
8. To study type of chips produced in machining Al/Composites materials/ HC alloy steels and to characterize chip thickness.
9. Construction of merchant circle diagram for turning operation of mild steel and to compute power requirement for turning operation.
10. Perform cutting/drilling/turning operations on mild steel/ high carbon steel/ composite material components and estimate power required for cutting/drilling/turning.
(Ex: for the hole, dia& feed values are provided; Student has to find the volume of metal removed and energy consumed)
11. Determine the true taper and actual taper mathematically and perform turning operations (roughing cuts) on lathe and estimate the tool life of tool on similar cuts at different speeds.

Second semester

INDUSTRIAL AUTOMATIONAND ROBOTICS

(Common to MAR,IAE,MCM)

Sub Code :	18MAR21	***IA Marks*** :	40
Hrs/ Week :	04	Exam Hour :	03
Total Hrs. :	50	Exam Marks :	60

Course Objectives:

1. This course is an attempt to provide a more updated view of the Automation and Robotics.
2. Study of various End Effectors And Robot Controls
3. Students will adopt the concept of Time and Motion in Robotics
4. Different technique for kinematics, dynamics and control system on various kinds of robot motions
5. Students will learn concepts of different sensor use in robots.

Course Content:

MODULE 1

Introduction: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, Types of Drive Systems and their Relative Merits, Concepts and Model about Basic Control System. **10 Hour**

MODULE 2

End Effectors And Robot Controls: Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control. **10 Hour**

MODULE 3

Time and Motion: Trajectories, Smooth One-Dimensional Trajectories, Multi Dimensional Case, Multi-Segment Trajectories, Interpolation of Orientation in 3D, Cartesian Motion, Time Varying Coordinate Frames, Rotating Coordinate Frame, Incremental Motion, Inertial Navigation Systems. Mobile Robot Vehicles, Mobility, Car-like Mobile Robots, Moving to a Point, Following a Line, Following a Path, Moving to a Pose. SLE: Flying Robots. **10Hour**

MODULE 4

Robot Arm Kinematics: Describing a Robot Arm, Forward Kinematics, A 2-Link Robot, A 6-Axis Robot, Inverse Kinematics, Closed-Form Solution, Numerical Solution, Under Actuated Manipulator, Redundant Manipulator, Trajectories, Joint-Space Motion, Cartesian Motion, Motion through a Singularity. **10Hour**

MODULE 5

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing. Programming – powered, manual. Textual Robo languages – first generation, second, future generation – VAL, VAL II, simple programming – exercises. **10 Hour**

Course outcomes:
At the end of the course students will be able to

1. U pon completion of the course, students will be able to understand importance of robotics in today and future goods production
2. S tudents will get the knowledge of End Effectors And Robot Controls
3. W ill be able to solve different type mathematical problems which use in calculation of movement of robot arm.
4. G et the knowledge of kinematics involved in robotics.
5. G ain the knowledge about different application area of robotics and use of sensors.

Text Books:

1. S .R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. I ndustrial Robotics, Technology programming and Applications, Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, McGraw Hill, 2012.
3. P eter Corke, "Robotics, Vision and control: Fundamental Algorithms in MATLAB", Springer publications, 2011

Reference Books

1. A Robot Engineering Textbook "– Mohsen Shahinpoor Harper & Row publishers,New York, – 1987.
2. R obotics, control vision and intelligence Fu, Lee and Gonzalez. McGraw HillInternational, 1987.
3. I ntroduction to Robotics: Mechanics and Control", Jo hn J. Craig, Pearson, 3e,2009

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

COMPUTER CONTROL OF MANUFACTURING SYSTEMS

(Common to MAR,IAE,MCM)

Sub Code	:	18MCM22	***IA Marks***	:	40
Hrs/ Week	:	04	Exam Hour	:	03
Total Hrs.	:	50	Exam Marks	:	60

Course Objectives:

1. To impart the basic concepts in manufacturing systems and fundamentals of NC & CNC system
2. Knowledge enhancement in design consideration and increasing productivity with NC machine tools, machining centers and tooling for CNC machines
3. To enhance student's awareness in system devices that includes feedback devices, counters, DAC converters and interpolators.
4. Improving knowledge in advance techniques in CNC.
5. To introduce the students to the standard terminologies, conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications merits and demerits of Computer Numerical Controlled (CNC) machines.

Course Content:

MODULE 1

Introduction to Computer integrated Manufacturing Systems: Manufacturing Systems,Types of Manufacturing Systems, , Machine Tools and related equipment's, Material Handling Systems, Computer monitoring and control, Manufacturing support systems, The Product Cycle and CAD/ CAM, Functions of computers in CIMS: CIMS Data Files, System Reports, Benefits of Computer integrated Manufacturing Systems.

Fundamentals of Numerical Control: Basic concepts of NC, Classification of NC- Point to Point and contouring, Incremental and absolute system, Open loop and closed loop system, Advantages of NC. **10 Hour**

MODULE 2

NC/ CNC Machine Tools: General architecture of CNC Machine, Components of the CNCSystems: Machine Control Unit , CNC Driving system components: Hydraulic, Servo Motors, Stepper Motors, Feedback Devices: Encoder, Resolver, Inductosyn, Tachometers, Counting devices.

Constructional Features of CNC Machines: Design considerations of CNC machines forimproving machining accuracy, Structural Members, Slide ways, bearings, Re-circulating ball Screws, Spindle drives, Work holding devices and tool holding devices, Automatic tool changers. **10Hour**

MODULE 3

N.C part programming: Introduction, NC/ CNC programming methods: Manual part programming for turning and milling centers, G codes, M codes, canned cycles, Programming with CAD/CAM integration, CAM packages for CNC part program generation, Practical Exercises on CNC part programming.

Computer Controls in NC: CNC Technology: Functions of CNC Control in Machine Tools,Advantages of CNC, Direct Numerical Control(DNC Systems): Configuration of DNC system, Functions of DNC, Communication between DNC computer & MCU, Advantages of DNC.

10Hour

MODULE 4.

Adaptive control: machining systems. Adaptive control optimization system, adaptive control constraint system, applications to machining processes, Benefits of Adaptive control Machining.

Industrial Robotics: Robotics technology : Types of Robots, Robot Technology Levels,Robot geometric configurations and Technical Features, basic robot motions, Robot control systems, robot drive systems, Work-cell control and Interlocks, robot sensors, robot safety,Robot-computer interface, industrial robot applications and benefits.**10 Hour**

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MODULE 5.

Computerized Manufacturing Planning and Control Systems: Computer aided processplanning, Variant and Generative approaches, Computer integrated production planning and control systems, Typical production planning and control system, Material planning systems, Capacity planning, Shop Floor Control, Automatic identification, Automated data collection systems. **10 Hour**

Course Outcome:

At the end of the course students will be able to

1. Students will get clear understanding Of NC/CNC machines
2. Various elements of CNC machines and its uses, Constructional features of CNC machine Tools
3. Will gain the knowledge about CAPP
4. Knowledge of CNC programming and its implementation.
5. Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology.

