

Reg. No.																			
-----------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Question Paper Code	13871
----------------------------	--------------

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Seventh Semester

Mechanical and Automation Engineering

20MUPC702 - MECHATRONICS SYSTEM DESIGN

Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. In the mechatronics system design process, which is the first step? (a) System modeling (b) Conceptual design and problem definition (c) Simulation (d) Implementation and testing	1	K1	CO1
2. Which of the following is not a key element of a mechatronics system? (a) Sensors (b) Actuators (c) Power source (d) Engine	1	K1	CO1
3. In a signal flow graph, the nodes represent: (a) System variables (b) System elements (c) Energy sources (d) Feedback paths	1	K1	CO2
4. The main purpose of system modeling is to: (a) Increase the system cost (b) Understand and predict system behavior (c) Reduce the physical size of components (d) Simplify circuit connections	1	K1	CO2
5. Which software environment is commonly used for controller prototyping in simulations? (a) MATLAB/Simulink (b) Fusion 360 (c) Excel (d) Ansys	1	K1	CO3
6. Which of the following is NOT a stage in the simulation life cycle? (a) Model formulation (b) Solution of equations (c) Hardware prototyping (d) Model validation	1	K1	CO3
7. Which of the following is nonlinear programming technique? (a) Simplex method (b) Graphical method (c) Transportation method (d) Gradient-based method	1	K1	CO4
8. Which of the following is a constraint in an optimization problem? (a) Objective function (b) Engine temperature (c) Maximum allowable stress (d) Cost function	1	K1	CO4
9. The modeling of an ABS system requires consideration of which key parameter? (a) Window speed (b) Wheel slip (c) Engine temperature (d) Air pressure	1	K1	CO5
10. In modeling a Stewart platform with actuators, the primary objective is to (a) Simulate multi-DOF motion for robotics or flight simulators (b) Control window deflection (c) Measure fuel consumption (d) Adjust engine timing	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. Define Mechatronics.	2	K1	CO1
12. What are recent advancements in Mechatronics technology?	2	K1	CO1
13. Illustrate any two advantages of the analytical modeling technique.	2	K2	CO2
14. Define non-touching loop.	2	K1	CO2
15. List the steps of the simulation life cycle.	2	K1	CO3
16. What is Hardware-in-Loop (HIL) simulation?	2	K1	CO3
17. Define Optimization Problem Formulation.	2	K1	CO4
18. Name two heuristic or meta-heuristic optimization techniques.	2	K1	CO4
19. What is the key parameter measured by an ABS system?	2	K1	CO5

20. Brief the role of a clutch lookup table in automotive engine control. 2 K2 CO5
21. Differentiate between zeroth, first, and second-order systems. 2 K2 CO1
22. How do Stewart platforms utilize actuators for precise movement? 2 K1 CO5

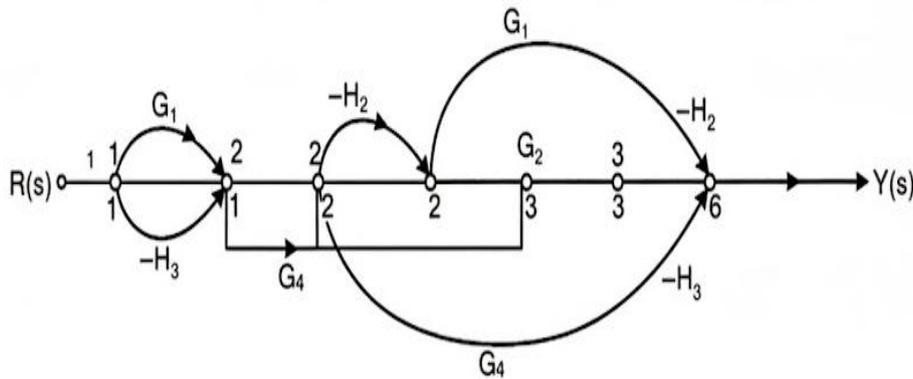
PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Explain in detail the Mechatronics system design process with a neat block diagram. 11 K2 CO1

OR

- b) Outline the key elements of a Mechatronics system and elaborate on the recent advancements in Mechatronics applications. 11 K2 CO1
24. a) Find the overall transfer function for the signal flow graphs shown below, using Mason's Gain Formula. 11 K3 CO2



OR

- b) Develop various methods of system representation: block diagrams, signal flow graphs, transfer functions, and state-space models. 11 K3 CO2
25. a) Infer how solutions for model equations are obtained and interpreted for zeroth, first, and second-order systems. 11 K2 CO3

OR

- b) How is HIL used in controller prototyping for real-time testing of mechatronics systems? Illustrate with an example. 11 K2 CO3
26. a) Outline the optimal design in the context of mechatronics engineering with a suitable case study. 11 K2 CO4

OR

- b) Find the initial solution for the problem given below using NWCM method 11 K2 CO4

	D	E	F	G	Supply
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

27. a) Explain the modeling and simulation of a power window system, including the role of motor, switch, and control logic. 11 K2 CO5

OR

- b) Explain how clutch lookup tables are used in simulating automatic transmission systems. Include a sample table and its interpretation. 11 K2 CO5

28. a) Explain the function of an ECU in an automotive system and how it manages engine parameters. 11 K2 CO5

OR

b) Explain the ABS case study simulation on wet and icy roads. Include wheel dynamics, slip control, and braking performance. 11 K2 CO5