COURSE TITLE	**COMPUTER INTEGRATED MANUFACTURING**
COURSE CODE	**01ME2723**
COURSE CREDITS	**4**

Objective:

1 This course provides a foundational understanding of modern manufacturing systems, focusing on the integration of CAD/CAM, CNC, robotics, and industrial automation for developing efficient, flexible, and intelligent production environments.

Course Outcomes: After completion of this course, student will be able to:

1 Analyze the role of CIM components in integrating lean and JIT practices for smart manufacturing.

2 Utilize solid modeling techniques such as CSG, B-rep, and feature-based methods to represent 3D objects in CAD.

3 Implement manual and CAM-based programming for milling and turning operations in CNC machines.

4 Examine how material handling, tool management, fixturing and process monitoring contribute to FMS performance.

5 Employ safety standards and coordinate systems in robotic programming and operation.

6 Apply PLC architectures, programming, I/O systems, and communication protocols for industrial automation.

Pre-requisite of course: Basic knowledge of manufacturing processes and engineering fundamentals.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to CIM** Types of Manufacturing Systems: Discrete, Batch, Continuous, and Hybrid, Components of CIM and the CIM Wheel, Evolution from CIM to Smart Manufacturing; Role of Management in Smart Manufacturing, Impact on Personnel and Organizational Structure;, Levels of Factory Automation, Principles of Lean Production and Just-In-Time (JIT)	6

Contents : Unit	Topics	Contact Hours
2	**Geometric and Digital Modelling** Overview of CAD/CAM in the context of CIM, Solid Modelling Techniques: Constructive Solid Geometry (CSG), Boundary Representation (B-rep) and hybrid approaches, Feature-Based and Constraint-Based Modelling, Assembly and Surface Modelling Techniques, Introduction to Parametric and Generative Design, 3D Modelling and Editing Capabilities in Modern CAD Software	8
3	**CNC and Digital Machining** Types and Components of CNC Machines, Construction Features including Re-circulating Ball Screws, Anti-friction Slides, Controllers, Drives, and Sensors, Stepper and Servo Motors in CNC Drive Systems, NC/CNC Tooling Systems and Axis Designations; Absolute vs Incremental Positioning, Manual Part Programming for Drilling, Milling, and Turning; G-code and M-code Programming, Advanced Manual Programming Techniques: Canned Cycles, Subroutines, and Macros, Smart Machining Techniques: Use of CAM Software, Adaptive Tool Paths, Real-Time Monitoring, and Closed-Loop Control.	10
4	**Flexible and Intelligent Manufacturing Systems** Types of Flexibility in Manufacturing; Components and Layouts of Flexible Manufacturing Systems (FMS), Smart Material Handling Systems: Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs), Automated Storage and Retrieval Systems (ASRS); Automated Tool Management, Condition Monitoring and Supply System, Flexible Fixturing and Assembly Systems, Real-Time Data Acquisition and Monitoring in Manufacturing	6
5	**Robotics and Human-Robot Collaboration** Anatomy of Industrial Robots; Laws of Robotics, Coordinate Systems, Configurations, Power Sources, and Actuators, Sensors, Transducers and End Effectors in Industrial Robots, Collaborative Robots (Cobots): Human-Robot Interaction in Modern Industry, Safety Protocols and Standards in Industrial Robotics, Basics of Robot Programming and Control	6
6	**PLC and Industrial Automation** Architecture and Operation of Programmable Logic Controllers (PLCs); Relay device components: electromechanical relays, contactors, timers, and counters, PLC Programming Fundamentals: Ladder Logic, Function Block Diagram, Structured Text, PLC Programming Practical Case Study, Sensors and Actuators in Industrial Automation; Input/Output Modules and Industrial Communication Protocols: PROFIBUS and OPC-UA, SCADA and HMI Systems in Industrial Automation, Applications of PLCs in Smart Manufacturing Environments	6
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Part modelling using a CAD tool.** Part modelling using a CAD tool.	2
2	**Assembly modelling using a CAD tool.** Assembly modelling using a CAD tool.	2
3	**Hands-on exercise on setting work offsets in CNC Lathe.** Hands-on exercise on setting work offsets in CNC Lathe.	2
4	**Hands-on exercise on setting work offsets in Vertical Machining Center (VMC).** Hands-on exercise on setting work offsets in Vertical Machining Center (VMC).	2
5	**Manual part programming for step turning, facing and grooving in CNC lathe.** Manual part programming for step turning, facing and grooving in CNC lathe.	2
6	**CNC lathe manual programming using macros and subroutines, and canned cycles.** CNC lathe manual programming using macros and subroutines, and canned cycles.	2
7	**Software-assisted part programming for milling job in VMC.** Software-assisted part programming for milling job in VMC.	2
8	**Software-assisted part programming for machining job in CNC lathe.** Software-assisted part programming for machining job in CNC lathe.	2
9	**Tool path optimization using CAM software.** Tool path optimization using CAM software.	2
10	**Simulation and analysis of Flexible Manufacturing System (FMS) layouts.** Simulation and analysis of Flexible Manufacturing System (FMS) layouts.	2
11	**Programming and execution of a basic pick-and-place operation using a robotic arm.** Programming and execution of a basic pick-and-place operation using a robotic arm.	2
12	**Interfacing sensors and actuators with a Programmable Logic Controller (PLC).** Interfacing sensors and actuators with a Programmable Logic Controller (PLC).	2
Total Hours		**24**