TEXT BOOKS:

1. GROOVER M P, Automation, Production Systems and Computer IntegratedManufacturing -, Prentice Hall India (P) Ltd, 1989.
2. Mikell P. Groover and Emory W. Zimmer, Jr., CAD/CAM Computer Aided Design andManufacturing, Prentice Hall India (P) Ltd, 1992. (unit 1)
3. M. Koren―Computer Controls of Manufacturing Systems,McGrawHill, 1983

REFERENCE BOOKS:

1. Martin J. ―Numerical control of machine tools".
2. P.N. Rao – CAD/CAM Principles and ApplicationsMcGr awhill 2002
3. Y. Koren&J.Benuri -"Numerical control of machine to ols -Khanna, 1992
4. Wilson F.M ―Numerical control in manufacturing- McGraw Hill Newyork
5. Suk-Hwan Suh, Seong-Kyoon Kang, Dea-Hyuk Chung and Ian Stroud, Theory andDesign of CNC Systems, , Springer, 2008

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

FLEXIBLE MANUFACTURING SYSTEMS

Common to MAR,IAE)

Sub Code :	18MCM23	***IA Marks***	:	40
Hrs/ Week :	04	Exam Hour	:	03
Total Hrs. :	50	Exam Marks	:	60

Course Objectives:

To make student understand

1. The need for flexibility in manufacturing industries
2. To learn the development and implementation of an FMS
3. To learn the different types of automated material handling systems its design and calculations for different applications both AS/RS
4. Will understand the concept of FMS tooling and fixture.
5. To have the students gain advanced skills in modeling, design and simulation of complex systems.

Course Content:

MODULE 1

Introduction Flexible and rigid manufacturing, F.M. Cell and F.M. System concept, Types and components of FMS, Tests of flexibility, Group Technology and FMS, unmanned factories, Economic and Social aspects of FMS. **10 Hour**

MODULE 2

Control structure of FMS: Architecture of typical FMS, Automated work piece flow, Control system architecture – Factory level, Cell level; hi erarchical control system for FMS, LANs - characteristics, transmission medium, signaling, network topology, Structure and functions of manufacturing cell, Distributed Numerical Control.**10 Hour**

MODULE 3

Scheduling & Loading Of FMS: Introduction, Scheduling of operations on a singlemachine, 2 machine flow shop scheduling, 2 machine job shop scheduling, 3 machine flow shop scheduling, scheduling 'n' operations on 'n' machines, Scheduli ng rules, loading problems , Tool management of FMS**10 Hour**

MODULE 4

Tooling in FMS: Modern cutting tools and tool materials, tool holders, modular tooling, tool monitoring, presetting and offsets, wear and radius compensation, tool magazines, automatic tool changers, robotized tool assembly, tool management system **10 Hour**

MODULE 5

Fixturing in FMS: Part holding on Pallets, standard fixtures, pallet changers, pallet pool, flexible fixturing – principles and methodologies, modular f ixturing system: T slot based, dowel pin based, fixturing components, computer aided fixture design – locating and clamping. **10 Hour**

Course outcome:

At the end of the course students will be able to

1. T he students will get a clear idea of importance of an FMS system in present manufacturing world.
2. I dentify various workstations, system support equipments and hardware components of FMS
3. T he student will learn the different types of FMS layouts, material handling and retrieval systems.
4. t hey will be able to solve the sequencing problems for different cases and tool management
5. W ill gain the knowledge about different storage system in manufacturing sector.

Text Books

1. Groover, Mikell P. (2002), 2/e, " Automation, Production Systems & Computer Integrated Manufacturing", Pearson Education or PHI
2. Viswanadhan, N. &Narahari, Y. (1998), "Performance Modelling of Automated Manufacturing Systems", PHI
3. Pinedo, Michael & Chao, Xiuly (1999), "Operations Scheduling with Applications in Manufacturing & Services", McGraw Hill International Editions (with 2 Floppy Disks of LEKIN Scheduling Software)

Reference Books

1. Kelton, Sadowsky&Sadowsky, "Simulation with ARENA",2/e, McGraw Hill International Editions (with CD of ARENA Simulation Software)
2. Radhakrishnan, Subramanyan, "CAD / CAM / CIM", John Wiley

3. Rao, PN, Tewari NK, Kundra TK, "Computer Aided Manufacturing", TMH
4. Rong, Yeming; "Computer Aided Fixture Design", Marcel Dekker, ISBN 0-8247-9961-5
5. Hobbs, "Lean Manufacturing Implementation", J. Ross Publishing, ISBN 1-932150-14-2
6. Chowdiah, Gargesa& Kumar, "Agile Manufacturing", TMH

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

Professional Elective –2

AGILE MANUFACTURING

(Common to MAR,IAE,MCM)

Sub Code	:	18MCM241	IA Marks	:	40
Hrs/ Week	:	03	Exam Hour	:	03
Total Hrs.	:	50	Exam Marks	:	60

Course Objectives:

The Student will

1. Get an overview of Agile Manufacturing, and their needs and strategies.
2. Know the process of developing an agile manufacturing/enterprise and development of Integration of Product /Process
3. To impart IT/IS Concept and Supply Chain Management in Agile Manufacturing
4. Learn the computer control and corporate knowledge management in agile manufacturing.
5. To impart the Skill & Knowledge of design in enhancing manufacturing technology.

Course Content:

MODULE 1

Agile Manufacturing: Definition, business need, conceptual frame work, characteristics,generic features. Four Core concepts: Strategy driven approach-integrating organization,People technology, interdisciplinary design methodology. **10 Hour**

MODULE 2

Developing Agile Manufacturing: Enterprise design, System concepts as the basicmanufacturing theory-joint technical & Organizational design and a model for the design of agile manufacturing enterprise. **Integration of Product /Process Development:** Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing People in Agile organization, Approaches **10 Hour**

MODULE 3

Application of IT/IS Concepts in Agile Manufacturing: Strategies, Management ofcomplexities and information. Flow, approaches, applications of multimedia to improve agility in manufacturing. **Agile Supply Chain Management:** Principles, IT/IS concepts in supply chain management,enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and learners – comparison of concepts. **10 Hour**

MODULE 4

Computer Control Of Agile Manufacturing: CAPP forcapacity planning and production line design / redesign manufacturing, concepts, examples.

Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in agile manufacturing, Role of standards. **10 Hour**

MODULE 5

Design of Skill & Knowledge: Enhancing technology for Machine tool system, Resumptionof design requirement geometry, definition, methods, decision support for selection of cutting Parameters, design enhancements, parametric approach only.**10 Hour**

TEXT BOOKS:

1. A gile Manufacturing - Forging Mew Frontiers',Poul T Kidd , Amagow Co. UK, ISBN-0 201-63163-6, 1994.
2. A gile Manufacturing, A Gunasekharan, the 21st CenturyCompetitive strategy, ISBN - 13978-0-08-04 3567-1, Elsevier Press, India.

