Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati.

(An Autonomous Institute)

Faculty of Science and Technology

Board of Studies

Mechanical Engineering

Syllabus

Honors with Specialization in Robotics & Automation

(Pattern 2024)

(w.e.f. AY: 2025-26)

Syllabus: Honors with Specialization in Robotics & Automation

(Pattern 2024) w.e.f. AY:2025-2026

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
		TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
ME24281	Automation and Robotics	2	2	-	10	-	60	-	30	-	100	2	1	-	3
ME24291	Industrial Robotics & Material Handling Systems	2	2	-	10	-	60	-	30	-	100	2	1	-	3
ME24381	Industrial Automation	3	2	-	10	30	60	-	30	-	130	3	1	-	4
ME24391	Manufacturing Systems and Simulation	3	2	-	10	30	60	-	30	-	130	3	1	-	4
ME24481	Computer Integrated Manufacturing	3	2	-	10	30	60	-	30	-	130	3	1	-	4
Total		**13**	**10**	**-**	**50**	**90**	**300**	**-**	**150**	**-**	**590**	**13**	**5**	**-**	**18**

Dept. Autonomy Coordinator

Dr. M. S. Lande

Dept. Academic Coordinator

Mr. S. C. Mahadik

Head of Department & BOS Chairman

Dr. M. S. Lande

Dean Autonomy

Dr. C. B. Nayak

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Dr. S. M. Bhosle

Principal

Dr. S. B. Lande

VPKBIET BARAMATI
Affiliated to S. P. P. U. Pune Id No./PU/PN/Engg/152/2008
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Principal
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Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

ME24281:- AUTOMATION AND ROBOTICS		
Teaching Scheme:	**Credits:03**	**Examination Scheme:**
TH: 02 Hrs/Week	**Theory : 02** **Practical : 01**	**CAA: - 10 Marks** **End-Semester Exam: 60 Marks**
PR: 02 Hrs/Week		**PR Exam: - 30 Marks**

Prerequisites: Engineering Physics, Engineering Mathematics, Basics of Electrical Engineering, Basics of Electronics Engineering & Engineering Graphics.

Objectives:

1. To provide students with foundational knowledge of industrial automation systems, and their applications in modern industries.
2. To introduce students to the fundamentals of PLC programming.
3. To introduce various types of Robots and the functional elements of Robotics.
4. To introduce various types of end effectors.

Course Outcomes:

The students will be able to learn:

CO1: To design and implement basic automation systems.

CO2: To develop and troubleshoot ladder logic programs using PLCs.

CO3: UNDERSTAND basic concepts of robotics.

CO4: To COMPARE and SELECT robot and end effectors as per application.

Course Contents

Unit-1: Basics of Industrial Automation	**[08 Hrs.]**
Definition of Industrial Automation, Types of Automation (Fixed, Programmable, Flexible), Applications in modern industries, Basic Components of Automation Systems Sensors and Transducers: Types and Functions, Actuators: Role in Automation Controllers: Overview of PLC and SCADA Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations, Hydraulic Actuators-Types and applications, Components of Basic hydraulic systems, Hydraulic circuits for Single acting and double acting actuator, Components of Basic Pneumatic systems, application of pneumatics in industrial automation.	

Unit-2: Programmable Logic Control	**[08 Hrs.]**
Introduction to PLC, Architecture of PLC, Ladder logic programming for different types of logic gates, Latching, Timers and Counters, Practical examples of Ladder programming.	
Unit-3: Fundamentals of Robotics	**[07 Hrs.]**
Historical development of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision of Robot.	
Unit-4: End Effectors	**[07 Hrs.]**
Grippers, Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Grippers; Various process tools as end effectors; Robot end effectors interface, Active and passive compliance, Selection and Design Considerations.	

Text Books:

1. Anthony Esposito, Fluid Power with Applications, PHI Learning Pvt. Ltd. , New Delhi.
2. William Bolton, Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering.
3. Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, Industrial Robotics, Technology, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd. New Delhi
4. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

Reference Books:

1. Andrew Parr, Hydraulics and Pneumatics: A Technician's and Engineer's Guide, Butterworth-Heinemann, 3rd Edition

2. C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi

3. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.

4. Mikell P. Groover, Automation, Production Systems & Computer Integrated Manufacturing,

PHI Learning Pvt. Ltd., New Delhi, ISBN: 987-81-203-3418-2, 2012.

