SRN

PES University, Bangalore

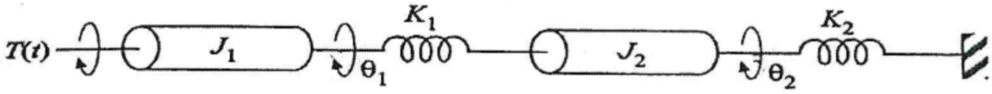
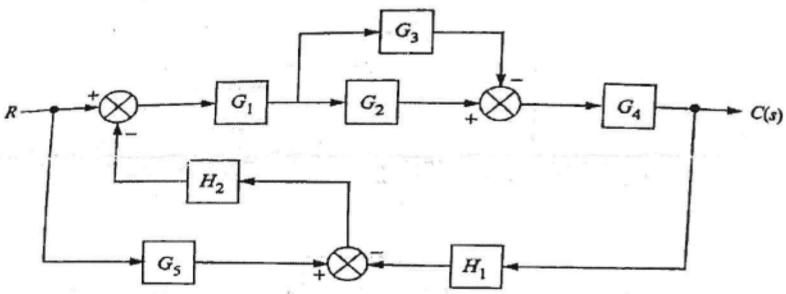
(Established under Karnataka Act No. 16 of 2013)

UE14EC403/UE18EC251

Dec 2021: END SEMESTER ASSESSMENT (ESA) B.TECH. 7th / 4th SEMESTER

UE14EC403/UE18EC251 - Control Systems

Time: 3Hrs	Answer All Questions	Max Marks: 100

1.	a)	Write the differential equation governing the mechanical rotational system shown in the below figure and determine the transfer function $\frac{\theta_1(s)}{T(s)}$ 	10
	b)	Using the block diagram reduction technique, find closed loop transfer function of the system shown in the below figure 	10
2.	a)	Consider a unity negative feedback system with open loop transfer function $G(s) = \frac{50}{s(s+5)}$, find the percentage overshoot and settling time for unit step input.	7
	b)	Find the steady state error for the input $r(t) = 2 + 4t + 12t^2, t \geq 0$ with open loop transfer function $G(s) = \frac{50}{s(s+5)}$ in the unity negative feedback configuration.	7
	c)	Define Sensitivity. Find the sensitivity S_G^T for the open loop transfer function $G(s) = \frac{100}{3s+1}$	6
3.	a)	A feedback control system has the charecteristic equation $q(s) = s^6 + 2s^5 + 9s^4 + 16s^3 + 24s^2 + 32s + 16 = 0$. Find the number of roots in right-half, left–half s-plane and imaginary axis using RH criteria.	10
	b)	Consider the open loop control system $G(s) = \frac{K}{s(s+1)(s+2)}$. Sketch the root locus of the closed loop system.	10

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4.	a)	The unit step response of a second order underdamped system has peak overshoot $M_p = 0.1$ and peak time $t_p = 2$ sec. Find the frequency domain specifications Resonant peak, resonant frequency and Bandwidth.	10
	b)	Draw the polar plot for $G(s) = \frac{100}{s^2+10s+100}$. Show its importance in stability analysis of closed loop systems using Nyquist criteria.	10
5.	a)	Define state of a system and find whether the given system is controllable and observable. The system matrix, input matrix and output matrix as given below. $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = [1\ 0\ 0]$	10
	b)	Consider the system with open loop transfer function $G(s) = \frac{10}{s(s+1)}$, design a lead compensator $G_c(s)$ such that the closed loop system will satisfy the requirements that the static velocity error is 20/sec, phase margin = 50 degree, and gain margin $\geq 10\ dB$. Take safety margin of 5^0.	10