REFERENCE BOOKS:

1. L evine Transitions to Agile Manufacturing, Joseph C Moutigomery and Lawrence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee. Wisconsin, USA, 1996.
2. A gile Development for Mass Customization, David M Anderson and B Joseph Pine,Irwin Professional Publishing, Chicago, USA, 1997.

Course Outcomes:

At the end of the course students will be able to

1. U nderstand conceptual strategies of agile manufacturing and their needs.
2. D evelopment of Integration of Product /Process in an agile manufacturing/enterprise
3. G et insight into Supply Chain Management and Enterprise design process to apply interdisciplinary design concepts.
4. D evelop the knowledge of usage of computer control systems in agile manufacturing.
5. A ppreciate benefits that can be derived by adopting newer manufacturing strategies.

NON-TRADITIONAL MACHINING

(Common to MAR,IAE)

Sub Code	:	18MCM242	***IA Marks***	:	40
Hrs/ Week	:	04	Exam Hour	:	03
Total Hrs.	:	50	Exam Marks	:	60

Course objectives:

1. To demonstrate the need for development of newer/ non-traditional machining processes.
2. Application of these machining methods in various fields
3. The student will be able to identify different energy sources like fluid motion, electric current, high speed electrons, high energy radiation, etc.
4. To analyze the concept, mechanism, parameters associated with the processes.

5. To demonstrate the operational principles, advantages applications, limitations of the various non-traditional machining processes.

Course Content:

MODULE 1

Introduction: Need for non-traditional machining processes, Process selection,classification, comparative study of different processes.

Ultra Sonic Machining: Definition, Mechanism of metal removal, elements of the process,Tool feed mechanisms, Theories of mechanics, effect of parameters, applications, Limitations.

Abrasive Jet Machining: Principle, Process parameters, Influence of process parameters onMRR, applications, advantages and disadvantages.**10 Hour**

MODULE 2

Water Jet Machining: Principle, Equipment, Operation, Application, Advantages andlimitations of water Jet machinery.

Thermal Metal Removal Processes: Electric discharge machining, Principle of operation,mechanism of metal removal, basic EDM circuitry, spark erosion generators, Analysis of relaxation type of circuit, material, removal rate in relaxation circuits, critical resistance parameters in Ro Circuit, Die electric fluids. **10 Hour**

MODULE 3

Electro Chemical machining (ECM): Classification of ECM process, Principle of ECM,Chemistry of the ECM process, parameters of the process, Determination of the metal removal rate, dynamics of ECM process, Hydrodynamics of ECM process, polarization, Tool Design, advantages and disadvantages-applications. **10 Hour**

MODULE 4

Chemical Machining: Introduction, fundamental principle types of chemical machining,Maskants, Etchants, Advantages and disadvantages, applications

Plasma arc Machining: Introduction, Plasma, Generation of Plasma and equipment,Mechanism of metals removal, PAM parameters, process characteristics

Electron beam machining (EBM): Introduction, Equipment for production of Electron beam,Theory of electron beam machining, Thermal & Non thermal type, Process characteristics, applications.

10 Hour

MODULE 5

Laser Beam Machining: Introduction, principles of generation of lasers, Equipment andMachining Procedure, Types of Lasers, Process characteristics, advantages and limitations, applications of laser beam machining.

Ion Beam Machining: principle, equipment, working, sputtering rate, applications.

High Velocity forming processes: Introduction, development of specific process, selection,comparison of conventional and high velocity forming methods.**10 Hour**

Text Books:

1. Modern Machining Process - P.C Pandy& H.S Shan Tata McGraw Hill.
2. Modern Machining Processes - P.K Mishra
3. Thermal Metal Cutting Processes-Dr.B.J.Ranganath,I K International,New Delhi.

Reference Books:

1. New technology - Bhattacharya, Institution of Engineers, India
2. Production technology - HMT Tata McGraw Hill.
3. Metals hand book - ASM Vol-3.
4. High velocity forming of metals - F.M Wilson ASTME PreticeHall.
5. Modern Manufacturing Methods - Adithan

Course Outcomes:

At the end of the course students will be able to

1. Student will be in a position to appreciate the merits of nontraditional machining and its application in Industries.
2. Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.
3. Students will be able to decide a process suitable for a particular material based on the availability of the sources.
4. Summarizes the merits and demerits of the non-traditional manufacturing process
5. Will gain the knowledge about different NTM process in various industries.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

FLUID POWER AUTOMATION

(Common to MAR,IAE,MCM)

Sub Code	: 18MAR243	*IA Marks*	:	40
Hrs/ Week	: 04	Exam Hour	:	03
Total Hrs.	: 50	Exam Marks	:	60

Course Objectives

1. To make the students to learn the basic concepts of hydraulics and pneumatics.
2. Principles and characteristics of the fluid power components.
3. Students will learn about controlling elements in the area of manufacturing process.
4. To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
5. Will understand the concept of fluid power automation in various application

MODULE I

Introduction: Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatic ,application in different filed , advantage, disadvantage.

10 Hour

MODULE 2

Fluid Power Generating/Utilizing Elements Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation. **10 Hour**

MODULE 3

Control And Regulation Elements Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and under lapped spool valves-operating characteristics electro hydraulic servo valves. **10 Hour**

MODULE 4

Circuit Design Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table- Karnaugh map method-sequencing circuits-combinational and logic circuit.

10Hour

MODULE 5

Electro Pneumatics & Electronic Control Of Hydraulic And Pneumatic Circuits Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits.**10 Hour**

Text book

1. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.
2. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.

References Text Book

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
2. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978
3. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
4. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967 7. Dudbey.
A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967

Course outcome

At the end of the course students will be able to

1. S tudent has to gain the knowledge about hydraulics pneumatics
2. W ill acquire the knowledge about applicationof hydraulics pneumatics in different filed.
3. R ecognize standard schematic symbols for common fluid power components.
4. K now about regulating system in fluid power automation
5. Come to about different circuit, adoption of hydraulics pneumatics in automation.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

CONCURRENT ENGINEERING FOR MANUFACTURING

(Common to MAR,IAE,MCM)

Sub Code :	18MAR244	***IA Marks*** :	40
Hrs/ Week :	04	Exam Hour :	03
Total Hrs. :	50	Exam Marks :	60

Course Objectives:

1. T o present historical review of industrial revolution from Ford to present days.
2. T o present basic knowledge of life-cycle management, process reengineering.
3. W ill know about benefits of CE in organization.
4. u nderstand the role of manufacturing processes on engineering design decisions
5. T o know about adoption of concurrent engineering in different manufacturing sector

Course content

MODULE 1

Introduction: Introduction. Review of Historical Events. Push and Pull for NewParadigms. Areas of Manufacturing Competitiveness. Product and Services. Process and Methodologies. Performance Indicators, Manufacturing Competitiveness.