Guidelines for Lab /TW Assessment (All Practical's are compulsory)

1. Study of various components of Hydraulic system.
2. Study of various components of Pneumatic system.
3. Simulation of Single Acting/ Double Acting Hydraulic actuators for simple reciprocating circuit using suitable Simulation Software.
4. Simulation of simple Electrohydraulic or Electro pneumatic circuit using suitable Simulation Software.
5. Ladder logic programming of various logic gates using suitable Simulation Software.
6. Ladder logic programming involving Latching, Timers and Counters using suitable Simulation Software.

Guidelines for Activity:

A mini project in "Automation studio" or similar software for designing any industrial application and/or real life technical problems related to automation. A design report giving all necessary calculations and specifications of the components should be submitted in separate file.

Mini project will give students hands-on experience in designing, simulating, and programming systems within Automation Studio while covering essential aspects of hydraulics, pneumatics, and PLCs.

Final evaluation will be based on completeness of the design, correctness of hydraulic/pneumatic circuits. Efficiency and functionality of the PLC program and creativity in solving practical industrial automation problems.

<table>
<tr><th colspan="3">ME24291:- INDUSTRIAL ROBOTICS & MATERIAL HANDLING SYSTEMS</th></tr>
<tr><td>Teaching Scheme:</td><td>Credits:03</td><td>Examination Scheme:</td></tr>
<tr><td rowspan="2">TH: 02 Hrs/Week</td><td rowspan="3">Theory : 02
Practical : 01</td><td>CAA: - 10 Marks</td></tr>
<tr><td>End-Semester Exam: 60 Marks</td></tr>
<tr><td>PR: 02 Hrs/Week</td><td>PR Exam: - 30 Marks</td></tr>
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Prerequisites: Introduction to Robotic Systems, Automation and Robotics.

Objectives:

1. To understand the design principles, material selection, and advanced technologies used in the development of end effectors and grippers for robotic applications.
2. To understand the mathematical modeling of robotic manipulator kinematics, including transformations, frame assignments, and solving direct and inverse kinematics problems.
3. To understand the fundamentals of robotic dynamics and develop trajectory planning techniques in joint and Cartesian spaces using methods like the potential field approach.
4. To learn the principles, equipment, and systems used in material handling, along with methods for analyzing transport systems.

Course Outcomes:

The students will be able to learn:

CO1: Design and evaluate robotic end effectors, considering mechanical, material, and technological aspects for various real-world applications..

CO2: Analyze and solve kinematic problems using Denavit–Hartenberg parameters, transformation matrices, and algebraic or geometrical methods for various robotic configurations.

CO3: Generate optimal trajectories for robotic manipulators while addressing motion planning challenges using advanced strategies like the potential field method.

CO4: Assess and optimize material transport systems, such as AGVs, conveyors, and cranes, for industrial applications.

Course Contents

Unit-1: Design of End Effectors and Grippers	**[07 Hrs.]**
Types and applications of various end effectors and grippers, Design requirements, Mechanical grippers - design principles, material selection, drive mechanisms, Advanced gripper types - Vacuum, magnetic and soft grippers, End effector integration with robots - interface design, sensors and feedback mechanisms, Real world design challenges, Emerging Technologies - AI in gripper optimization, modular and adaptive grippers.	
Unit-2: Kinematics of Manipulators	**[08 Hrs.]**
Kinematics : Transformation matrices and their arithmetic, link and joint description, Denavit– Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics of two joints, solvability, algebraic and geometrical methods. **Velocities and Static Forces in Manipulators:** Motion of the manipulator links, Jacobians, Singularities, static forces, Jacobian in force domain.	
Unit-3: Motion Planning and Control	**[07 Hrs.]**
Introduction to Dynamics, Trajectory generations, Motion planning and control: Joint and Cartesian space trajectory planning and generation, potential field method for motion planning Manipulator Mechanism Design, Force control and hybrid position/force control	
Unit-4: Introduction to Material Handling	**[08 Hrs.]**
Principles of Material Handling, Unit load concept, Material Handling equipment, and Material transport systems: AGVs, Monorails, Conveyor systems, Cranes and hoists, Analysis of material transport systems: Charting technique, analysis of vehicle based systems, Conveyor analysis.	
Text Books: 1. Groover M. P., "Automation, Production Systems, and Computer –Integrated Manufacturing", Pearson Education,ISBN-81-7808-511-9. 2. Deb S.R., "Robotics", Tata McGraw Hill Publications, New Delhi. ISBN 13: 9780070077911.	

