Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem Examination May-2024

ME3EL24 Cyber Physical Production Systems

Programme: B.Tech. Branch/Specialisation: ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. Which of the following is NOT typically considered a key feature of Cyber-Physical Systems (CPS)? **1**

(a) Integration of computational and physical processes
(b) Remote control via network infrastructures
(c) High dependability on human intervention for operation
(d) Real-time data acquisition and control

ii. What is one of the major challenges in designing and validating CPS? **1**

(a) Minimizing system performance
(b) Reducing data processing capabilities
(c) Ensuring interoperability between heterogeneous systems
(d) Limiting the scope of applications

iii. What type of network is commonly used for real-time communication in automotive applications? **1**

(a) WiFi (b) CAN (Controller Area Network)
(c) Bluetooth (d) Zigbee

iv. In CPS, what role do actuators play? **1**

(a) They gather data from the environment
(b) They process data from sensors
(c) They convert electrical signals into physical action
(d) They provide power to the sensors

v. Which of the following is a common feature in the design of asynchronous processes in CPS? **1**

(a) Coordination protocols that require a central clock
(b) Frequent use of leader election algorithms to manage dependencies
(c) Design primitives that eliminate the need for error checking
(d) Reliable transmission techniques that depend on synchronous timing

P.T.O.

vi. What is a key difference between synchronous and asynchronous circuits in CPS? **1**
(a) Synchronous circuits require a clock signal, whereas asynchronous circuits do not
(b) Asynchronous circuits require a clock signal, whereas synchronous circuits do not
(c) Synchronous circuits are primarily used in software applications, while asynchronous circuits are not
(d) Asynchronous circuits handle real-time operations better than synchronous circuits

vii. What is a primary cybersecurity requirement for Cyber-Physical Systems? **1**
(a) Reduction of system processing power for security tasks
(b) Ensuring physical safety and operational continuity under cyber attacks
(c) Isolation of physical devices from the network
(d) Complete removal of automated updates and maintenance

viii. Which of the following best describes an attack model in the context of CPS security? **1**
(a) A theoretical model that describes how to build secure systems
(b) A conceptual model used only in the development phase of CPS
(c) A description of potential threats and vulnerabilities along with expected types of attacks
(d) A system model that excludes potential cyber threats

ix. What is a primary benefit of implementing Cyber-Physical Systems (CPS) in healthcare and medical settings? **1**
(a) Reduction in the use of electronic medical records
(b) Increase in manual processes in patient monitoring
(c) Enhanced patient monitoring through real-time data and automated interventions
(d) Decreased collaboration between different healthcare systems

x. Which application of CPS is critical for the functioning of Smart Cities? **1**
(a) Autonomous vehicles that operate independently of any network systems
(b) Integration of Wireless Sensor Networks (WSN) for infrastructure management, including traffic and environmental monitoring
(c) Use of non-digital communication systems for urban management
(d) Decreasing the automation within public transportation systems

Q.2	i.	Write any two key features of CPS.	**2**
	ii.	Explain basic principles of design and validation of CPS.	**8**
OR	iii.	Give some applications and challenges of CPS.	**8**
Q.3	i.	What are CPS HW platforms?	**2**
	ii.	Differentiate between synchronous model and asynchronous model.	**8**
OR	iii.	Discuss about scheduling real time CPS tasks.	**8**
Q.4	i.	Define reactive components.	**3**
	ii.	Discuss asynchronous processes and operations.	**7**
OR	iii.	What are coordination protocols in asynchronous process?	**7**
Q.5	i.	What is the contribution of CPS in security of country?	**4**
	ii.	Discuss attack model and countermeasures.	**6**
OR	iii.	Discuss advanced techniques in CPS securities.	**6**
Q.6		Write short notes on any two:	
	i.	Health care CPS	**5**
	ii.	Smart grid CPS	**5**
	iii.	WSN based CPS	**5**

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Scheme of Marking

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Note: The Paper Setter should provide the answer wise splitting of the marks in the scheme below.

Q.1	i)	C) High dependability on human intervention for operation	1
	ii)	C) Ensuring interoperability between heterogeneous systems	1
	iii)	B) CAN (Controller Area Network)	1
	iv)	C) They convert electrical signals into physical action.	1
	v)	B) Frequent use of leader election algorithms to manage dependencies	1
	vi)	A) Synchronous circuits require a clock signal, whereas asynchronous circuits do not.	1
	vii)	B) Ensuring physical safety and operational continuity under cyber attacks	1
	viii)	C) A description of potential threats and vulnerabilities along with expected types of attacks	1
	ix)	C) Enhanced patient monitoring through real-time data and automated interventions.	1
	x)	B) Integration of Wireless Sensor Networks (WSN) for infrastructure management, including traffic and environmental monitoring.	1
Q.2	i.	(i) Interconnectedness (ii) Flexibility & adaptibility (iii) Resource ebbi (iv) Human m/c Collabon (1 Mark each)	
	ii.	Modelling, Design & Analysis Explain. (3, 3, 2)	
OR	iii.	application - (4) challenges (4) - (i) Improve product (ii) Standardization (i) Dynamic reconfiguration (iv) Information Technology.	
Q.3	i.	Arduino, Raspberry Pi, Nvidia Jetson 1 mark ea	
	ii.	min (4) Point 2 mark ea	
OR	iii.	(i) Task characterization (2) Scheduling Algorithm selects (iii) Resource mgmt (iv) implementation & monitoring (2 Mark each)	
Q.4	i.	Definition - 3 Mark	
	ii.	Process → Non-blocking, Improve responsiveness (ii) Better resource utilization / operations → individual tasks (2) → independent	
OR	iii.	Coordination (5)	

Diag (2) (5)

Q.5	i.	Contribution Points (1 Mark ea.)	
	ii.	Physical attacks Cyber attacks → (i) Denial of Service (ii) Man in the middle (3)	
OR	iii.		
Q.6			
	i.	Short note Heart ca CPS	5
	ii.	— In Smart grid CPS	5
	iii.	— In LNSN bas. CPS	5

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Q5(ii) Counter measures, (1) Access control (2) Encryption (3) Intrusion prevention & detection system (4) Secure Software Development practices

Q5(iii) Advanced tech → (i) Formal Methods (ii) Run time Monitoring & intrusion detection sys. (iii) Attack Resilient control system (iv) Secure comm. protocols.

ans (3) → 2 marks ea