Life-Cycle Management: Shrinking Life Cycle. Life-Cycle Management. New ProductIntroduction. Strategic Technology Insertions. Managing Continuity. Managing Revision Changes. Life-Cycle Cost Drivers. Life-Cycle Management Tools **10 Hour**

MODULE 2

Process Reengineering: Understanding and Managing Change, ReengineeringApproaches. Tenents of Process Improvement. Work Flow Mapping. Information Flow-Charting. Enterprise Models. Process Improvement Methodology. Change Management Methodology. Concurrent Process Reengineering. **10 Hour**

MODULE 3

Concurrent Engineering Definitions: Introduction, CE Definitions. Basic Principles ofCE. Components of CE. Concurrency and Simultaneity. Modes of Concurrency. Modes of Cooperation. Benefits of Concurrent Engineering. **10 Hour**

MODULE 4

System Engineering: Introduction. An Automobile Manufacturing Process. SystemEngineering. Systems Thinking. Approaches to System Complexity. Sharing and Collaboration in CE 300. System Integration. Agile Virtual Company. **10 Hour**

MODULE 5

Information Modeling : Information Modeling. Modeling Methodology. Foundation ofInformation Modeling. Concurrent Engineering Process Invariant. Enterprise Model-Class. Specification Model-Class. Product Model-Class. Process Model- Class. Cognitive Models. Merits and Demerits. **10 Hour**

Text Books:

1.“Concurrent Engineering Fundamentals -Integra ted product and processorganization”- Vol I& II, Prasad.B, PHI..
2.“Concurrent Engineering”- Shortening lead times, Ra ising Quality and LoweringCosts, Johan.R. Hartely, Productivity press, Portland, Oregon 1992.

Reference Books :

1.“Concurrent Engineering” -The Product Development Environment for the 1990’s,Carter DE and Baker BS, Addison Wesley Publishing Company.
2.“Concurrent Engineering in Product Design and Dev elopment”- Editor-ImadMoustapha,Reprint-2006, New Age International Publishers

Course Outcome:

At the end of the course students will be able to

1. K now about what concurrent engineering means.
2. K now about play of concurrent engineering in industries.
3. K now about life cycle management of a product.

4. L earned to appreciate the difficulties of change, and acquired skills of effective communication.

5. W ill have the knowledge about adoption of CE in organization

Professional Elective - 3

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

(Common to MAR,IAE,MCM)

Sub Code	:	18MCM251	*IA Marks*	:	40
Hrs/ Week	:	04	Exam Hour	:	03
Total Hrs.	:	50	Exam Marks	:	60

Course Objectives:

1. T he course is aimed at providing a complete overview Artificial Intelligence and Expert System and machine thinking tools.
2. S tudent has to aware of development of expert system and techniques for advanced programming.
3. W ill get the knowledge of different type of programming techniques which is used in AI and knowledge of smart systems
4. T o impart the knowledge of basic and advanced plan generation systems.
5. S tudents will get the knowledge about Application of AI and Expert systems

Course Content:

MODULE 1

Human and Machine Intelligence; Concepts of fifth generation computing, programmingAI environment, developing artificial intelligence system, definition of Expert systems, Natural Language processing,

Tools for Machine Thinking: Forward chaining, backward chaining, use of probability andfuzzy logic. **10 Hour**

MODULE 2

Expert System Development: Choice of Domain, collection of knowledge base, selectionof inference mechanism, case studies of expert system development in design and manufacturing.

Advanced Programming Techniques: Fundamentals of object oriented programming; creating structure and object, object operations. **10 Hour**

MODULE 3

Advanced knowledge representation for smart systems: semantic nets-structure andobjects, ruled systems for semantic nets; certainly factors.

Languages in AI: Using PROLOG to design expert systems**.** **10 Hour**

MODULE 4

Planning and Machine Learning

Basic plan generation systems – Strips -Advanced pl an generation systems – K strips - Strategic explanations -Why, Why not and how explanations.

10 Hour

MODULE 5

Expert System Tools: General structure of an expert system shell, examples of creation ofan expert system using an expert system tool.

Industrial Application of AI and Expert systems: Robotic vision systems, Imageprocessing techniques, application to object recognition and inspection. **10 Hour**

Text Books:

1. Robert Levine et al; "A Comprehensive guide to AI a nd Expert Systems"- McGraw Hill Inc, 1986.
2. Henry C.Mishkoff; " Understanding AI", BPB Publicat ion "-New Delhi 1987

Course Outcome:

At the end of the course students will be able to:

1. G ain the knowledge of Human and Machine Intelligence, tools for machine thinking and associated advanced programming techniques.
2. S eek the knowledge about development of expert system in different area.
3. W ill come to know about Adaptation of AI in different area of manufacturing.
4. W ill get the knowledge of advanced plan generation systems.
5. G ain the knowledge about programming language which is used in AI

ADVANCED MECHATRONICS

(Common to MAR,IAE,MCM)

Sub Code :	18MCM252	***IA Marks***	:	40
Hrs/ Week :	04	Exam Hour	:	03
Total Hrs. :	50	Exam Marks	:	60

Course objectives

1. Have a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering
2. Will understand the solid command of the newest technologies.
3. Comprehend and apply advanced theory-based understanding of engineering fundamentals and specialist bodies of knowledge in the selected discipline area to predict the effect of engineering activities.
3.Able to design, analyze, and test "intelligent" p roducts and processes that incorporate appropriate computing tools, sensors, and actuators.
4. Will learn the application of different sensors in manufacturing sector

MODULE 1

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, temperature and light sensors. **10 Hour**

MODULE 2

Solid state electronic devices, PN junction diode, BJT,and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications**10 Hour**

MODULE 3

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems. **10 Hour**

MODULE 4

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers. **10 hour**

MODULE 5

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response **10Hour**

Text Books:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.

REFERENCE BOOK:

1. Mechatronics – N. Shanmugam / Anuradha Agencies Pu blishers.
2. Mechatronics System Design / Devdasshetty/Richard/Thomson.
3. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
4. Mechatronics – Electronic Control Systems in Mec ha nical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton 8. Mechatronics – Principle s and Application Godfrey C. Onwubolu, Elsevier, 2006 Indian print.

