INTRODUCTION TO SMART MANUFACTURING

Course code	23ME2701E	Year	IV	Semester	I
Course category	Open Elective - III	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Manufacturing Processes
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	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 withIndustry4.0 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 Industry4.0 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 comestowardsthe achievementofprogram outcomes &Strengthofcorrelations(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	**CONCEPTS OF SMART MANUFACTURING**: Definition and key characteristics of smart manufacturing, Corporate adaptation processes, manufacturing challenges, challenges vs technologies, Stages in smart manufacturing.MinimizingSixbiglossesinmanufacturingwithIndustry4.0,and their benefits	**CO 1**
II	**SMART MACHINES AND SMART SENSORS:** Concept and Functions of a Smart, Machine Salient features and Critical Subsystems of a Smart Machine,Smartsensors;smartsensorsecosystem,need,benefitsandapplicationsofsensors in industry, Sensing for Manufacturing Process in IIoT, Block Diagram of aIoT Sensing Device, Sensors in IIoT Applications, Smart Machine Interfaces	**CO 2**
III	**ARCHITECTUREOFCYBER-PHYSICALSYSTEM(CPS):**Functionsof 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	**DIGITAL TWINS**: Introduction, applications of digital twins, impact zones of digitaltwinsinmanufacturing(factories/plantsandOEMs),advantagesofdigital twins, basic steps of digital twin technology **MACHINELEARNING(ML)ANDARTIFICIALINTELLIGENCE(AI) IN MANUFACTURING:** Introduction, benefits and applicationsof ML in industries, common approaches of ML; supervised and unsupervised, semi-supervised and reinforced ML. **PREDICTIVE MAINTENANCE**: 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	**IoT CONNECTIVITY FOR INDUSTRY 4.0:** 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	**CO5**
Learning Resource		
Textbooks:		
1. **TEXT BOOKS:** Industry4.0 The Industrial Internet of Things by Alasdair Gilchrist, Apress		

2. Industrial Internet of Things, CyberManufacturing System by abinaJeschke, Christian Brecher, Houbing Song Danda B. Rawat, Springer