

**MID 301(A)**  
**Mechatronics and Flexible Manufacturing**

**Unit 1**

**Defining mechatronics**, its characteristics, scope and key issues, advantages and development of CNC horizontal and vertical machining centers, tool monitoring on CNC machines, differentiation between FMC, FMS and CIM, benefits of FMS and suitability to batch production.

**Unit 2**

**Design of CNC machines**, structure, guide-ways, feed drives, and spindle bearings, measurement and control systems, software and user interfaces, gauging and tool monitoring systems, assembly techniques for guide-ways, ball-screw and nut, spindle bearings, feedback elements and hydraulics.

**Unit 3**

**Review of electrical and electronic devices**; Drives, spindle and feed drives, servo principle, drive protection and optimization, selection criteria for drives, power supply, electrical cabinets and air cooling, electrical standards.

**Unit 4**

**CNC systems**, configuration of CNC systems, interfacing, monitoring and diagnostics, compensation for machine accuracies, machine data, Programmable Logic Controllers (PLC), Direct Numerical Control (DNC); testing of CNC machine tools, verification of technical specifications and functional aspects, Idle running tests, machine tool and work-piece accuracies, metal removal capability and safety aspects.

**Unit 5**

**Programming and operations of CNC machines**, part programming, coordinate system, dimensioning, axes and motion nomenclature, structure of part programs, G02/ G03 circular interpolation, tool compensation, subroutines/ macro, canned cycles (G81/ G89), mirror imaging, parametric programming and R-parameters, constant speed and constant cutting speed (G97/ G96), machining cycles, examples of machine center programming, case studies.

**References:**

1. HMT edited; Mechatronics; TMH.
2. Kuttan Appu KK; Introduction to Mechatronics; Oxford press
3. Mahalik NP; Mechatronics principles, concepts and applications; TMH
4. Smaili A and Mrad F; Mechatronics Integrated Technology; Oxford Press

**MID -301(B)**  
**AUTOMATION IN MANUFACTURING**

**UNIT-I**

**Introduction to Automation:** Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, , Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

**UNIT-II**

**Introduction to Material Handling:** Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

**UNIT -III**

**Manual Assembly Lines** : - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

**UNIT-IV**

**Transfer lines** : Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

**UNIT-V**

**Automated Assembly Systems** : Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines , Partial Automation.

**Text Books:**

1.Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/  
Pearson Education.

**Reference Books:**

1. CAD CAM : Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

**MID -301(C)**  
**PRODUCT DATA MANAGEMENT**

**UNIT 1**

**Centralized Systems:** Client Server Systems, Parallel Systems, Distributed Systems, NetworkTypes, Parallel Database, Distributed Database, Security and Integrity, Standardization views **Product Data Management** : Product life cycle, Complexity in Product Development, General Description of PDM

**UNIT 2**

**Basic functionality of PDM:** Information architecture, PDM System architecture, Applications used in PDM systems. Trends in PDM

**UNIT 3**

**Document Management Systems:** Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet.

**UNIT 4**

**Workflow Management in PDM:** Structure Management, Engineering ChangeManagement, Release Management, Version Management, Configuration Management **Creating Product Structures:** Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures  
PDM Tools: Matrix One, TeamCenter, Windchill.Enovia, PDM resources on the Internet.

**UNIT 5**

**PDM Implementation Case Studies:** Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Electronics AB

**REFERENCE BOOKS:**

**1. Implementing and Integrating Product Data Management and Software**

**Configuration Management** - 21 - Ivica Cmkovic Ulf Asklund - Annita Persson Dahlqvist - Archtech House Publishers.

**2. Product Data Management** - Rodger Burden - Publisher: Resource Publishing- ISBN-10: 0970035225, ISBN-13: 978-0970035226 – 2003.

**3. The AutoCAD Database Book – Accessing and Managing CAD Drawing**

**Information** - Galgotia Publications - Third Edition.

**MID -302(A)**  
**INDUSTRIAL ROBOTICS**

**UNIT: I**

**Introduction:** Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. Control System And Components: basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

**UNIT: II**

**Motion Analysis And Control:** Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller,

**UNIT: III**

**End Effectors:** Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. **SENSORS:** Desirable features, tactile, proximity and range sensors, uses sensors in robotics. **MACHINE VISION:** Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

**UNIT: IV**

**ROBOT PROGRAMMING:** Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations. **ROBOT LANGUAGES:** Textual robot Janguages, Generation, Robot language structures, Elements in function.

**UNIT: V**

**ROBOT CELL DESGIN AND CONTROL:** Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work eel 1 controller. **ROBOT APPLiCATION:** Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

**Text Books:**

1. Industrial robotics, Mikell P.Groover/McGraw Hill.
2. Robotics, K.S.Fu / McGraw Hill.

**MID 302 (B)**

**PRODUCT ANALYSIS AND COST OPTIMIZATION**

**UNIT 1**

**Introduction:** New products, new product strategy -market definition Idea generation introduction to the design process -forecasting sales potential -product engineering and markets monopoly competitive.

**UNIT 2**

**Manufacturing Planning:** Selection of optimum process, standardization. Break even analysis application and area of use -problems -multi - product analysis.

**UNIT 3**

**Value Analysis:** Steps in selection, analysis and implementation, Selection of cutting speed for optimum cost -problems.

**Cost Accounting:** Cost estimation -difference -types -steps involved in cost estimation.

**Types of Cost:** Cost Centres, Direct –indirect, material cost -direct indirect material cost Overhead cost, Elements in overheads: Preparation of cost sheet, machine hour rate, apportioning methods.

**UNIT 4**

**Variance Analysis** – Labour variance, Material variance and Overhead variance, Activity based costing - Introduction to target costing.

**Cost Calculation:** Cost calculation for machined components, welding, casting and forged components illustrations -calculation of sales cost.

**UNIT 5**

**Cost Optimization Techniques:** Analytical, Graphical and incremental methods Learning curves.

**REFERENCE BOOKS:**

1. **Design and Marketing of New Products** - Glen L Urban - John R Hauser- Prentice Hall. New Jersey, 1980.
2. **Production and Costing** - Narang CBS & Kumar V - Khanna Publishers- 2001.
3. **Cost management in the New Manufacturing Age** -Yasuhiro Monden, Productivity Press-1992.
4. **Technique for Value Analysis And Engineering** - Miles Lawrence.D - McGraw Hill, New york-1972.

**MID – 302 (C)**  
**COMPOSITE MATERIALS**

**UNIT – I**

**INTRODUCTION:** Definition – Classification and characteristics 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.

**UNIT – II**

**REINFORCEMENTS:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

**UNIT – III**

**Manufacturing of Metal Matrix Composites:** Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

**UNIT – IV**

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

**UNIT – V**

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

**TEXT BOOKS:**

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

**REFERENCES :**

1. Hand Book of Composite Materials-ed-Lubin
2. Composite Materials – K.K.Chawla
3. Composite Materials Science and Applications – Deborah D.L. Chung
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.