Course outcome

at the end of the course students will be able to

1. Select and apply the knowledge, techniques, skills and modern tools in mechatronics engineering technology.
2. Apply concepts of circuit analysis, analog and digital electronics, automation and controls, motors, electric drives, power systems.
3. Describe mechanical design within the context of intelligent solutions and assess the interaction between sensing and actuation in designing intelligent mechanical systems.
4. Gain the knowledge aboutinstrumentation, and computers to aid in the design, characterization, analysis, and troubleshooting of mechatronics systems.
5. Have a briefly idea about digital electronics, data acquisition and its techniques

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

MICRO ELECTRO MECHANICAL SYSTEMS

(Common to MAR,IAE,MCM)

Sub Code	: 18MAR253	***IA Marks***	:	40
Hrs/ Week	: 04	Exam Hour	:	03
Total Hrs.	: 50	Exam Marks	:	60

Course Objective:

1. S
   tudents get exposure to various Micro Electronic Mechanical systems which find extensive usage in Industrial applications.
2. U

nderstand the operational theory of common MEMS sensors and MEMS actuators.

3. S tudents will come to know about verity of Micro Electronic Mechanical systems in industry.

4. Will learn working of different memes system.

5. W ill understand the fabrication of different memes devices and its application.

MODULE 1

Introduction: Micro Electro-Mechanical Systems, Ultra Precision Engineering, Micro-sensors; Micro-actuators; Microelectronics Fabrication; Micromachining; Mechanical MEMS; Thermal MEMS, MOEMS, Magnetic MEMS, RF MEMS, Micro-fluidic Systems, Bio and Chemo – Devices.

10 Hour

MODULE 2

Microfabrication and Micromachining: Integrated Circuit Processes, Bulk Micromachining:Isotropic Etching and Anisotropic Etching, Wafer Bonding

Mechanical Sensors and Actuators: Principles of Sensing and Actuation; Beam and Cantilever;Microplates; Capacitive Effects; Piezoelectric material as Sensing and ActuatingElements, Strain Measurement, Pressure measurement

10 Hour

MODULE 3

Thermal and Fluidic Micro Sensors and Actuators : Thermal sensors, Electrical Sensors,Chemical and Biosensors Electromagnetic and Thermal micro actuation, Mechanical design of micro actuators, Micro actuator examples, Micro Fluidic systems, Fluid actuation methods, micro valves, micro pumps, micromotors-Microactuator systems **10 Hour**

MODULE 4

Surface Micromachining: One or two sacrificial layer processes, Surface micromachiningrequirements, Polysilicon surface micromachining, Other compatible materials, Silicon Dioxide, Silicon Nitride, Piezoelectric materials **10 Hour**

MODULE 5

MEMS: Characterization: Technologies for MEMS characterization, Scanning ProbeMicroscopy (SPM): Atomic Force Microscopy (AFM), Scanning tunneling microscopy (STM), Magnetic Force Microscopy, Scanning Electron Microscope **10 Hour**

Text Books:

1.Rai-Choudhury P. MEMS and MOEMS Technology and Applications, PHI Learning PrivateLimited, 2009.

2.Stephen D. Senturia, "Microsystem Design" Springer, 2001.

3.MarcMadou, “Fundamentals of Microfabrication” Tay lor& Francis Group, 2002.

4.Gregory Kovacs, “Micromachined Transducers Source book” McGraw Hill 1998.

Reference Books

1.M.H. Bao, “Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes” Handbook, Elsevier.

2.NadimMaluf, An Introduction to Microelectromechanical Systems Engineering, Artech House Publishers, 2000.

3.Stephen D. Senturia, "Microsystems Design" Kluwer Academic Publishers, New York.

Course Outcome:

At the end of the course students will be able to

1. Students will be in a position to demonstrate their knowledge in micro machining and micro electro mechanical systems.
2. Students will come to know about application of memes in manufacturing sector.

3. Will acquire the knowledge about working of different memes devices.
4. Students will come to know characteristics of different memes devices and its application
5. Develop new ideas and applications for MEMS devices.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

MODERN CONTROL ENGINEERING

(Common to MAR,IAE)

Sub Code	: 18MAR254	*IA Marks*	: 40
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objectives

1. Students get exposure to various control techniques used in industrial automatic Controls with various response and system compensation methods.
2. To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains
3. Students get sufficient knowledge about working of different control system
4. Will learn about mathematicrepresentation of different control system.
5. Will understand the concept of control system and its application

MODULE 1

Introduction to Automatic Controls: Representation of Control Components,Representation of Control Systems, Characteristic functions, Steady-State Operation, Laplace Transforms, Basic Control Actions and Industrial Automatic Controllers. **10 Hour**

MODULE 2

The Root-Locus Method: -Introduction, Root Locus Plots, Illustrations, General rules forConstructing Root Loci, Root Locus Analysis of Control Systems, Transport Lag and RootContour Plots**10 Hour**

MODULE 3

Frequency Response Methods:-Introduction, Frequency Response, LogarithmicRepresentation, Evaluating the Gain K, Equivalent Unity-Feedback Systems.Polar Plots, M And Circles, Correlation between Transient and Frequency Response.**10 Hour**

MODULE 4

System Compensation: Nyquist Stability Criterion, Gain Margin and Phase Margin, LeadCompensation, Lag Compensation.
State-Space Methods: - Introduction, Basic materials in State-Space Analysis, TransferMatrices, Controllability, Observability, System Representation, Signal Flow Graphs.**10 Hour**

MODULE 5

Control Action and System Compensation: Concept of proportional, integral, proportionalintegral, proportional- integral- differential controllers, series and feedback compensation.
Introduction to State Variable Techniques: Introduction to state concepts, state equation oflinear

continuous data system. Matrix representation of state equations, controllability and observability.

10 Hour

Text Books:

1. Automatic Control Engineering - Francis H. Raven, McGraw- Hill International.
2. Modern Control Engineering - K. Ogata, PHI.

Reference Books:

1. Automatic Control Systems - B.C. Kuo, Prentice hall.
2. Automatic Control Systems - Harrison & Bollinger, International Text Book Company.
3. Feed Back Control System -Schaum's Series, McGraw Hill.
4. Control Systems -Gopal, McGraw Hill.

Course Outcomes
At the end of the course students will be able to

1. Students will be able to understand various control techniques used in modern engineering control system.
2. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. Will come to know about solving control system with help of mathematical models.
4. Gain the knowledge about application of control system in manufacturing sector.
5. Acquire the knowledge about steps in control system and different techniques to alter.

Manufacturing Engineering Lab 2

Sub Code: 18MAR26IA Marks: 40
Hrs/ Week: 03
Total Hrs: 84 Exam Marks: 60

Note:

1. The focus is on experimental investigations on one or more topics identified below.
2. Physical experiments as well as numerical experiments are welcome.
3. Parametric studies and correlation studies are implied.
4. Each student must prepare and submit a comprehensive report on the problemsInvestigated and give a presentation on the same for Internal evaluation.
5. Any one of the exercises done from the following list has to be asked in the Examinationfor evaluation.

Exercises:

1. Study waviness produced by grinding process and characterizes the resulting surface.
2. Develop and implement a program for pick and place of an object by a robot.
3. Modeling and simulation using MATLAB of a vibration control system and to draw time Response/ frequency response curves.
4. Kinematic analysis of forward/reverse linkages of robots using MATLAB (Denavit-Hartenberg convention).
5. Trajectory planning of robots using MATLAB.
6. Design and analysis of PID controller for mechanical engineering applications using MATLAB.
7. Reduce MLT using Lean principles that are followed in major industries (using case studies and data from industries and make a proposal for redesigning existing machine shop).