Textbook :

1 Automation, Production Systems, and Computer-Integrated Manufacturing, M. Groover, Pearson, 2024

Textbook :

2 Computer-integrated Manufacturing, R. Panneerselvam, P. Senthilkumar, P. Sivasankaran, Cengage, 2020

References:

1 Computer Integrated Manufacturing , Computer Integrated Manufacturing , James A. Rehg, Henry W. Kraebber, Pearson, 2004

2 Smart Manufacturing: Concepts and Methods, Smart Manufacturing: Concepts and Methods, Masoud Soroush, Michael Baldea, Thomas F. Edgar, Elsevier, 2020

3 CAD/CAM: Computer-Aided Design and Manufacturing , CAD/CAM: Computer-Aided Design and Manufacturing , M. Groover, E. Zimmers, Pearson, 2003

4 CAD/CAM theory and practice , CAD/CAM theory and practice , Ibrahim Zeid, McGraw Hill Education, 2009

5 Flexible Manufacturing Systems in Practice , Flexible Manufacturing Systems in Practice , Joseph Talavage, CRC Press, 2020

6 CNC Programming Handbook , CNC Programming Handbook , Peter Smid, Industrial Press, 2007

7 Computer Numerical Control Machining & Turning Centers, Computer Numerical Control Machining & Turning Centers, Robert Quesada, Pearson, 2004

8 Programming of CNC Machines , Programming of CNC Machines , K Evans, Industrial Press, 2016

9 Machine Tool Design and Numerical Control , Machine Tool Design and Numerical Control , N K Mehta, McGrawHill, 2017

10 Robotics and Control , Robotics and Control , R.K. Mittal, I.J. Nagrath, McGraw Hill Education, 2017

11 Introduction to Industrial Robotics , Introduction to Industrial Robotics , Ramachandran Nagarajan, Pearson, 2016

12 Industrial Robotics , Industrial Robotics , Keith Dinwiddie, Delmar Cengage Learning, 2018

13 Programmable Logic Controllers: Principles and Applications , Programmable Logic Controllers: Principles and Applications , John W. Webb, Ronald A. Reis, Pearson, 2015

14 Programmable Logic Controllers: Principles and Applications , Programmable Logic Controllers: Principles and Applications , Glen A. Mazur, William J. Weindorf, American Technical Publishers, 2021

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	40.00	40.00	10.00	10.00

Instructional Method:

1 ICT and Problem based teaching learning

Supplementary Resources:

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

2 https://archive.nptel.ac.in/courses/112/105/112105211/