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Bengaluru

Mid Term Examinations - October 2026

Date: 05/10/2026 **Time:** 02:00 PM - 03:30 PM

Course Code: MEC3063 **Course Name:** Control Engineering

Semester: Sixth Semester **Max. Marks:** 50 **Weightage:** 50%

CO - Levels	CO1	CO2
Marks	50	40

PART A: Answer Following Questions. 10 M

Q.N.	Questions	M	CO	BT
1	Explain how a control system can provide power amplification.	2	CO1	BT2
2	Explain how feedback helps a closed-loop system correct an error.	2	CO1	BT2
3	Why is a closed-loop system generally more accurate but more complex than an open-loop system?	2	CO1	BT2
4	Explain how increasing the controller gain can affect the transient response of a position-control system.	2	CO1	BT2
5	Explain why simplifying assumptions are made while developing a mathematical model of a control system.	2	CO1	BT2

PARTB: Answer Any 1 Following Questions. 20 M

Q.N.	Questions	M	CO	BT
06.A	Consider a simplified DC motor-based electromechanical system characterized by an armature resistance (R_a), motor torque constant (K_t), back-emf constant (K_b), rotor moment of inertia (J), and viscous friction coefficient (B). Neglect the armature inductance. The applied armature voltage is ($V_a(t)$), and the motor produces an angular displacement ($\theta(t)$). Assume zero initial conditions and that the back electromotive force is proportional to the angular velocity. Using Kirchhoff's Voltage Law (KVL) for the electrical subsystem, and Newton's rotational law for the mechanical subsystem, derive the overall transfer function, explicitly incorporating the motor torque constant (K_t) and back-emf constant (K_b).	10	CO2	BT3
06.B	Consider a series RLC circuit consisting of a resistance (R), inductance (L), and capacitance (C). The applied input voltage is ($V_i(t)$), and the output is the voltage across the capacitor, ($V_c(t)$). Using Kirchhoff's Voltage Law and assuming zero initial conditions: 1. Derive the governing differential equation relating the input voltage ($V_i(t)$) to the capacitor voltage ($V_c(t)$). 2. Using the Laplace transform, obtain the transfer function of the circuit.	10	CO2	BT3
07.A	A rotational mechanical system consists of a moment of inertia (J), viscous friction coefficient (B), and torsional spring constant (K). An input torque (T(t)) is applied to the system, resulting in an angular displacement ($\theta(t)$). Using the torque balance equation and assuming zero initial conditions: 1. Derive the governing differential equation relating the input torque (T(t)) to the angular displacement ($\theta(t)$). 2. Using the Laplace transform, obtain the transfer function of the system.	10	CO2	BT3

PTO (Please Turn Over)

07.B	A translational mechanical system consists of a mass (M), viscous damper with damping coefficient (B), and spring with stiffness (K), all connected in parallel. An external force (F(t)) is applied to the mass, resulting in a displacement (x(t)). Using Newton's second law and assuming zero initial conditions: 1. Derive the differential equation relating the applied force (F(t)) and the displacement (x(t)). 2. Using the Laplace transformation, obtain transfer function of the system.	10	CO2	BT3

PARTC: Answer Any 1 Following Questions. 20 M				
Q.N.	**Questions**	**M**	**CO**	**BT**
08.A	Explain the standard test input signals commonly used in control-system analysis. Discuss impulse, step, ramp, parabolic, and sinusoidal inputs, including their mathematical representations and the type of system response or performance characteristics that can be evaluated using each input.	10	CO1	BT2
08.B	Explain the working of an antenna azimuth position control system with the help of suitable diagrams. Describe its physical components, schematic representation, functional block diagram, input and output variables, controller, motor, sensor, and feedback path. Explain how the system uses feedback to achieve and maintain the desired angular position of the antenna.	10	CO1	BT2
09.A	Explain the six-step control system design process. Describe the objective and significance of each step, beginning with the conversion of system requirements into a physical system and progressing through modeling, analysis, design, and testing of the control system.	10	CO1	BT2
09.B	With the help of suitable block diagrams, explain the working principles of open-loop and closed-loop control systems. Compare the two systems in terms of feedback, disturbance rejection, accuracy, complexity, cost, and sensitivity. Also, provide suitable practical examples of open-loop and closed-loop control systems.	10	CO1	BT2