COMPUTER INTEGRATED MANUFACTURING SYSTEMS **Course Code : 316359**

Programme Name/s : **Mechanical Engineering/ Production Engineering**
Programme Code : **ME/ PG**
Semester : **Sixth**
Course Title : **COMPUTER INTEGRATED MANUFACTURING SYSTEMS**
Course Code : **316359**

I. RATIONALE

The manufacturing industry has undergone significant transformations in recent years, driven by advances in computer technology, automation, and robotics. As a result, there is a growing need for skilled professionals who can design, implement, and manage computer-integrated manufacturing systems. This course intends to help the students of Mechanical Engineering with a comprehensive understanding of the concepts, techniques, and applications of Computer Integrated Manufacturing.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences to: Apply skills related to Computer-Integrated Manufacturing Systems in real-world manufacturing environment.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the components of CIM architecture for a given application.
- CO2 - Apply CAD techniques to design simple mechanical parts.
- CO3 - Apply CAM techniques to optimize machining processes.
- CO4 - Use different software and hardware in CIM efficiently.
- CO5 - Develop program to manage robotic / automation system using relevant software.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316359	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	CIM	DSE	4	-	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 State the importance of CIM in modern manufacturing. TLO 1.2 Explain the terms production rate, quality, accuracy, repeatability and flexibility related to quality metrics. TLO 1.3 Organize the various components in CIM framework architecture.	**Unit - I Introduction to Computer Integrated Manufacturing (CIM)** 1.1 Historical development, Definition, concept, and importance of CIM in modern manufacturing 1.2 Current Production Needs- Production rate, Quality, Accuracy, Repeatability, Flexibility 1.3 CIM Architecture and Components- Computer-Aided Design (CAD), Computer Aided Process Planning (CAPP), Computer Aided Manufacturing Control (CAMC), Computer Aided Business Function (CABF)	Lecture Using Chalk-Board Video Demonstrations Presentations Case Study
2	TLO 2.1 State the importance of finite element analysis and optimization techniques. TLO 2.2 Distinguish between concurrent and sequential engineering with different parameters. TLO 2.3 Prepare the simple engineering component by using CAD/CAE software. TLO 2.4 Explain the concept of CAPP, CABF, ERP, MRP and their applications in CIM.	**Unit - II Computer-Aided Design (CAD)** 2.1 Introduction to CAD-Geometric Modelling, Finite Element Analysis and optimization, Overview of CAD-CAE Integration 2.2 Concurrent Engineering (CE) and Sequential Engineering (SE) -Concept, Elements, Advantages, Disadvantages. 2.3 CAD software and systems: Introduction of Software for CAE, Simulation, Automated Drafting, and generation of report 2.4 Logical steps in CAPP, CABF, Enterprise Resource Planning (ERP), Role of ERP in Business, Advantages and applications of ERP Software, Material Resource Planning (MRP), Role of MRP in Business, Advantages and benefits of MRP Software's.	Presentations Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 State the importance of CAM in CIM. TLO 3.2 Explain the importance of HMI and SCADA in the Industrial Automation. TLO 3.3 Plan and prepare the sequence of processing steps for an NC machine in CAMC. TLO 3.4 Describe the emerging trends in CAM.	**Unit - III Computer-Aided Manufacturing (CAM)** 3.1 Introduction to CAM: CAM software and systems, CAM data exchange and compatibility 3.2 Human Machine Interface (HMI) and Supervisory Control and Data Acquisition (SCADA): Introduction, need, benefits and typical applications 3.3 Computer-Aided Manufacturing Control (CAMC): Interfacing Part Program to CNC, Computerized Control Monitoring and Control, Computer Aided Quality Control (CAQC) 3.4 Overview of Emerging Areas: Supply Chain Management (SCM), Digital Manufacturing, Industry Revolution 4.0.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Case Study
4	TLO 4.1 Distinguish different network topologies in CIM with sketch. TLO 4.2 Explain the given application of software, network software, and network hardware with its purpose. TLO 4.3 Describe the types of DBMS with their functions.	**Unit - IV CIM Networking and Data Base Management System** 4.1 CIM Networking: Types of networks and its characteristics, applications, Types of network topologies-star, bus and ring topology 4.2 Component of Networking: Application software for CIM, Network software, and network hardware 4.3 Database Management System (DBMS): Database types (Hierarchical, Network, Relational, Object Oriented), Function of DBMS, Selection of DBMS, Advantages of DBMS.	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Case Study
5	TLO 5.1 Define automation and robotics and their importance in CIM. TLO 5.2 Make use of automation and robotic elements for given application. TLO 5.3 Distinguish between different types of automation and robots. TLO 5.4 Explain the applications of automation and robotics in CIM.	**Unit - V Automation and Robotics** 5.1 Automation: Definition, need, principles and benefits , Robotics: Definition, need, basic concepts and benefits 5.2 Elements of Automation, Levels of automation, Components of Robotics-End effectors-grippers and tools, Drive systems, Control systems 5.3 Types of Automation and Robotics -Concept, Definition, need, and elements of Fixed, Programmable, Flexible Automation -Concept and constructional details of Cartesian, Cylindrical, Polar Configuration Robot, Gantry robot, Selective Compliance Articulated Robot Arm (SCARA). 5.4 Advantages, limitations and applications of automation and robotics in CIM	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Case Study