Reference Books:

1. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
2. Mikell P. Groover, Automation, Production Systems & Computer Integrated Manufacturing, PHI Learning Pvt. Ltd. , New Delhi, ISBN:987-81-203-3418-2, 2012.
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009.
4. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 2015.
5. A Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press.

Guidelines for Lab /TW Assessment (Any 8 Practical's to be performed)

The student shall perform Practical's from following list:

1. Design and analysis of robot grippers.
2. Simulation of target teaching on RoboDk for Scara & Articulated Robot.
3. Simulation of target teaching for curve surface.
4. Simulation of material handling systems using RoboDK.
5. Pick and Place programming on SCARA Mitsubishi Robot using MELFA.
6. Pick and Place programming on Articulated Mitsubishi Robot Mitsubishi using MELFA.
7. Forward Kinematics of robotics arm using RoboAnalyzer.
8. Inverse Kinematics of robotics arm using RoboAnalyzer.
9. Simulation of conveyor material handling systems using RoboDK.
10. Offline and online programming of robotics arm.

Guidelines for Activity:

1. One robot programming exercise for any one industrial application.
2. Designing of Robot End effectors for given application

ME24381 - INDUSTRIAL AUTOMATION		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 3 Hrs/Week	**Theory : 03** **Practical : 01**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks
Pr: 2 Hrs/Week		**PR Exam: - 30 Marks**

Prerequisites: Automation and Robotics

Objectives: The course aims to:

1. Provide fundamental knowledge of industrial automation and its importance.
2. Explain hydraulic and pneumatic systems, components, and circuit design.
3. Develop hands-on skills in PLC programming and control strategies.
4. Introduce industrial automation tools like Automation Studio for system simulation.
5. Familiarize students with modern trends like Industry 4.0 and their applications.
6. Encourage interactive activities, case studies, and industrial exposure.

Course Outcomes: Upon successful completion, students will be able to:

CO1: Explain the fundamentals and significance of industrial automation.

CO2: Design and analyze hydraulic and pneumatic systems.

CO3: Develop automation logic using PLCs and ladder diagrams.

CO4: Simulate and test automation systems using Automation Studio.

CO5: Understand advanced hydraulic applications in modern industries.

CO6: Evaluate the role of Industry 4.0 in future manufacturing.

Course Contents

Unit-1: :Advanced Industrial Automation Systems	**[06 Hrs.]**
Definition and Importance of Automation, Classification of Automation: Fixed, Programmable, and Flexible, Components of an Automated System, Role of automation in modern industries, Advanced industrial sensors (Laser, Ultrasonic, Vision systems), Overview of SCADA, DCS & IoT in automation, Introduction to Industrial Communication Protocols (Modbus, Profibus, Ethernet/IP).	

Unit-2: Hydraulic Systems in Industrial Automation – Fundamentals	**[06 Hrs.]**
Basic Components: Pumps, Valves, Cylinders, Motors, Filters, Accumulators, Hydraulic Actuators: Single-Acting and Double-Acting Cylinders, Pressure Control Circuits: Relief Valves, Pressure Reducing Valves, Flow and Directional Control Circuits: Flow Control Valves, Directional Valves, Hydraulic Circuit Design and Troubleshooting, Simulation of Hydraulic Circuits using Automation Studio.	
Unit-3: Pneumatic Systems in Industrial Automation	**[06 Hrs.]**
Pneumatic Components: Compressors, FRL Unit, Valves, Actuators, Pneumatic Circuit Design and Troubleshooting, Electro-Pneumatics: Solenoid Valves, Sensors, Relay Logic, Comparison of Pneumatic and Hydraulic Systems, Pneumatic System Simulation using Automation Studio.	
Unit-4: Advanced Hydraulic Applications & Integration with PLCs	**[06 Hrs.]**
Servo and Proportional Valves in Hydraulics, Hydraulic Power Transmission in Heavy Machinery, PLC Integration with Hydraulic Systems, Hydraulic Press, Lift, and Robotics Applications, Safety and Maintenance of Hydraulic Systems.	
Unit-5: Programmable Logic Controllers (PLCs) and it's Simulation	**[06 Hrs.]**
PLC Architecture and Components, PLC Programming: Ladder Logic, Timers, Counters, Advanced PLC programming techniques (Function Blocks, Sequential Function Charts), PLC Applications in Industrial Automation, PLC-based Control of Hydraulic and Pneumatic Systems, Simulation and Testing in Simulation Software.	
Unit-6: Industry 4.0 and Future Trends in Automation	**[06 Hrs.]**
Introduction to Industry 4.0, Cyber-Physical Systems and Smart Factories, Industrial IoT (IIoT) and Cloud-Based Automation, AI and Machine Learning in Automation, Case Studies on Advanced Industrial Automation.	