8. To develop a CIM Layout consisting of 3 machining centers, one AGV and 3 material handling robots. Layout developed must indicate complete CIM environment consisting of tool crib, raw material storage and finished product storage area. (Using solid edge, AutoCAD or any other available software).
9. Monitoring of vibrations/noise of a machine tool and to compare it with industry standards. List the causes of variation and suggest remedial measures.
10. Detection, location and characterization of defects in castings / welds/ adhesive bonds.

Third Semester

ADVANCED MATERIALS AND PROCESSING

(Common to MAR, IAE)

Sub Code	: 18MAR31	IA Marks	: 50
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objective:

1. This course provides a comprehensive knowledge of production, structure, property, function.
2. To equip the students with the theoretical knowledge, concepts and skills necessary for original thought and problems analysis related to engineering materials such as polymers, metals, ceramics and composites with specific advanced properties.
3. Will come to know about relation and application of a number of advanced materials used in industrial applications.
4. Students has to learn about diffident advance material and its characteristics.
5. Understand the fabrication techniques for advance material.

Course Content:

MODULE 1

Classification and Characteristics: Metals, Non ferrous Metals and Ferrous Metals,classification of Ferrous Metals and Non Ferrous Metals, Types of Ceramics, Polymers and composites and classification of composites.

General Properties and Structure: Atoms, molecules bonds in solids, Crystalline - Defectsin Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening. **10 Hour**

MODULE 2

Ferrous Alloys: iron carbon equilibrium diagrams - Steels and cast irons - properties,structure, composition and applications transformation hardening in steels - TTT diagrams - Heat treatment processes - Effect of alloying elements - High alloy steels, Stainless steel types, tool Steels, Manganese steels.

Non Ferrous Alloys: Alloys of copper, Aluminum, nickel, magnesium, titanium, lead, tin,Zinc - composition, heat treatment, structure **10 Hour**

MODULE 3

Polymers and Polymerizations: Structure and properties of thermoplastics and thermosets – Engineering Applications - property modifications - Mechanical and thermal behavior.

Ceramics : Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics- Advanced ceramics processing methods. **10 Hour**

MODULE 4

Composites : Definition - classification and characteristics of composite materials -Volume fraction - laminated composites particulate composites, fibrous composites - Types of reinforcements, their shape and size - production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites - Applications. **10 Hour**

MODULE 5

Processing of Polymer Matrix Composites: Hand layup, Spray-Up Process,Vacuum Bag molding, Pressure bag molding, Resin Transfer Molding, Filament winding, Pultrusion, Autoclave moulding, Injection moulding process, Thermoforming process. 10 Hour

TEXT BOOKS:

1. Engineering Metallurgy - Raymond and Higgens - ELBS/EA
2. Introduction to Material Science and Engineering James.F.Shackleford - Mc Millan, NY - 7th edition.

REFERENCE BOOKS:

1. Powder Metallurgy-Metals Hand Book -ASM, USA - Vol.7, 1974.
2. Composite Materials - Science and Engineering - Chawla K.K. , - Springer - Verlag, Newyork - 2nd edition, 19910.
3. Cast Metal Matrix Composites ASM Metals Hand Book - P.K. Rohagti - VI5.
4. Elements of Material Science and Engineering - Van Vlack L.H. - Addison Wesley, NY - 19109.
5. Material science and metallurgy - by Calliester, John Willey & Sons.

Course Outcome:

At the end of the course students will be able to

1. Understand and apply the various processing and manufacturing techniques
2. Knowledge of basics of process and important parameters of equipment design.
3. Understand and apply the techniques and their characteristics/limitations of synthesis of polymers.
4. Understand the structure-processing-property relationship of metals and polymers.
5. Understand the basic issues involved in polymer blends, metal matrix composites and ceramic matrix composites.

Professional Elective - 4

MODELING OF MANAGEMENT INFORMATION SYSTEMS

(Common to MAR,IAE,MCM)

Sub Code	: 18MAR321	*IA Marks*	: 40
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objectives:

1. Introduce various aspects of MIS as applied to engineering problems in a systematic manner.
2. This course is designed to introduce students to the impacts of information systems on the firm, industry, society and the economy.
3. The students also would understand the activities that are undertaken in acquiring an Information System in an organization.
4. The management of the information resource and issues related to accessing, processing, and distributing information within a business context are emphasized.
5. Impart the knowledge of fundamentals of data base, business applications

Course Content:

MODULE 1

Information Basics: Definition of information system, classification of IS, Need forInformation system, Contemporary approaches to information system, Key system applications in the organization, Challenges of information systems. **10 Hour**

MODULE 2

Managing with Information and its Resources: Managing in 21st Century, Strategicplanning and IS, Information needs for strategic planning, IS for decision support, Quality and privacy issues. Information resource management, strategic planning for IS function, justification for IS, IT/IS facilities and operations. **10 Hour**

MODULE 3

Information systems and Organizations: Relationship between organizations andinformation systems, feature of organizations, effect of organizations on information systems.
Information, Management and Decision-making: Role of managers, Decision-making,Individual models of decision-making, Organizational models of decision-making.**10 Hour**

MODULE 4

Information System Development: system development life cycle and methodologies,principles of system design. System analysis- Definition, Strategies and Phases.
Object Oriented Technology: Object orientation, object oriented analysis (OOA),systemdevelopment through OOT, Object Oriented Languages. **10 Hour**

MODULE 5

System modeling: Introduction to system modeling, system concepts for data modeling,logical data modeling, and construction of data model. Process modeling: Introduction to process modeling, system concepts for process modeling.

Decision Support Systems: DSS issues, Structure Constructions-approaches,generators, tools, software and cost benefits and simple examples of applications. **10 Hour**

Text Books:

1. Management information systems organization and technology, 4th edition - Kenneth C.Laudon and Jane P.Laudon, Prentice Hall India/Pearson Education.
2. Systems analysis and design methods, 4th edition - Jeffery L.Whitten and LonnieD.Bentley, Tata McGraw Hill.

Reference Books:

1. Management Information Systems-Conceptual foundations, Structure and development - Davis.G.B, McGraw Hill Intl.Book.Co.
2. Management Information Systems - Robert Schulties and Marry summer, Tata McGraw Hill Publishing Co., Ltd. New Delhi.
3. Management Information System- A Concise Study - S.A.Kelkar, PHI.
4. Management Information systems - W.S Jawadekar, TMH
5. Information System for modern management -Murdick Ross &Claggett ,PHI.

