Ref No. : Ex/ EE/5/T/314/2017(S)

Bachelor of Electrical Engineering (Evening), 3rd Year 1st Semester Supplementary Examination, 2017

LINEAR CONTROL SYSTEM

Time: Three Hours | Full Marks: 100 (50 each part)

Use a separate Answer-Script for each part

PART - I

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

1. i) The impulse response of a system is $e^{-3t} - e^{-5t}$. What will be the rise time and steady-state error of the system subjected to a step input? **4x5=20**

   ii) A system has an open loop transfer function of
   $$G(s) = Y(s) / U(s) = 18(2s^2+5s+10)/(3s^3 + 5s^2 + 5s +15).$$
   Determine the state-space model of the system

   iii) A type-one system has a transfer function of $G(s) = 1/(5s^2 + 3s)$. Determine error constants, K_p, K_v, K_a of the system.

   iv) Show that by using an analog circuit having Op-Amp, a system $G(s) = 10/(s+2)$ can be realized.

2. i) Derive the mathematical Model of a position control DC Servo system. **12+3=15**

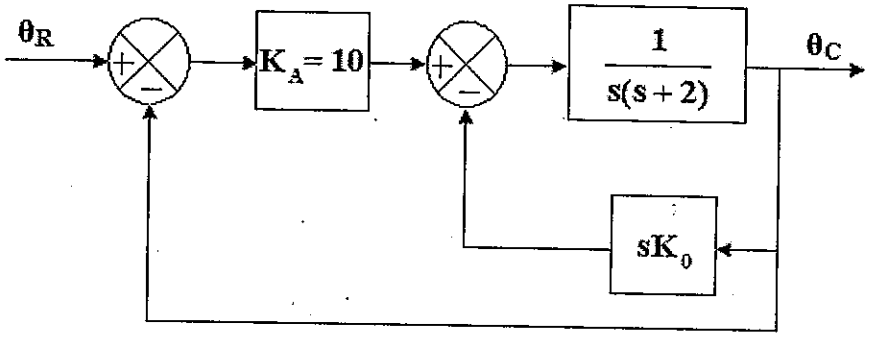
   ii) Show how it can be reduced to 2nd order type one system.

3. i) The frequency response of a system is $\mathbf{G(f) = \frac{2}{1 + j20\pi f}}$ **5+10=15**

   Determine the step response of the system.

PART - I

ii) A feedback system employing output rate damping is shown in the figure. In the absence of the derivative feedback, i.e., $K_o = 0$, determine the damping ratio and natural frequency of the system. What is the steady state error resulting from unit ramp input?



Determine the derivative feedback constant, K_o, which will increase the damping ratio of the system to 0.7. What is the steady state error resulting from unit ramp input for this new setting of derivative feedback constant.

4. i) The System Matrix, A of an L.T.I system is 8+7 =15

$$\begin{bmatrix} 1 & 0 \\ 1 & -1 \end{bmatrix}$$

Determine the state-transition matrix

ii) Check whether the above system is completely controllable and completely observable if the input matrix, B and output matrix are as follows

$B = [2 \quad 1]^T$, $C = [1 \quad 2]$

5. Write short notes on (any two). 15

i) Solution of homogeneous State-equation

ii) Potentiometers

iii) Synchros

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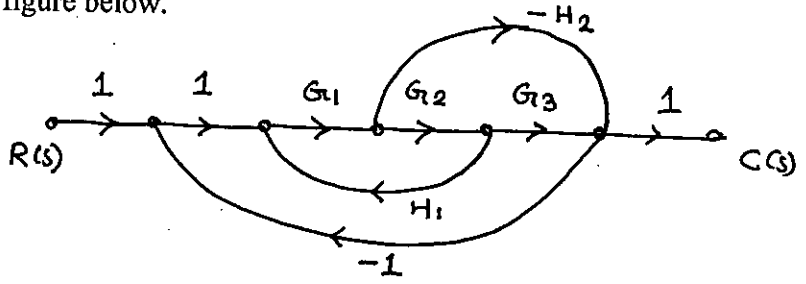
B. ELECTRICAL ENGG. (EVENING) 3RD YEAR 1ST SEMESTER SUPPLE EXAM, 2017
(Supplementary)

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	PART II	Marks
	Answer any three. ***Two marks reserved for neatness and well organized answers.***	
1.(a)	Explain Masson's gain formula.	6
(b)	Determine the overall gain of the system using SFG shown in figure below. 	10
2. (a)	Define stability.	6
(b)	For the following characteristic equation, determine the range of K for stability. Determine the value of K so that the system is marginally stable and find the frequency of sustained oscillations. $s^4 + Ks^3 + 5s^2 + 10s + 10k = 0$	10
3.	A unity feedback control system has an open loop transfer function $G(s) = \frac{K}{s(s^2 + 4s + 8)}$ Sketch the Root Locus of the system on a graph paper by determining the following: (i)Number of root loci, number of asymptotes, angle of asymptotes. (ii) Angle of departure of root locus from the poles. (iii)Breakaway points, if any. (iv) Imaginary axis intercepts.	16

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Full Marks 100
(50 marks for each part)

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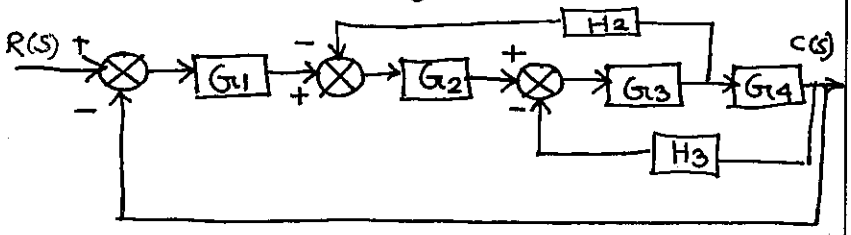
No. of Questions	PART II	Marks
4.	Construct the BODE plot for a system having the open loop TF as $$G(s)H(s) = \frac{100(s+15)}{s(s+7)(s+22)}$$ Determine GM, PM, ω_{gc}, ω_{pc}. Comment on stability.	16
5.(a)	Using block diagram reduction technique, find the closed loop transfer function for the block diagram shown below. 	10
(b)	Check the stability of the system represented by $6s^7+9s^6+8s^5+12s^4+20s^3+87s^2+91s+90=0$	6