



PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May/June 2026

Date: 15- 05-2026

Time: 09:30am – 12:30pm

School: SOIS-PG	Program: MCA	
Course Code: CSA4049	Course Name: Cyber Digital Twin	
Semester: IV	Max Marks: 100	Weightage: 50%

CO - Levels	C01	C02	C03	C04	C05
Marks	25	25	25	25	

Instructions:

- (i) Read all questions carefully and answer accordingly.
- (ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks.

10Q x 2M=20M

1	Define a Cyber Digital Twin.	2 Marks	L1	C01
2	What is a Digital Shadow?	2 Marks	L1	C01
3	List the four layers of Digital Twin Architecture.	2 Marks	L1	C02
4	What is the role of MQTT protocol in IIoT communication?	2 Marks	L2	C02
5	Define Cognitive Digital Twin.	2 Marks	L1	C03
6	What is the objective function in optimization?	2 Marks	L2	C03
7	List two examples of System Failure Risks in Digital Twin.	2 Marks	L1	C04
8	What is Virtual Commissioning?	2 Marks	L2	C04
9	Mention two key characteristics of a Security-Focused Digital Twin.	2 Marks	L1	C04
10	What is a Digital Thread?	2 Marks	L2	C01

Part B

Answer the Questions.

Total Marks 80M

11.	a)	Define Cyber-Physical Systems (CPS) and explain the "Sense-Analyze-Act" feedback loop with a diagram.	10 Marks	L2	CO1
	b)	Differentiate between a Cyber Digital Twin and a Traditional Digital Model based on connectivity and real-time data.	5 Marks	L4	CO1
	c)	Illustrate how the Digital Thread acts as the "single source of truth" across a product's lifecycle.	5 Marks	L3	CO1
Or					
12.	a)	Describe the three levels of Digital Twin Maturity (Asset, System, Process Twin) with examples.	10 Marks	L2	CO1
	b)	Compare and contrast the key pillars of a Cyber Digital Twin: Connectivity, Fidelity, and Intelligence.	5 Marks	L4	CO1
	c)	Explain the working principle of a Digital Twin using the continuous bi-directional data flow model.	5 Marks	L2	CO1

13.	a)	Explain the steps involved in implementing a Model in a Digital Twin environment (from design to deployment).	10 Marks	L2	CO2
	b)	Based on the above implementation, describe the importance of Model Validation and Calibration to ensure prediction accuracy.	5 Marks	L2	CO2
	c)	Why is continuous learning and model updating necessary after deployment? Justify with an example.	5 Marks	L5	CO2
Or					
14.	a)	Distinguish between Edge Computing and Cloud Computing in the context of Industrial IoT (IIoT) architecture.	10 Marks	L4	CO2
	b)	Using the above distinction, solve the challenge of high latency for real-time robot control using Edge computing.	5 Marks	L3	CO2
	c)	Defend the need for a hybrid Edge-Cloud architecture for large-scale smart factory deployment.	5 Marks	L5	CO2

15.	a)	Explain how Reinforcement Learning (RL) is used for real-time optimization in a Digital Twin environment.	10 Marks	L2	CO3
	b)	Based on RL principles, describe how a Digital Twin agent learns optimal temperature control in a data center.	5 Marks	L2	CO3

	c)	Compare Reinforcement Learning with Supervised Learning for dynamic decision-making applications.	5 Marks	L4	C03
Or					
16.	a)	Describe the concept of Human Behavior Modeling in Cognitive Digital Twins for industrial safety.	10 Marks	L2	C03
	b)	Building on this, explain how Anomaly Detection models can identify unusual operator behavior that may lead to accidents.	5 Marks	L2	C03
	c)	Devise a strategy to integrate AI-based behavior prediction while addressing privacy and ethical concerns.	5 Marks	L6	C03

17.	a)	Describe the types of Risks in Digital Twin systems (Operational, Cybersecurity, Data Integrity, System Failure).	10 Marks	L2	C04
	b)	Based on these risk types, analyze how a manufacturing Digital Twin can predict operational risks before failure occurs.	5 Marks	L4	C04
	c)	Propose a mitigation strategy for Data Integrity Risks caused by faulty sensor readings.	5 Marks	L6	C04
Or					
18.	a)	Explain the layers of the Digital Twin Reference Model (Physical, Data, Communication, Application).	10 Marks	L2	C04
	b)	Using this reference model, illustrate the data flow from a physical sensor to the application dashboard.	5 Marks	L3	C04
	c)	Criticize a Digital Twin implementation that lacks a proper Communication Layer design for real-time sync.	5 Marks	L5	C04