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Convert 3D modeled components into detailed 2D engineering drawings with proper views and projections. LLO 1.2 Use dimensioning and tolerances as per ISO, ASME, or BIS standards.	1	*Drawing of simple mechanical parts modeled using the drafting workbench of CAD Software.	2	CO1 CO2
LLO 2.1 Develop orthographic projections (front, top, and side views) and isometric projections for component visualization. LLO 2.2 Apply GD&T principles in technical drawings for accurate part specifications.	2	*Development of the simple mechanical part by using the geometric modeling workbench (Any 3 D modelling software).	2	CO2
LLO 3.1 Generate a Bill of Materials (BOM) and properly format the title block. LLO 3.2 Generate automated BOMs from CAD assemblies using built-in tools in software (like SolidWorks, CATIA, AutoCAD, Creo or any suitable software.)	3	Generation of Bill of Material (BOM) and other data using CAD Software.	2	CO2
LLO 4.1 Prepare a process plan for a suitable manufacturing operations (e.g. casting, forming, welding) LLO 4.2 Develop an optimized sequence of operations for manufacturing a selected part using any suitable CAPP software.	4	Computer Aided Process Plan for the selected part using various CAPP Software.	2	CO1 CO2
LLO 5.1 Choose appropriate G and M codes for preparing part on CNC (Turning or Milling) LLO 5.2 Develop a part with simple machining operations (like facing, turning, drilling, etc.) as per given drawing.	5	*CNC code for a simple machining operation using a CNC Machine/Trainner/Simulator.	2	CO1 CO2 CO3
LLO 6.1 Inspect the dimensional accuracy of component using available CAQC software.	6	Inspection of the part using available CAQC software.	2	CO3
LLO 7.1 Select a suitable MRP software for CIM and assembly. LLO 7.2 Prepare report on the real-time data obtained by MRP Software in automated manufacturing.	7	MRP (Material Resource Planning) software for CIM and assembly.	2	CO1 CO3 CO4
LLO 8.1 Prepare a layout using suitable network topology in given situation. LLO 8.2 Connect given computer systems/hardware as per network layout.	8	*Layout of network topology and network hardware/network software for given situation.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Simulate the given system component (s) such as conveyors, machining centers, assembly lines using available software.	9	*Design simple manufacturing cells (e.g., machining cell, assembly cell) using available CAD software.	2	CO1 CO2 CO3 CO5
LLO 10.1 Write a simple Ladder Logic program for simple applications. LLO 10.2 Program for simple automation applications.	10	*PLC Programming to control a simple automation system.	2	CO5
LLO 11.1 Select the required hardware components (motors, sensors, Prime controllers) and their functions. LLO 11.2 Program for the simple robot with wrist or arm movements (to move forward, backward, turn, and stop) using motor control commands.	11	Programming of a robot to perform simple task.	2	CO5
LLO 12.1 Prepare a robot program to perform simple tasks by using available Teach Pendant/Offline Programming/Simulation Software.	12	*Use Teach Pendent/Offline Programming/Simulation Software to program a robotic arm to perform pick and place and stacking of objects.	2	CO1 CO5
LLO 13.1 Prepare a detailed report on the elements of an FMS and its computer-controlled automation. LLO 13.2 Arrange a presentation in a group on FMS technology in modern smart factories.	13	Elements of FMS and its nature of controlling by computer through Video film/actual demonstration (plant visit).	2	CO3 CO5
LLO 14.1 Prepare a detailed report on robotic elements, type, configuration, and control mechanisms. LLO 14.2 Arrange a presentation in a group on findings of robotics trends in Industry 4.0 and Smart Manufacturing.	14	Various elments of Robotic Systems, types of robots, their configuration, and the nature of controlling by computer through video/actual demonstration (plant visit).	2	CO4 CO5
LLO 15.1 Select suitable networking peripherals/components to establish network. LLO 15.2 Set up networking of CNC machines, computers and other devices using the relevant method efficiently.	15	*Establish networking between CNC Machines, computers and supported peripherals of your Institute to exchange the manufacturing data and produce simple component.	2	CO4

