MANIPAL INSTITUTE OF TECHNOLOGY
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DECLARATION BY THE QUESTION PAPER SETTER

I Mr. __NEVIN AUGUSTINE__________, hereby declare that, I do not have any relatives who is/are appearing for the exam of this course, the question paper of which is set by me and have taken utmost care not to retain the copy of the paper.
I also confirm that the question paper is personally handed over to the office of the examination of our department.
Certified that this question paper is prepared to cover the entire syllabus and followed all the guidelines set by me in the form of blue print submitted during the beginning of the semester.

Semester	IV
Course Code	ICE 2227
Course Title	INTRODUCTION TO CYBER PHYSICAL SYSTEMS

Submitted by : NEVIN AUGUSTINE

Signature

Date:

Name:

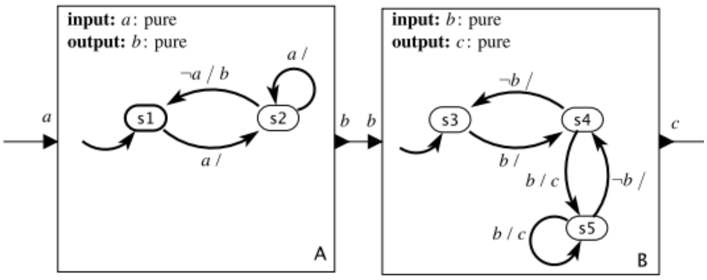
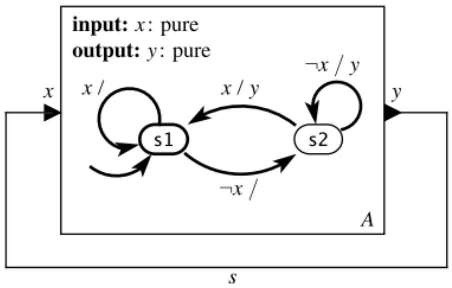
IVth SEMESTER (B.TECH) (CYBER PHYSICAL SYSTEMS)
END SEMESTER MAKEUP EXAMINATIONS JUNE 2024
SUBJECT: INTRODUCTION TO CYBER PHYSICAL SYSTEMS (**ICE 2227)**
Note: Answer All questions.

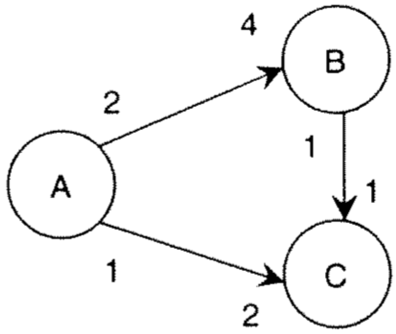
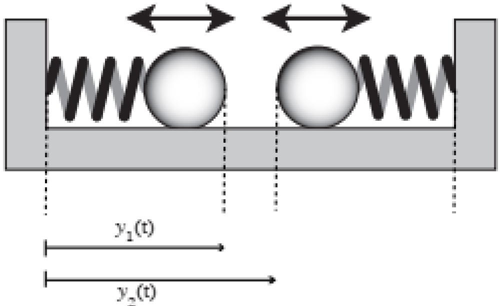
Time:3 Hours **2023 -2024** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.

Q.No.	Description	M	CO	PO'S	BL
1A	Design a cyber-physical system (CPS) for a smart irrigation system that optimizes water usage in agricultural fields. Describe the key components, the interactions between physical and computational elements, and how the system ensures efficient water management. Highlight the sensors, actuators, and control algorithms involved, and explain how data is processed and utilized to make real-time decisions. Additionally, discuss potential challenges and how they can be addressed to ensure the system's reliability and effectiveness.	5	CO2	1,3	3

1B	A fully automated washing machine is an embedded system. Describe how it can be converted to a cyber-physical system? Give any two benefits of doing so.	**3**	**CO1**	**1,2**	**3**
1C	Differentiate between mesh topology and tree topology in Zigbee network architecture.	**2**	**CO1**	**1,4**	**2**
2A	Draw the actor model of the Ordinary differential equation $\dot{x} = ax$	**2**	**CO3**	**1,3**	**2**
2B	Model a thermostat, which regulates temperature to maintain a set point by turning on/off a heater with a hysteresis of 5ºC.	**3**	**CO3**	**2**	**3**
2C	Design a synchronous state machine for a home security system. Your design should include states for arming the system, disarming the system, detecting a breach, and handling an alarm. Provide a state transition diagram and explain the conditions that trigger transitions between states. Ensure your design considers features such as entry/exit delays, sensor activation, and user inputs. Discuss how the system manages multiple sensors and prioritizes security events.	**5**	**CO3**	**3**	4
3A	Give the differences between a Finite state machine and an Extended state machine.	**2**	**CO3**	**3**	**3**
3B	Design a synchronous state machine for a coffee vending machine. Your design should include states for accepting coins, selecting a coffee type, dispensing the coffee, and returning to the idle state. Provide a state transition diagram and explain the conditions that trigger transitions between states. Ensure your design considers features such as handling insufficient funds, cancelling the order, and maintaining the machine.	**3**	**CO3**	**2,3**	**4**
3C	Consider the following composition of two state machines A and B. Construct a single state machine C representing the composition. 	**5**	**CO4**	**3,12**	**3**
4A	Is the below feedback model formed or ill formed? 	**2**	**CO4**	**2**	**3**
4B	Design a smart home lighting system using the actor model. The system consists of three rooms, each with its own set of lights that can	**3**	**CO4**	**3,12**	**4**

	be controlled individually. The lights should respond to different inputs, which are a central controller, motion sensors, and manual switch.				
4C	For the data flow model below: using topology matrix, find out whether a periodic schedule exists and obtain a feasible Periodic Admissible Sequential Schedule (PASS). 	**5**	**CO4**	**3**	**4**
5A	Describe the importance of state refinements in timed automation.	**2**	**CO5**	**2**	**4**
5B	Explain the importance of key exchange protocol design with regard to protocol and network security for the design of cyber physical systems.	**3**	**CO5**	**2**	**4**
5C	Consider the physical system depicted in figure below. Two sticky round masses are attached to springs. The springs are compressed or extended and then released. The masses oscillate on a frictionless table. If they collide, they stick together and oscillate together. After some time, the stickiness decays, and masses pull apart again. Develop a hybrid model for this system. 	**5**	**CO5**	**2,3**	**4**