CBCS SCHEME

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BAE703/BAS703

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Control Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Distinguish between open loop and closed loop control system with examples.	6	L1	CO1
	b.	Describe the requirement of an ideal control system.	6	L2	CO1
	c.	Explain the concept of feedback control system with basic structures. List its effect on control system.	8	L2	CO1
		OR			
Q.2	a.	Draw the equivalent mechanical system of the given system. Hence write the sets of equilibrium conditions for it and obtain analogous circuits using F-V analogy. Fig Q2(a)	10	L2	CO1
	b.	Derive the transfer function of an armature controlled DC motor.	10	L3	CO1
		Module – 2			
Q.3	a.	Obtain the overall transfer function of the block diagram shown in Fig Q3(a) by reducing technique. Fig Q3(a)	10	L3	CO2

	b.	Determine the overall gain C(S) / R(S), for the signal flow graph shown in Fig Q3(b). Fig Q3(b)	10	L3	CO2
		OR			
Q.4	a.	Obtain an expression for the time response of the first order system subjected to unit step input.	10	L3	CO2
	b.	Measurement conducted on a servo mechanism show that the system response to be $c(t) = 1 + 0.2\,e^{-60t} - 1.2e^{-10t}$, when subjected to step input. Obtain the expression for closed loop transfer function. Determine the undamped natural frequency and damping ratio.	10	L3	CO2
		Module – 3			
Q.5	a.	The characteristics equation of a feedback control system is $s^4 + 20ks^3 + 5s^2 + 10s + 15 = 0$. Find the range of k for which system is stable.	10	L3	CO3
	b.	Sketch the root locus for a negative feedback control system having an open loop transfer function. $G(s)\,H(s) = \dfrac{K}{s(s^2+6s+10)}$.	10	L3	CO3
		OR			
Q.6		Sketch the Bode plot for $G(s)\,H(s) = \dfrac{2}{s(1+s)\,(1+0.2s)}$. Also obtain Gain Margin, Phase Margin and Cross Over Frequencies.	20	L3	CO3
		Module – 4			
Q.7	a.	For a standard second order system. derive the expression for the following: i) Resonant peak ii) Resonant frequency	10	L3	CO3
	b.	Plot the polar plot for the open loop transfer function of a unity feedback and determine the phase margin and gain margin. $G(s) = \dfrac{10}{s(s+1)\,(s+2)}$.	10	L3	CO3

		OR			
Q.8		Construct Nyquist plot for a feedback control system whose open loop transfer function is given by $G(s) = \frac{5}{s(1-s)}$. Comment on the stability of open loop and closed loop system.	**20**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Briefly explain with block diagram proportional Plus Integral Plus Derivative (PID) and state its characteristics of this controller.	**10**	**L2**	**CO1**
	b.	Explain the lead and lag compensator in control system.	**10**	**L2**	**CO1**
		OR			
Q.10	**a.**	Write short notes on state equations and state variable representation.	**10**	**L2**	**CO1**
	b.	Consider the system with state equation $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} [u]$ $y = [1 \quad 0 \quad 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ Determine the controllability and observability of the system using Kalman Test.	**10**	**L3**	**CO1**

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