Textbooks:

1. Mikell P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing*, Pearson Education (ISBN: 978-0134605463)
2. Andrew Parr, *Hydraulics and Pneumatics: A Technician's and Engineer's Guide*, Elsevier (ISBN: 978-0080966748)
3. Frank D. Petruzella, *Programmable Logic Controllers*, McGraw-Hill Education (ISBN: 978-0073373843)

Reference Books:

1. John W. Webb and Ronald A. Reis, *Programmable Logic Controllers: Principles and Applications*, Prentice Hall (ISBN: 978-0135048818)
2. S. R. Majumdar, *Pneumatic Systems: Principles and Maintenance*, McGraw-Hill (ISBN: 978-0074602317)
3. Peter Rohner, *Industrial Automation: Hands-On*, McGraw-Hill (ISBN: 978-0071361699)

List of Practical Experiments

1. Design and Testing of Basic Hydraulic Circuits.
2. Hydraulic Actuator Speed Control using Flow Control Valves.
3. Hydraulic Press Operation and Force Measurement.
4. Hydraulic Circuit Simulation using Simulation Software.
5. Implementation of a simple process control system using PID controller.
6. Design and Testing of Basic Pneumatic Circuits.
7. Electro-Pneumatic Control using Solenoid Valves.
8. Interfacing PLC with HMI and SCADA system.
9. Ladder Logic Implementation for Basic Industrial Automation
10. PLC-based Control of Hydraulic and Pneumatic Systems

Activities: (Any 02)

1. Industrial Visit: A visit to a factory or automation setup to observe real-world automation applications.
2. Mini Project: Design and implement a basic hydraulic/pneumatic automation project.
3. Group Discussion: Impact of Industry 4.0 and future of automation in manufacturing.
4. Software Simulation Contest: Students compete in Automation Studio circuit design.
5. Case Study Analysis: Breakdown of hydraulic-based automation in real industries.

ME24391 - MANUFACTURING SYSTEMS AND SIMULATION		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 3 Hrs/Week	**Theory : 03** **Practical : 01**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks
Pr: 2 Hrs/Week		**PR Exam: - 30 Marks**

This course explores the design, analysis, and simulation of manufacturing systems. It covers the principles and methodologies for modeling and simulating manufacturing processes and systems, focusing on improving efficiency, productivity, and quality. The course integrates theoretical knowledge with practical applications through simulation software and case studies.

Prerequisites: Basic knowledge of manufacturing processes, Familiarity with computer-aided design (CAD) tools, Basic understanding of statistics and probability

Objectives:

1. To introduce fundamental concepts of manufacturing systems, their components, and types, enabling students to understand their evolution and significance.
2. To analyze various manufacturing processes and production planning techniques to optimize system performance.
3. To develop simulation models for manufacturing systems and understand their applications in performance evaluation.
4. To implement and validate simulation models using modern tools for decision-making and system optimization.
5. To apply simulation techniques for analysis and optimization of manufacturing systems, enhancing productivity and efficiency.
6. To explore advanced simulation methodologies, including AI-driven and digital twin simulations, for real-world industrial applications.

Course Outcomes: The students will be able to:

CO1: Explain the fundamental concepts, types, and components of manufacturing systems, along with their evolution and significance in industrial applications.

CO2: Analyze different manufacturing processes, operations, and production planning methods to optimize manufacturing performance.

CO3: Demonstrate knowledge of simulation modeling techniques and their application in manufacturing systems for performance evaluation.

CO4: Develop, validate, and implement simulation models using modern tools to analyze manufacturing system behavior.

CO5: Evaluate simulation results, perform sensitivity analysis, and apply optimization techniques to improve manufacturing efficiency.