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Free / Educational versions of CAD Software (1+20 users)	1,2,3,4
2	Free / Educational versions of 3D Modelling software (1+10 users)	1,2,3,4
3	Computers minimum 4GB RAM and above	1,2,3,4,5
4	Microcontrollers (e.g., Arduino, Raspberry Pi), sensors (e.g., temperature, humidity).	10,11,12,13
5	Free / Educational versions software of networking, Robot programming, simulation.	10,11,12,13,9
6	Educational programmable robotics arm to manipulate objects.	10,11,14,15
7	Free / Educational versions software of networking FMS Simulation Software	13
8	CNC Milling 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type-X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, with ATC along with essential accessories.	15
9	Free / Educational versions software of CAM Software (1+20 user)	4,6,8
10	CNC Turning 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type minimum diameter 25 mm, Length 120 mm with ATC along with essential accessories.	5,15
11	CNC Simulation software and control pads (CAMLAB CNC Software, MasterCAM/NXCAM/, DONC CNC machine simulator, PRO, SWANSOFT, CAPSMILL and CAPSTURN IN cam software, DONCMILL AND DONCTURN software), CutViewer Turn& Mill, Sinewave Turn& Mill or equivalent simulation software.	5,15
12	Free / Educational versions software of CAQC software or CMM/other system	6
13	Free / Educational versions software of MRP/ERP/CRM/SCM and PLM Software (1+10 user)	7,10,12,13,9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Computer Integrated Manufacturing (CIM)	CO1	8	4	8	0	12
2	II	Computer-Aided Design (CAD)	CO2	12	4	10	0	14
3	III	Computer-Aided Manufacturing (CAM)	CO3	14	2	6	6	14
4	IV	CIM Networking and Data Base Management System	CO4	14	4	4	6	14
5	V	Automation and Robotics	CO5	12	4	6	6	16
Grand Total				**60**	**18**	**34**	**18**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks and average of two-unit tests, For laboratory learning 25 Marks

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning, End semester assessment of 70 marks.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	3	2	-	1	1			
CO2	3	2	3	3	1	2	1			
CO3	3	2	3	3	1	2	1			
CO4	3	2	3	2	-	2	1			
CO5	3	2	3	3	1	2	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Rao P N	Computer Aided Manufacturing	McGraw-Hill Education, New Delhi (2010), ISBN-9780074631034
2	Groover, Mikell P	Automation Production System and Computer Integrated Manufacturing	Pearson Education Ltd. Canada ISBN: 9780130546524
3	Dr. Sushil Kumar Chaudhary, Dr. R S Jodoun	Computer Integrated Manufacturing & Computer Aided Manufacturing	Walnut Publication, ISBN: 9391145272
4	R K Rajput	Robotics and Industrial Automation	S Chand Publishing, ISBN: 9788121929974
5	Kant S	Principles of Computer-Integrated Manufacturing	Prentice Hall India Learning Private Limited ISBN-13. 978-8120314764
6	R. Panneerselvam, P. Senthilkumar, P. Sivasankaran	Computer-Integrated Manufacturing: Automation in Manufacturing	Cengage India Private Limited ISBN: 9353503205
7	Radhakrishnan P.	CAD/CAM/CIM	New Edge International Publisher, New Delhi ISBN: 8122439802
8	Chang, T.C. and Wysk, R. A	Computer-aided manufacturing	Prentice Hall PTR, ISBN-10. 0131429191.
9	Alavudden A, Venkateshwran N	Computer Integrated Manufacturing	PHI Learning Pvt. Ltd., 2008, ISBN-9788120333451
10	Waldner J B	CIM: Principles of Computer Integrated Manufacturing	John Wiley & Sons Inc. UK (1992) ISBN: 9780471934509
11	Scheer A W	CIM Computer Integrated Manufacturing Towards the Factory of The Future	Springer-Verlag Berlin and Heidelberg GmbH & Co. I SBN: 9783642789908

Sr.No	Author	Title	Publisher with ISBN Number
12	William W.	Flexible Manufacturing Cells and System	Luggen Hall, England Cliffs, New Jersy, ISBN: 0133217388
13	Pabla B.S., Adithan M.	CNC Machines	New Age International, New Delhi, ISBN: 8122434266

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=2HbHmdVf6nI	Automation & Control Computer Integrated Manufacturing Trainer
2	http://www.digimat.in/nptel/courses/video/112104289/L02.html	NPTEL Video Course on CIM
3	https://www.youtube.com/watch?v=_zr4__3Rz0c	How Computer-Integrated Manufacturing is Revolutionizing the Industry?
4	https://www.youtube.com/watch?v=XJjc923jiKk	Introduction of CIM
5	https://www.youtube.com/watch?v=N-QyvP3FqKI	Robotics and Automation
6	https://www.youtube.com/watch?v=66WYARKYz5c	Industry 4.0: Robotics & Automation
7	https://www.youtube.com/@PSDettmerMATC	Robotics & Automation
8	https://www.youtube.com/watch?v=xBLdHyVdYew	Robotic Process Automation (RPA)
9	https://www.youtube.com/watch?v=C-Xljmtfk38	Robotics and Automation: Revolutionizing Maintenance
10	https://www.youtube.com/watch?v=U2AGLeJBFNg	World’s most advanced robotic warehouse
11	https://www.youtube.com/watch?v=3rkqzmAG7G4	WH FLEX - Flexible Automation System
12	https://www.youtube.com/watch?v=Hx6DXuildSc	Computer Aided Manufacturing (CAM)
13	https://www.youtube.com/watch?v=FdipJNG_vV8	Computer Aided Manufacturing (CAM)

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students