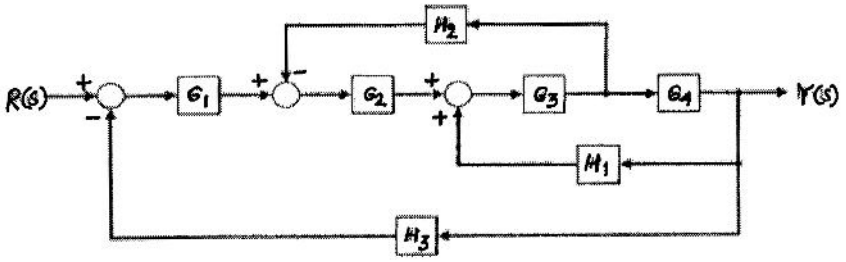
B.E. ELECTRICAL ENGG. (PART TIME) 3RD YEAR 1ST SEMESTER EXAM 2018

SUBJECT: -LINEAR CONTROL SYSTEM

Time: Three hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PARTI	Marks
	Answer any three. ***Two marks reserved for neatness and well organized answers.***	
1.(a)	Explain conditional stability and asymptotic stability.	6
(b)	Using block diagram reduction technique, find the closed loop transfer function for the block diagram shown below. 	10
2. (a)	What are the difficulties faced while solving by Routh Stability criterion?	6
(b)	For a system with F(s)= $s^4 + 22s^3 + 10s^2 + s + k = 0$ Obtain the marginal value of k, and the frequency of oscillations for that value of k.	10
3.	Draw the Root Locus of the unity feedback system whose open loop transfer function is $$G(s) = \frac{s}{(s+2)(s^2+4)}$$ Determine the following: (i)Number of root loci, number of asymptotes, angle of asymptotes. (ii) Calculate centroid. (iii)Breakaway points, if any. (iv) Imaginary axis intercepts. (v)Angle of departure.	16

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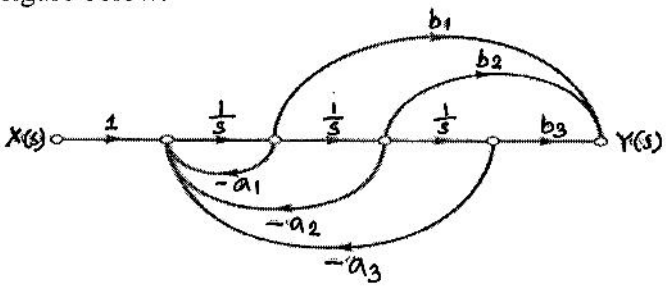
4.	Construct the BODE plot for a system having the open loop TF as $$G(s)H(s) = \frac{k(s+20)}{(s+1)(s+2)(s+10)}$$ Assume k=10. Determine GM, PM, ω_{gc}, ω_{pc}. Comment on stability.	16
5. (a)	Determine the overall gain of the system using SFG shown in figure below. 	10
(b)	Define stable, unstable and marginally stable system using BODE Plot.	6

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PART - II

Answer Question No. 1 and any two from the rest.

1. i) The transfer function of a linear time invariant system is given as **5x4=20**

$$\frac{1}{s^2 + 3s + 2}$$

What will be the approximate value of the output of the system for a unit impulse input applied at time instant t = 50 s.

ii) For a system with the transfer function

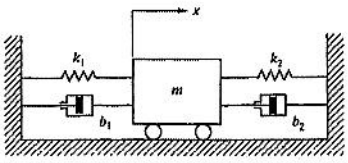
$$\frac{3(s-2)}{4s^2 - 2s + 1}$$

Find out the matrices A and B in the state space form.

iii) An integrator is connected in cascade with a system having a transfer function of G(s) = 1/(3s + 5). Determine error constants, K_p, K_v, K_a for the whole system.

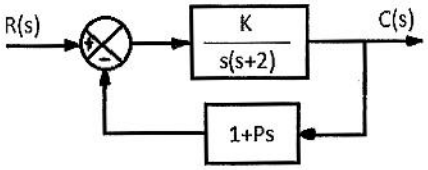
iv) A second order system has poles at -2 and -2. What is the value of the damping ratio? What will be the values of rise time and maximum peak overshoot in %.

2. i) Derive the mathematical model of the following system **9+6=15**



ii) Write the electrical analogous of the above mechanical system

3. i) The block diagram of a closed loop control system is given in the figure. Find the values of K and P such that the system has a damping ratio of 0.7 and an un-damped natural frequency of 0.5 rad/s. **9 +6**



Find out the rise time, peak time, settling time of the above system

4. i) Find the solution of the following state equation **12+3**

$$\dot{x} = Ax + Bu,$$

for $X_0 = [0 \quad 1]$ and $u = 0$ and $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$

What are the properties of state transition matrix?

5. Write short notes on (any two).

i) Controllability and Observability of a system

ii) Potentiometers used as control system components **2x7.5**

iii) PID controllers