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PES University, Bangalore

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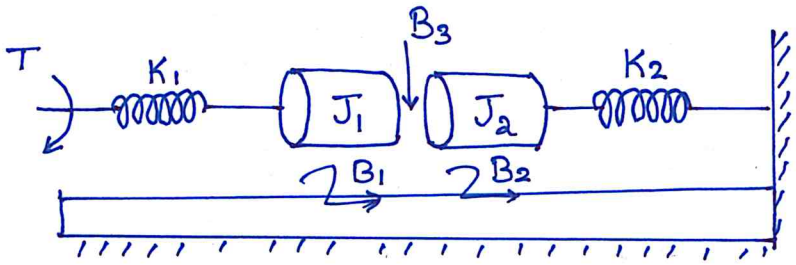
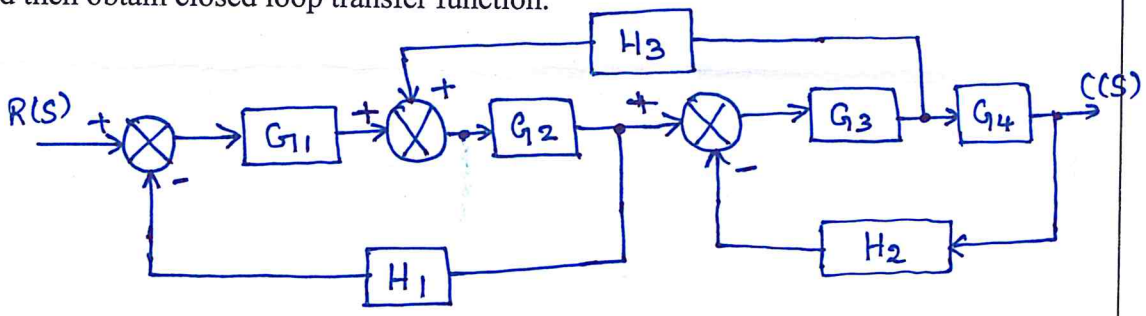
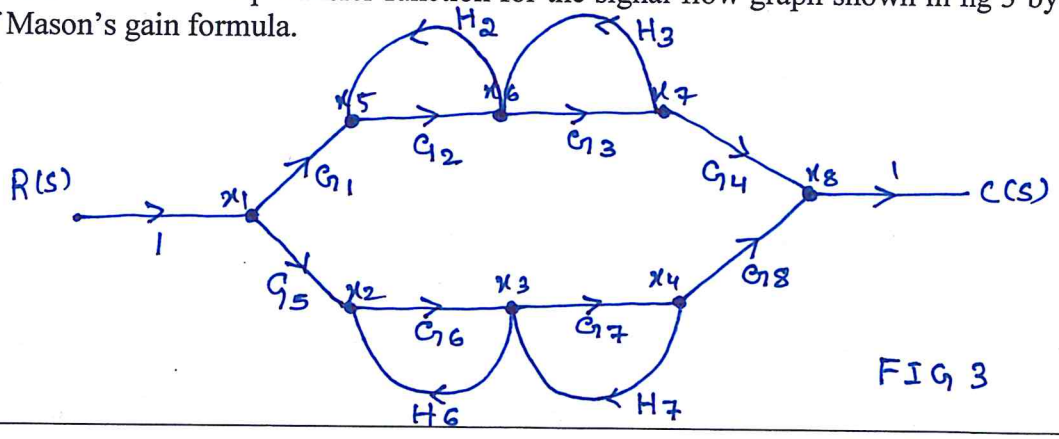
UE16EC335

MAY 2019: END SEMESTER ASSESSMENT (ESA) B.TECH. VI SEMESTER

UE16EC335- CONTROL SYSTEMS.

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1.	a)	For the mechanical system shown in fig1, write the differential equations and obtain torque-current analogous network.  FIG 1	6
	b)	Using block diagram reduction techniques, simplify the block diagram shown in fig 2, and then obtain closed loop transfer function.  FIG 2	7
	c)	Obtain the closed loop transfer function for the signal flow graph shown in fig 3 by use of Mason's gain formula.  FIG 3	7