CO6: Explore and apply advanced simulation methodologies, including AI-driven simulations and real-world industrial case studies.

Course Contents

Unit-1:Introduction to Manufacturing Systems	**[06 Hrs.]**
Definition and types of manufacturing systems, Components and operations of manufacturing systems, Manufacturing system design and planning, Role of simulation in manufacturing systems.	
Unit-2: Manufacturing Processes and Operations	**[06 Hrs.]**
Overview of manufacturing processes (machining, assembly, etc.), Process planning and scheduling, Material handling and storage systems, Quality control in manufacturing.	
Unit-3: Simulation Fundamentals	**[06 Hrs.]**
Basics of simulation modeling, Discrete-event simulation, Continuous and hybrid simulation models, Simulation software tools (e.g., Arena, Simul8).	
Unit-4: Simulation Model Building	**[06 Hrs.]**
Steps in developing a simulation model, Data collection and input analysis, Model verification and validation, Case studies on manufacturing system simulation.	
Unit-5: Simulation Analysis and Optimization	**[06 Hrs.]**
Performance measures in manufacturing systems, Experimentation and output analysis, Sensitivity analysis, Optimization techniques in simulation.	
Unit-6: Advanced Topics in Manufacturing Simulation	**[06 Hrs.]**

Supply chain simulation, Lean manufacturing and simulation, Human factors in manufacturing simulation, Future trends in manufacturing systems and simulation.
Reference Books: 1. "Manufacturing Systems Engineering" by Stanley B. Gershwin 2. "Simulation with Arena" by W. David Kelton, Randall Sadowski, and Nancy Zupick 3. Research papers and case studies on manufacturing systems and simulation 4. Online resources and tutorials on relevant simulation software

List of Practical's:

ANY EIGHT experiments to be conducted during the course.

1. Basic Simulation of a Production Line: Use simple simulation software (e.g., Arena, Simul8) to model a basic production line and analyze its performance.

2. Queue Management Simulation: Create a simulation of a queue system (e.g., in a manufacturing plant) to study waiting times and resource utilization.

3. CNC Machine Programming: Write and simulate a basic CNC program for machining a simple part.

4. 3D Printing Process Simulation: Simulate the 3D printing process of a basic geometric shape to understand layer-by-layer manufacturing.

5. Assembly Line Balancing: Simulate and optimize the balance of tasks in a simple assembly line to improve efficiency.

6. Inventory Management Simulation: Model a basic inventory system to understand reorder points and safety stock levels.

7. Material Flow Analysis: Simulate the flow of materials through a manufacturing process to identify bottlenecks and optimize layout.

8. Robotics in Manufacturing Simulation: Program and simulate a robotic arm for basic pick-and-place tasks in a manufacturing setup.

9. Predictive Maintenance Simulation: Analyze machine data to simulate and predict maintenance needs, reducing downtime.

10. Lean Manufacturing Simulation: Implement and simulate lean manufacturing principles in a simple production process to minimize waste and improve efficiency.

Guidelines for Lab /TW Assessment

i) **TW**: Assignment on each unit

ii) **PR**: Practical Performance or Oral exam will be conducted to evaluate Practical's

ME24481- COMPUTER INTEGRATED MANUFACTURING		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03** **Practical : 01**	**Course Activity: 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks**
Pr: 02 Hrs/Week		**PR Exam: - 30 Marks**

Prerequisites: Knowledge of earlier studied subjects like Solid Modeling and Drafting, Computer Aided Engineering, Industrial Engineering

Objectives:

1. Understand and realize the need of CIM and factory automation.
2. Learn CAD & CAM in manufacturing.
3. Learn to integrate hardware and software elements for CIM.
4. Learn to integrate processes planning, quality and MRP with computers.
5. Know about flexible, cellular manufacturing and group technology.
6. Learn quality in Design and Manufacturing.

Course Outcomes: The students will be able to learn:

On completion of the course the learner will be able to;

CO1. EXPLAIN CIM and factory automation.

CO2. Understand CAD & CAM manufacturing concept.

CO3. UNDERSTAND the integration of hardware and software elements for CIM

CO4. ANALYZE processes planning, quality and MRP integrated with computers.

CO5. INTERPRET flexible, cellular manufacturing and group technology.

CO6. Understand Quality in Design and Manufacturing.

Unit-1: Introduction to CIM	**[06 Hrs.]**
Need of CIM, Introduction, Evolution of CIM,CIM Hardware and software, Role of CIM System, Definition of CIM, automation and types of automation, Reasons for automation, Functions in Manufacturing, CIM wheel, Computerized element of CIM, Advantages of CIM.	
UNIT 2:Introduction to CAD and CAM	**[06 Hrs.]**
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control	

Introduction to CAD/CAM – Concurrent Engineering - CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In Time Production.

Unit-3: Data Integration	**[06 Hrs.]**
CAD-CAM Integration, Product development through CIM, Design Activities in a networked environment, Networking in a manufacturing company, hardware elements of networking, CIM Database, Database requirements of CIM, Database management, Database Models, EDM, Product Data Management (PDM), Product life cycle Management (PLM).	

Unit-4: Computer Aided Process Planning and Quality Control	**[06 Hrs.]**
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems. Manufacturing Execution System(MES)	

Unit-5: FMS & Cellular Manufacturing	**[06 Hrs.]**
Introduction Flexible Manufacturing Systems, FMS components, Material handling and storage system, applications, benefits, computer control systems, types of FMS Layout, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. Group Technology(GT), Part Families – Parts Classification and coding, Simple Problems in Opitz Part Coding system – Production flow Analysis, Cellular Manufacturing – Composite part concept – Machine cell design and layout, Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method, Arranging Machines in a GT cell – Hollier Method – Simple Problems	

Unit-6: Quality in Design and Manufacturing	**[06 Hrs.]**
The Modern View of Quality Control, Traditional Quality Control Traditional and Modern Quality Control Process Variability and Process Capability Process Variations Process Capability and Tolerances Statistical Process Control Control Charts Other SPC Tools	

Implementing SPC Six Sigma Overview and Statistical Basis of Six Sigma Measuring the Sigma Level Taguchi Methods in Quality Engineering Robust Design The Taguchi Loss Function ISO 9000 The Six Sigma DMAIC Procedure Automated Inspection.

Text Books:

1. Automation, Production system & Computer Integrated manufacturing, M. P. Groover PersonIndia, 2007 2nd edition.

2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India

References Books:

1. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR.

2. Xu, X., 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference.

3. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann.

4. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley Publications.

5. Harrington J, Computer Integrated Manufacturing Krieger Publications 1979.

6. Zeid, CAD/CAM, Tata McGraw Hill. 7. Jha, N.K. “Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.

7. Applied Statistical Quality Control and Improvement, KRISHNAIAH, K.

NPTEL Link:

1.https://youtube.com/playlist?list=PLFW6lRTa1g808_CfYhZKdv2eXplAQiAwS

2. https://nptel.ac.in/courses/112104289

3.https://onlinecourses.nptel.ac.in/noc22_me10/preview

4.https://archive.nptel.ac.in/courses/112/104/112104289/

5. https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-me44/

Link for Virtual Lab: - http://vlabs.iitkgp.ac.in/cim/#

Guidelines for Laboratory Conduction

1. Practical/Tutorial must be conducted in FOUR batches per division only.

2. Minimum 08 numbers of Experiments/Assignments shall be completed.

3. Experiments shall be conducted following 'Case Based Methodology'

4. Open source software, simulation tools may be used wherever required.

5. Students can perform any 6 experiments from 1 to 8 and 2 case studies from 9 to 11.

Guidelines for Lab /TW Assessment

The student shall complete the following activity as a Term Work:

1. Generate Bill of Material (BOM) from Assembly and other data using CAD Software.
2. Prepare Computer Aided Process Plan for selected part using a variant type of CAPP Software.
3. Use MRP (Material Resource Planning) Software for CIM and Assembly.
4. Generate Part Family Code for a machine components using OPITZ Method
5. Study the FMS system from Video clip and identify various elements of FMS and its controlling by computer.
6. Modeling and Simulation of Computer Integrated Manufacturing System. (VLab IIT, Kharagpur OR comparable sources)
7. Machine vision based quality control. (VLab IIT, Kharagpur OR comparable sources)
8. Remote Monitoring and Operation of a Computer Integrated Manufacturing System. (VLab IIT, Kharagpur OR comparable sources).
9. Case study on Statistical Process Control Charts.
10. Case study on Taguchi Methods in Quality Engineering Robust Design .
11. Case study on Flexible manufacturing system.