Course Code	18ME61	Course Title	Computer integrated Manufacturing	Semester	VI
Credits	3	L – T – P –TL*	2 – 1 – 0 – 3	Teaching Hrs	42
Total Marks	100	CIE*	40	SEE*	60
*NOTE: L – Lecture; T – Tutorial; P – Practical; TL – Total; CIE – Continuous Internal Evaluation; SEE – Semester End Examination					

	Teaching Hrs
Course Learning Objectives: This course will enable students to: • Impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models. • 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. • Expose to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems. • Exhibit to computer aided process planning, material requirement planning, capacity planning etc. • Expose to CNC Machine Tools, CNC part programming, and industrial robots.	**Teaching Hrs**
Module-1	
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, numerical problems.	10
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.	8

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. **Line Balancing:** Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method.	**8**
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 off-line methods. Robot industrial applications: Material handling, processing and assembly and inspection	**8**
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. Recent trends in manufacturing, Hybrid manufacturing. **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.	**8**

Course outcomes: By the end of the course the students can able to:
CO1: Define CIM and Automation and different concepts of automation by developing mathematical models.
CO2: Explain automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems.
CO3: Analyze computer aided process planning, material requirement planning, capacity planning etc.
CO4: Explain CNC Machine Tools, CNC part programming, and industrial robots.
CO5: Visualize and appreciate the modern trends in Manufacturing like Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory.

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module.

Textbooks:
  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.

Reference Books:
  1. Computer Integrated Manufacturing, J. A. Rehg& Henry. W. Kraebber.
  2. CAD/CAM by Zeid, Tata McGraw Hill.