COURSE MODULE

Faculty Name/s:			Academic Year:**2023 - 2024**				
Department: **Mechanical Engineering**							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
18ME72	**Computer Aided Design and Manufacturing**	**Core**	**Metal Casting and Welding & Machine Tools and Operations**	**4**	**-**	**-**	**50**

Course Objectives	**Course objectives: This course (18ME72) will enable students to:** **CLO**1: To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models. **CLO2**: To make students to understand the Computer Applications in Design and Manufacturing [CAD / CAM) leading to Computer integrated systems. Enable them to perform various transformations of entities on display devices. **CLO3**: To expose students to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems. **CLO4**: To expose students to computer aided process planning, material requirement planning, capacity planning etc. **CLO5**: To expose the students to CNC Machine Tools, CNC part programming, and industrial robots. **CLO6**: To introduce the students to concepts of Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory.

Topics Covered as per Syllabus

MODULE-I

Introduction to CIM and Automation: Automation in Production Systems, automated manufacturing systems-types of automation, reasons for automating, Computer Integrated Manufacturing, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in- process, numerical problems.

Automated Production Lines and Assembly Systems: Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numericals. **(RBT: L1, L2 and L3)**

MODULE-2

CAD and Computer Graphics Software: The design process, applications of computers in design**,** software configuration, functions of graphics package, constructing the geometry.

Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations.

Computerized Manufacture Planning and Control System: Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control. **(RBT: L1, L2 and L3)**

MODULE - 3

Flexible Manufacturing Systems: Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture.

Line Balancing: Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method, Mixed Model line balancing, computerized line balancing methods. **(RBT: L1, L2 and L3)**

MODULE-4

Computer Numerical Control: Introduction, components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning, drilling and milling systems, programming with canned cycles. Cutter radius compensations.

Robot Technology: Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy

and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and offline methods. Robot industrial applications: material handling, processing and assembly and inspection. **(RBT: L1, L2 and L3)**

MODULE-5

Additive Manufacturing Systems: Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM.

Future of Automated Factory: Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems. **(RBT: L1, L2 and L3)**

List of Text Books

1. Automation, Production Systems and Computer-Integrated Manufacturing, by Mikell P Groover, 4th Edition, 2015, Pearson Learning.
2. CAD / CAM Principles and Applications by P N Rao, 3rd Edition, 2015, Tata McGraw-Hill.
3. CAD/CAM/CIM, Dr. P. Radhakrishnan, 3rd edition, New Age International Publishers, New Delhi.

List of Reference Books

1. Computer Integrated Manufacturing, J. A. Rehg& Henry. W. Kraebber.
2. CADlCAMby Zeid, Tata McGraw Hill. S
3. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
4. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015), Ian Gibson, David W. Rosen, Brent Stucker
5. "Understanding Additive Manufacturing", Andreas Gebhardt, Hanser Publishers, 2011
6. Industry 4.0: The Industrial Internet of Things, Apress, 2017, by Alasdair Gilchrist

List of URLs, Text Books, Notes, Multimedia Content, etc

Video Demonstration of Different types of automation and Mechanisms
http://nptel.ac.in/courses/112102103/8
http://nptel.ac.in/courses/112101098/
http://nptel.ac.in/courses/112102103/Module%20G/Module%20G(5)/p3.htm

Printed Copy (Soft Copy): Available

Course Outcomes	**Students will be able to** **CO1:** Define Automation, CIM, CAD, CAM and explain the differences between these concepts. Solve simple problems of transformations of entities on computer screen **CO2:** Explain the basics of automated manufacturing industries through mathematical models and analyze different types of automated flow lines. **CO3:** Analyze the automated flow lines to reduce time and enhance productivity. **CO4:** Explain the use of different computer applications in manufacturing, and able to prepare part programs for simple jobs on CNC machine tools and robot programming. **CO5:** Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

Internal Assessment Marks: 40 (30 Marks three Session tests are conducted during the semester and marks allotted based on the average of three performances and additional 10 Marks for Assignments /Unit tests/ written quizzes).

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code:	18ME72	TITLE: Computer Aided Design and Manufacturing				Faculty Name:							
List of Course Outcomes	Program Outcomes											PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PS O2
CO-1	2	-	2	-	3	-	-	-	3	2	2	3	2	2
CO-2	3	2	2	2	2	-	-	-	-	2	-	2	2	2
CO-3	2	-	-	2	2	-	-	-	-	-	-	2	2	2
CO-4	-	-	-	-	2	-	-	-	-	2	-	2	2	2
CO-5	-	-	2	2	3	-	1	-	3	2	2	3	2	2

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution