

### INTRODUCTION TO SMART MANUFACTURING

<b>Course code</b>		<b>Year</b>	IV	<b>Semester</b>	I
<b>Course category</b>	<b>Open Elective - III</b>	<b>Branch</b>	ME	<b>Course Type</b>	Theory
<b>Credits</b>	3	<b>L-T-P</b>	3-0-0	<b>Prerequisites</b>	Manufacturing Processes
<b>Continuous Internal Evaluation:</b>	30	<b>Semester End Evaluation:</b>	70	<b>Total Marks:</b>	100

**Course Outcomes:** At the end of the course students will be able to

CO's	Statement	Blooms Level	Units
CO1	Introduce the fundamentals and evolution of smart manufacturing with Industry 4.0 technologies	L2	1
CO2	Identify smart machine components and describe sensor roles and interfaces in IoT-based manufacturing systems	L2	2
CO3	Analyze CPS architecture and compare traditional and Industry 4.0 factories using 5C implementation	L3	3
CO4	Apply digital twins, ML/AI techniques, and predictive maintenance tools including AR for system reliability	L2	4
CO5	Evaluate IoT communication protocols and select suitable connectivity models for smart manufacturing	L3	5

Contribution of Course out come towards the achievement of program outcomes & Strength of correlations (High :3, Medium:2, Low:1)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		2						3	2	2
CO2	3	3	2	1	3				1		2	3	2
CO3	3	3	3	2	2				1	1	2	3	2
CO4	3	2	3	2	3			1	1	2	3	3	3
CO5	3	3	2	1	3				1	2	2	3	3

Unit	Contents	CO
I	<b>CONCEPTS OF SMART MANUFACTURING:</b> Definition and key characteristics of smart manufacturing, Corporate adaptation processes, manufacturing challenges, challenges vs technologies, Stages in smart manufacturing. Minimizing Six big losses in manufacturing with Industry 4.0, and their benefits	CO 1
II	<b>SMART MACHINES AND SMART SENSORS:</b> Concept and Functions of a Smart, Machine Salient features and Critical Subsystems of a Smart Machine, Smart sensors; smart sensor ecosystem, need, benefits and applications of sensors in industry, Sensing for Manufacturing Process in IIoT, Block Diagram of a IoT Sensing Device, Sensors in IIoT Applications, Smart Machine Interfaces	CO 2
III	<b>ARCHITECTURE OF CYBER-PHYSICAL SYSTEM (CPS):</b> Functions of CPS, 5C Architecture; Smart Connection Level, Data-to- Information Level, Cyber Level, Cognition Level, Configuration Level. Design of PHM based CPS systems. Comparison of today's factory and Industry 4.0 factory by the implementation of 5C CPS architecture	CO 3
IV	<b>DIGITAL TWINS:</b> Introduction, applications of digital twins, impact zones of digital twins in manufacturing (factories/plants and OEMs), advantages of digital twins, basic steps of digital twin technology <b>MACHINE LEARNING (ML) AND ARTIFICIAL INTELLIGENCE (AI) IN MANUFACTURING:</b> Introduction, benefits and applications of ML in industries, common approaches of ML; supervised and unsupervised, semi-supervised and reinforced ML. <b>PREDICTIVE MAINTENANCE:</b> Introduction of predictive maintenance, difference between preventive and predictive maintenance, working and various components of predictive maintenance, benefits and tools of predictive maintenance. Common approaches to IoT predictive maintenance; Rule-based (condition monitoring) and AI (artificial intelligence) based predictive maintenance.	CO 4
V	<b>IoT CONNECTIVITY FOR INDUSTRY 4.0:</b> Industrial communication requirement and its infrastructure, an overview of different types of networks, mesh network in industrial IoT, IoT protocols and the internet, TCP/IP (transmission control protocol/internet protocol) model, IoT connectivity standards: common protocols, application layer protocols, internet/network layer protocols, physical layer IoT protocols, choosing the right IoT connectivity protocol	CO 5
<b>Learning Resource</b>		
<b>Textbooks:</b>		
<ol style="list-style-type: none"> <li>1. <b>TEXT BOOKS:</b> Industry 4.0 The Industrial Internet of Things by Alasdair Gilchrist, Apress</li> <li>2. Industrial Internet of Things, Cyber Manufacturing System by abina Jeschke, Christian</li> </ol>		

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