Course Outcomes:
At the end of the course students will be able to

1. To understand fundamentals of MIS and be able to compare it with other approaches.
2. The student would understand the classifications of MIS, understanding of functional MIS and the different functionalities of these MIS. This would be followed by case study on Knowledge management.
3. Identify and utilize fundamentals of data base management as applied to the respective tasks.
4. Demonstrate the ability to define and formulate the properties and characteristics of data base management by any engineer.
5. Will learn the flow and control of various parameters in the organization.

PRODUCTION PLANNING AND CONTROL

(Common to MAR,IAE)

Sub Code	: 18MAR 322	***IA Marks***	:	50
Hrs/ Week	: 04	Exam Hour	:	03
Total Hrs.	: 50	Exam Marks	:	60

Course Objectives:

1. T
   o understand the problems and opportunities faced by the operations manager in manufacturing and service organizations.
2. T
   o develop an ability to apply PPC concepts in a various areas like marketing, accounting, finance, engineering, personnel management, logistics, etc.
3. T
   o integrate operations concepts with other functional areas of business
4. T
   o understand the PPC function in both manufacturing and service organizations.
5. T
   o examine several classic Operations Management planning topics including production planning and inventory control.

Course content

MODULE 1

INTRODUCTION

Objectives and benefits of planning and control-Functions of production control-Types of production job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration**10 Hour**

MODULE 2

WORK STUDY

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards. **10 Hour**

MODULE 3

PRODUCTION PLANNING : Forecasting techniques – causal and time series mo dels, movingaverage, exponential smoothing, trend and seasonality; aggregate production planning, numerical. **10 Hour**

MODULE 4

MASTER PRODUCTION SCHEDULING

MRP and MRP-II; order control and flow control; routing, scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system; logistics, distribution, and supply chain management**10 Hour**

MODULE 5

INVENTORY CONTROL AND RECENT TRENDS IN PPC

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size.BC analysis-Recorder procedure-Introduction to computer integrated production planning systems.**10 Hour**

OUTCOMES:

At the end of the course students will be able to

1. Recognize the objectives, functions, applications of PPC and forecasting techniques.
2. Explain different Inventory control techniques.
3. Solve routing and scheduling problems
4. Summarize various aggregate production planning techniques.
5. Describe way of integrating different departments to execute PPC functions.

TEXT BOOK:

1. MartandTelsang, “Industrial Engineering and Prod uc tion Management”, First Edition,S. Chand and Company, 2000.
2. James.B.Dilworth,”Operations management – Design , Planning and Control for manufacturing and services” Mcgraw Hill International Edition1992 .

REFERENCES:

1. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.19104
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Prod uc tion / b Operations Management”, 10th Ed. John Wiley and Sons, 2000.
3. Kanishka Bedi, “ Production and Operations manag em ent”, 2 nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, “ Operations Management – A val ue driven approach” Irwin Mcgrawhill.
5. Norman Gaither, G. Frazier, “ Operations Managem en t” Thomson learning 9th edition IE, 2007
6. K.C.Jain& L.N. Aggarwal, “Production Planning C ont rol and Industrial Management”, Khanna Publishers, 1990.
7. S.N.Chary, “Theory and Problems in Production & Ope rations Management”, Tata McGraw Hill, 1995.

10. Upendra Kachru, " Production and Operations Man age ment – Text and cases" Excel books 1st edition 2007.

TOOLING FOR MANUFACTURE IN AUTOMATION

(Common to MAR,IAE,MCM)

Sub Code	: 18MAR323	*IA Marks*	: 50
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

Course Objective:

1. Students are introduced to metal cutting principles, cutting tool materials, types of cutting tools and its nomenclature.
2. The aims of this course are to introduce to the students the basic concepts of tool and develop their technical abilities to supervise a modern tool.
3. Students will get information about different type of tool and its material
4. Students get orientation into clamping methods and jigs used in automated environment.
5. Will understand the concept of CNC tooling

Course Content:

MODULE 1

Mechanics of metal cutting: Introduction, measurement of cutting forces and chipthickness, force components, chip formation and primary plastic deformation, shear plane and slip line theories for continuous chip formation.

Modern Cutting tool materials: Material properties, HSS related materials, sintered tungstencarbide, cermets, ceramics, polycrystalline tools, tool coatings

Cutting tools: Basic types of cutting tools, turning tools, indexable inserts, groove geometry,edge preparation, wiper geometry, insert clamping methods, tool angles, threading tools, cutters.**10Hour**

MODULE 2

Optimization: Machining cost and production rate verses cutting speed, role ofcomputerized optimization system, economic considerations, optimization of machining system.

Tooling Requirements for CNC Machines: Tool holding systems modular and quick changetool holding system, tool holder spindle connection, cutting tool clamping systems, milling cutter driver, side lock type chuck, collet chucks, hydraulic chucks, milling chucks. Tool magazines, Automatic Tool Changers.**10 Hour**

MODULE 3

Location and Clamping Methods: Basic principles of locating, locating methods &devices, Basic principles of clamping, clamping methods.

Fixtures: Definitions, General considerations, Machine considerations, Process considerations,Product considerations, Types of fixtures, Vise fixtures, Milling fixtures.**10 Hour**

MODULE 4

Fixtures for Automation: Work holders for CNC, Fixturing in FMS: Part holding onPallets, standard fixtures, pallet changers, pallet pool, flexible fixturing – principles and methodologies, modular fixturing system: Tslot based, dowel pin based, fixturing components. **10 Hour**

MODULE 5

Plastics for tooling materials: Introduction, Commonly used plastics for tooling, Epoxyplastics tools,

Construction methods, Urethane dies, Force calculation for Urethane pressure pads. **10 Hour**

Textbooks:

1. Cyrol Donaldson, Tool Design -, Tata McGraw Hill, India.
2. Edward G Hoffman, Fundamentals of Tool Design -, SME, USA.
3. Joshi, P.H., Jigs & Fixtures, Second Edition, Tata McGraw-Hill Publishing Company Limited,New, Delhi 2004
4. Hiram E Grant, Jigs and Fixture Tata McGraw-Hill, New Delhi, 2003

Reference Book

1. William E Boyes, Handbook of Jigs & Fixtures Design -, SME, USA.
2. G.R. Nagpal, Tool Engineering & Design -, Khanna publications.
3. David A.Stephenson, John S. Agapiou, Metal cutting theory and practice, Second edition CRC taylor and Francis publishers.
4. Dr. B.J. Ranganath, Metal cutting and tool design, Vikas publishing house
5. ASTME; Die Design Hand book; McGraw Hill.

Course Outcome:

At the end of the course students will be able to

1. Students are able to decide a type of tool appropriate for machining a material, decide on nomenclature parameters and be able to design a clamping method.
2. Will gain the concept of various cutting tool and its mechanics.
3. Will come to know about different tooling techniques of CNC
4. List and use the general principles involved in tool and its design.
5. Acquire the knowledge about different type of jigs and fixture, tooling material.

