20/05/2025 TE ELECTRICAL SEM-VI C-SCHEME CSD QP CODE: 10085104

Duration :3 Hr. **Marks:80**

Note :

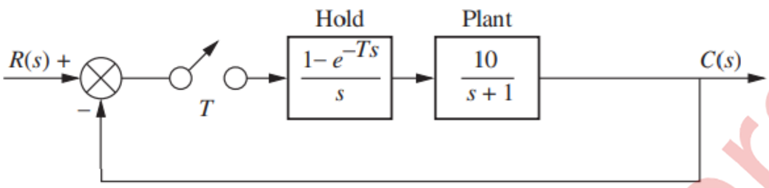
- **Question No.1 is compulsory.**
- Solve **ANY THREE** questions from the **remaining** five questions.
- Figure to the right indicates full marks.
- Assume suitable data wherever required, but justify the same.

Q. 1		Solve **any four** questions from following. (Each question carries 5 marks)	**20**
	a)	Define controllability and observability in state space. Which form of State space representation is best to directly observe the controllability and observability of system and why?	**05**
	b)	Digital compensator is given by G(s)=10/(S+5). Obtaine the discrete transfer function for T=0.02 msec.	**05**
	c)	Realize a PD controller with passive network. Given the controller transfer function $Gc(s) = \frac{s+3}{s+10}$	**05**
	d)	For a system with G(s)=$\frac{35(s+5)}{s(s+3)(s+10)}$, determine the corner frequencies, intial slope and magnitude of the bode plot at ω=0.1 rad/sec.	**05**
	e)	The open loop transfer function G(s) of a plant has 3 poles: one at origin and the other two at -1 and -3 respectively. The constant %OS line corresponds to 10% overshoot intersect the Root locus at the point A. Evaluate the settling time corresponding to the point A.	**05**
Q. 2	**a)**	Design an integral controller to yield a 16% overshoot, 0.6sec. peak time and zero steady state error for a step input for the following plant. Analyse the designed system and verify the zero steady state error. $\dot{x} = \begin{bmatrix} -2 & 1 \\ 0 & -4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \quad y = [1 \quad 1]\, x$	**10**
	b)	Identify the active and passive compensators which can be used to improve only the steady state response for the given system. Model the compensators with the corresponding typical Transfer functions and pole-zero plots. Also, draw the corresponding compensator circuits.	**10**
Q. 3	**a)**	Design a lag compensator for the unity feedback system with forward path $G(S) = \frac{K}{S(S+8)(S+30)}$ to meet percentage overshoot of 10% and K_v=10. Use frequency response analysis.	**10**
	b)	Explain the selection criteria of cpmpensators. Explain the steps in lag-lead compensator design using frequency domain analysis.	**10**

Q. 4 **a)** A unity feedback system with forward path transfer function $G(s)=\frac{K}{(s+2)(s+4)(s+6)}$ has 15% overshoot. Analyse the system with the help of root locus and determine the dominant pole and gain K for the given % overshoot. **10**

b) Analyse the system given in Q. 4a) to determine the current peak time for 15% overshoot, design a PD controller to reduce the peak time by a factor of 1.5. Draw the compensated root locus and verify the design. **10**

Q. 5 **a)** Determine the range of T that will make the system stable and the range that will make the system unstable. **10**

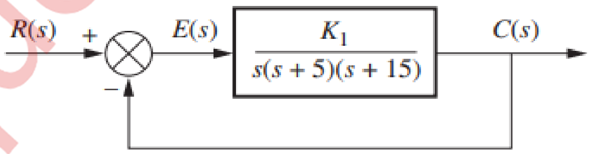


b) Design a lag compensator using root locus technique with open loop transfer function **10**

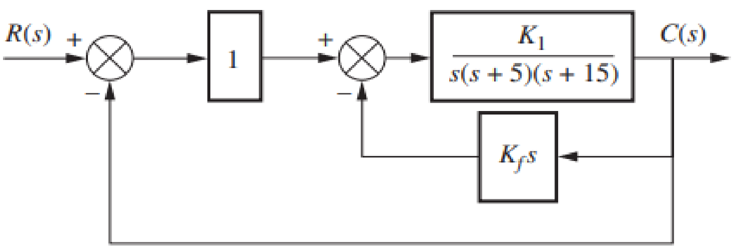
$G(S)=\frac{K}{S((S+2)(S+8)}$ to meet damping ratio =0.5, settling time=5 and velocity error >5

Q. 6 **a)** $G(s) = \frac{20(s+2)}{s(s+5)(s+7)}$. Analyse the system for controllability and if controllable, determine the transformation matrix to do the state feedback controller design in phase variable form, if the plant is represented in the parallel form. **10**

b) What is rate feedback controller. Given the system of Figure (a), design rate feedback compensation, as shown in Figure (b), to reduce the settling time by a factor of 4 while continuing to operate the system with 20% overshoot. **10**



(a)



(b)

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