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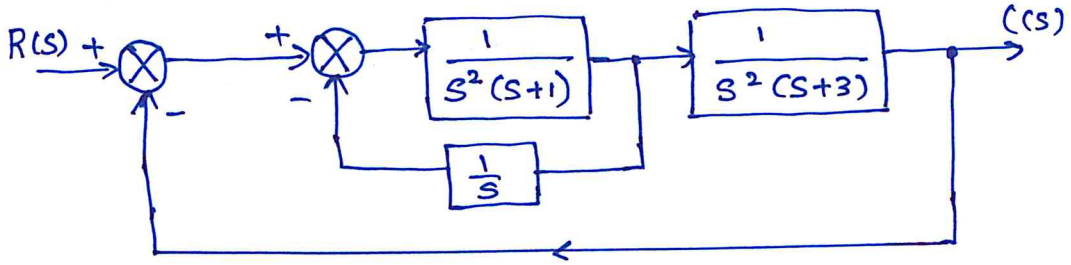
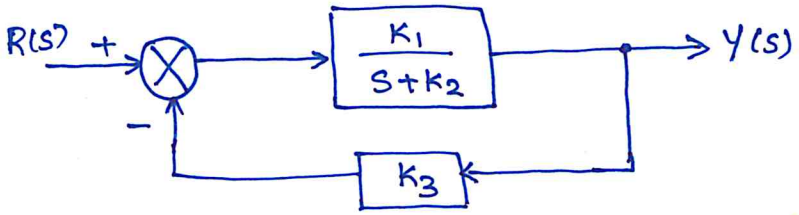
2.	a)	The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{k}{s(sT+1)}$ Where k and T are positive constants. By what factor should the amplifier gain k be reduced so that the peak overshoot of step response reduces from 75% to 25%.	7
	b)	Given the system shown in fig 4, find the following (i) The closed loop transfer function (ii) The system type (iii) The steady state error for an input 5u(t) (iv) The steady state error for an input 5tu(t) (v) Discuss whether the answers calculated in (iii) and (iv) are valid answers.  FIG 4	7
	c)	Find the sensitivities of the transfer function show in fig 5, to small changes in k1, k2 and k3 about the nominal values of k1=1,k2=2 and k3=3.  FIG 5	6
3.	a)	Determine the region of values for parameter k so that the system with the characteristic equation $s^4 + 7s^3 + 15s^2 + (25+k)s + 2k = 0$ is stable. Compute the critical frequency of oscillation ωc.	8
	b)	Perform a root locus analysis and draw the root locus, for the unity feedback control system with open loop transfer function. $kG(s)H(s) = \frac{4.62k}{S(S+8)(S+10)}$	10
	c)	A unity feedback control system has an open loop transfer function $G(s) = \frac{k}{S(S^2+7S+12)}$ Find the gain for which s= -1+j will lie on the root locus of this system.	2

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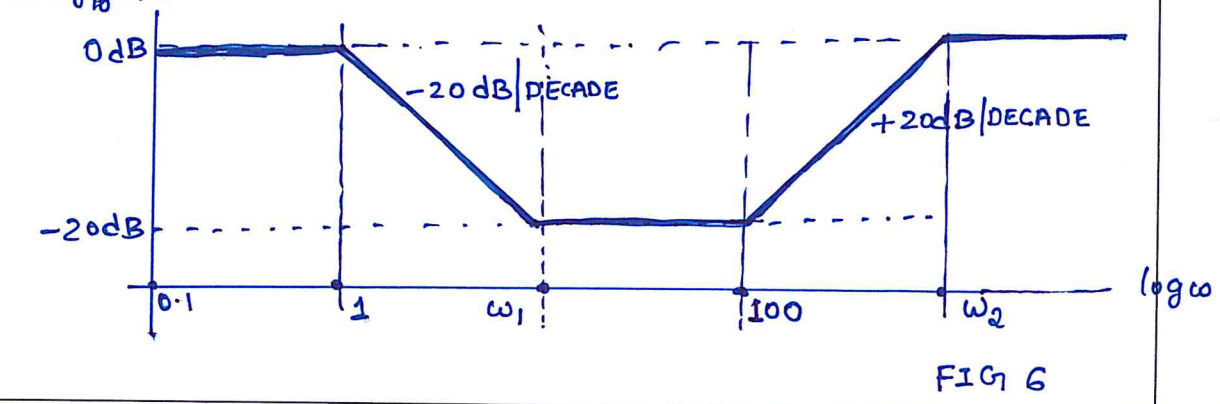
4.	a)	Draw the Bode plot for the system having $G(s)H(s) = \frac{5000(S+10)}{S(S+1)(S+500)}$ Analyze the stability of the system using Bode plot.	8
	b)	Bode plot of a system is shown in fig 6. Find the transfer function of the system.  FIG 6	4
	c)	Draw Nyquist plot for the open loop transfer function $L(s) = \frac{5}{S(S+1)}$ And discuss the stability of the closed loop system.	8
5.	a)	Obtain state model using SFG approach of system whose transfer function is $\frac{c(S)}{R(S)} = \frac{(3S+2)}{S^2+7S+5}$	5
	b)	From the following state space model, determine the transfer function of the system. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -12 & -8\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}[u]$ (&) $y = [8 \quad 1]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$	5
	c)	What is compensator? Explain the need of compensator. Obtain the transfer function of 1st order lag compensator electrical network and lead compensator electrical network. Draw its pole zero plot.	6
	d)	Show that the system represented by $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -a & -b & -c\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 1\end{bmatrix}[u]$ Is completely controllable.	4