COMPUTER CONCEPTS FOR AUTOMATION

(Common to MAR,IAE)

Sub Code	: 18MAR324	*IA Marks:*	40
Hrs/ Week	: 04	Exam Hour:	3
Total Hrs.	: 50	Exam Marks:	60

Course Objective:

1. Categorize and Summarize Big Data and its importance. And Manage Big Data and analyze Big Data
2. Will identify the area big data and cloud computing.
3. Will understand the concept of data base management system
4. Apply tools and techniques to analyze Big Data.
5. Students will get information about different technology used in Big Data.

Course Content:

MODULE 1

Introduction to big data:Big Data and its Importance – Four V's of Big Data – Drivers for Big Data –

Introduction to Big Data Analytics – Big Data Analy tics applications. Hadoop's Parallel World – Data discovery– Open source technology for Big Data Analytics – cloud and Big Data –Predictive

Analytics – Mobile Business Intelligence and Big Da ta – Crowd Sourcing Analytics –Inter- and Trans-Firewall, Analytics -Information Management. **10Hour**

MODULE 2

Processing big data: Integrating disparate data stores -Mapping data to the programming framework Connecting and extracting data from storage -Transforming data for processing -Subdividing data in preparation for Hadoop Map Reduce.**10Hour**

MODULE 3

Hadoop map reduce:Employing Hadoop Map Reduce -Creating the components of Hadoop Map Reduce jobs -Distributing data processing across server farms -Executing Hadoop Map Reduce jobs -Monitoring the progress of job flows -The Building Blocks of Hadoop Map Reduce – Distinguishing Hadoop daemons -Investigating the Hadoop Distributed File SystemSelecting appropriate execution modes: local, pseudo-distributed, fully distributed**10Hour**

MODULE 4

Database Management System: Comparison of File System, Database Management System, Characteristic Features of Database Management Systems, Relational Databases.
Data Base Models:DBMS Languages and Interfaces. Data Base Security and Authorization.**10Hour**

MODULE 5

Big data tools and techniques: Installing and Running Pig –Comparison with Databas es – Pig Latin – User-Define Functions – Data Processing Operators – Installing and Running Hive – Hive QL – Tables – Querying Data – User-Defined Functions – O racle Big Data. **10Hour**

Text Books:

1. Fundamentals of DBMS – RamezElmasri and Navathe, A ddison Wesley, 5thedition, 2009.
2. Michael Minelli, Michehe Chambers, “Big Data, Bi g Analytics: Emerging Business Intelligence and Analytic Trendsfor Today’s Business”, 1st Editi on, AmbigaDhiraj, Wiely CIO Series, 2013.
3. ArvindSathi, “Big Data Analytics: Disruptive Tec hn ologies for Changing theGame”, 1st Edition, IBM Corporation, 2012.
4. Bill Franks, “Taming the Big Data Tidal Wave: Fi nd ing Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Bus inessSeries, 2012.
5. Tom White, “Hadoop: The Definitive Guide”, 3rd E di tion, O’reilly, 2012.

References:

1. Introduction to DBMS – Date C.J, Addison Wesley, 3 rdedition, 1981

Course Outcome:

At the end of the course students will be able to

1. Analyze several key technologies used in manipulating, storing, and analyzing big data.
2. Acquire clear understanding of processing data
3. Acquire clear understanding of Hadoopmap reduce.
4. Categorize and Summarize Big Data and its importance.
5. Manage Big Data and analyze Big Data

Professional Elective-5

OPERATIONS RESEARCH

Sub Code : 18 MAR331	*IA Marks*	:	40
Hrs/ Week : 04	Exam Hour	:	03
Total Hrs. : 50	Exam Marks	:	60

Course Objective:

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

MODULE 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models**10 Hour**

MODULE 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming**10 Hour**

MODULE 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT**10 Hour**
MODULE 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. **10 Hour**

MODULE 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.**10 Hour**

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COST MANAGEMENT OF ENGINEERING PROJECTS

Sub Code : 18 MAR332	*IA Marks*	:	40
Hrs/ Week : 04	Exam Hour	:	03
Total Hrs. : 50	Exam Marks	:	60

MODULE 1: Introduction and Overview of the Strategic Cost Management Process

6 Hour

MODULE 2: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

8Hour

MODULE3: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process. **12Hour**

MODULE 4: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.**12Hour**

MODULE 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.**12 Hour**

References:

1. C ost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. C harles T. Horngren and George Foster, Advanced Management Accounting
3. R obert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. A shish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N .D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS

Sub Code : 18 MAR333	*IA Marks*	:	40
Hrs/ Week : 04	Exam Hour	:	03
Total Hrs. : 50	Exam Marks	:	60

MODULE –I: INTRODUCTION: Definition – Classification and char acteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.**10 Hour**

MODULE-2: Matrix Materials:Polymer Matrices-Thermosets, Thermoplastics and Elastomers. **Metallic Matrices**-Aluminum, Titanium, Magnesium and Copper alloys. **Ceramic Matrices**-Alumina, Zirconia, Silica, Mullite.
Reinforcement Materials: Fibers-Natural Fibers-Sisal, Jute, Basalt, Areca. Synthetic fibres-Glass, Carbon, Kevlar and Boron. **Whiskers**-Polymeric-PTFE, PEEK, PP, PA**.** Metallic-Copper, Zinc, Titanium, Aluminum**.** Ceramic- Carbides, Oxides and Nitrides of Silicon, Boron, Titanium and Alumina. **10 Hour**

MODULE – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic press ing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composi tes: Knitting, Braiding, Weaving. Properties and applications. **10 Hour**

MODULE –IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autocl ave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

10 Hour

MODULE – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations. **10 Hour**

TEXT BOOKS:

1. M aterial Science and Technology – Vol 13 – Composite s by R.W.Cahn – VCH, West Germany.
2. M aterials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. H and Book of Composite Materials-ed-Lubin.
2. C omposite Materials – K.K.Chawla.
3. C omposite Materials Science and Applications – Debor ah D.L. Chung.

Composite Materials Design and Applications – Dania l Gay, Suong V. Hoa, and Stephen W. Tasi.

WASTE TO ENERGY

Sub Code	: 18 MAR334	*IA Marks*	: 40
Hrs/ Week	: 04	Exam Hour	: 03
Total Hrs.	: 50	Exam Marks	: 60

MODULE -I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Con versio n devices – Incinerators, gasifiers, digesters. **10 Hour**

MODULE -II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – M anufacture of charcoal – Methods - Yields and application – Manufacture of p yrolytic oils and gases, yields and applications. **10 Hour**

MODULE -III: Biomass Gasification: Gasifiers – Fixed bed syste m – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Desig n, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier e ngine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.**10 Hour**

MODULE -IV: Biomass Combustion: Biomass stoves – Improved chu llahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors. **10 Hour**

MODULE -V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.**10 Hour**

REFERENCES:

1. N on Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. B iogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. F ood, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. B iomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.