The LNMIIT, Jaipur
Department of Electronics and Communication Engineering
Cyber-Physical Systems (ECE-XXXX)

Programme: **M. Tech. (ECE)**	**Course Title:** **Cyber Physical Systems**			**Course Code:** **ECE-**
Type of Course: **Program Elective**	**Prerequisites:** **MICROI/ CoA , Computer Networks and Computer Programing**			**Total Contact Hours:** **40**
Year/Semester:	**Lecture Hrs/Week:** **3**	**Tutorial Hrs/Week:** **0**	**Practical Hrs/Week:** **0**	**Credits:** **3**

Learning Objective:

Cyber Physical Systems (CPS) has emerged as new frontier which is transforming the way people interact with modern systems. Today CPS has major involvement in medical equipment, automotive, process automation, digital twins and smart city infrastructure. In this course students will learn the concepts, design methodologies and implementation of CPS. The course also offers discussion and implementation of Intelligence in CPS through case studies and practical examples.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		**Bloom's Level**
CO-1	To **define**, **explain** and **examine** CPS components with examples.	**1, 2, 4**
CO-2	To **recognize** and **evaluate**, principles and applications of various models and approaches to design CPS	**1, 4**
CO-3	To **examine** and **demonstrate** various outcomes of the model based design	**3, 4**
CO-4	To **Implement** specific application for CPS using existing tools	**1, 4**
CO-5	To **recognize** and **Implement** the Intelligent CPS models	**1, 4**
CO-6	To **define**, **recognize** and **implement** techniques and methods for designing CPS	**1, 2, 3**

Topics		**Lecture Hours**	
UNIT – I (Introduction)			4
1.1	Introduction, Motivation and Overview	1	
1.2	Basic principles of design and validation of CPS	1	
1.3	Industry 4.0, AutoSAR, IIOT implications, Medical CPS	2	
UNIT – II (Platform components)			12
2.1	CPS HW platform-Processors, Sensors, Actuators	2	
2.2	CPS Network- WirelessHart, CAN, Automotive Ethernet	3	
2.3	Scheduling Real Time CPS tasks	2	
2.4	Controller Design Techniques	1	
2.5	Performance under Packet drop and Noise	2	
2.6	Dynamic Systems and Stability	2	

UNIT - III (CPS Implementation issues)		
3.1 From features to automotive software components, Mapping software components to ECU	2	10
3.2 CPS Performance Analysis-effect of scheduling, bus latency, sense and actuation faults on control performance	3	
3.3 Network Operations	2	
3.4 Building real-time networks for CPS	3	
UNIT - IV Intelligent CPS		
4.1 Safe Reinforcement learning	2	7
4.2 Robot motion control	1	
4.3 Autonomous Vehicle Control	2	
4.4 Smart Grid Demand Response	1	
4.5 Building Automation	1	
UNIT - V Secure Deployment of CPS		
5.1 Secure Task Mapping and Partitioning	2	7
5.2 State Estimation for attack detection	1	
5.3 Automotive Case Study: Vehicle ABS hacking	2	
5.4 Power Distribution Case Study	1	
5.5 Smart City Case Study	1	

Textbook References:

[1]. Raj Rajkumar, Dionisio de Niz and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional, 2016

[2]. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.

Reference books:

[1]. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, MIT Press 2011.

[2]. P. Tabuada, Verification and control of hybrid systems: a symbolic approach, Springer-Verlag 2009

Additional Resources (NPTEL, MIT VEdio Lectures, Web resources etc):

[1]. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs24/

Evaluation Methods:

Item	Weightage
Quiz1	10
Quiz2	
Project	20
Midterm	30
Final Examination	40

* Please note, as per the existing institute's attendance policy the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% lectures will be debarred from the End Term/Final/Comprehensive examination.

CO and PO Correlation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1		1							3	3	1	
CO2	3	3	2				1			1		3	3	1	
CO3	3	3	2	1								3	3	1	
CO4	3	3	3	2			1					3	3	2	
CO5	3	3	3	2					1			3	3	2	
CO6	3	3	3	3								3	3	2	

Last Updated On: 26th May 2021
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Approved By: