B.E. ELECTRICAL ENGINEERING (PART TIME), 3RD YEAR 1ST SEMESTER EXAMINATION, 2018(OLD)

CONTROL SYSTEM ENGINEERING

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 $1 - e^{-5t}$. What will be the rise time and steady-state error of the system subjected to a step input? **5x4=20**

ii) For a system with the transfer function

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

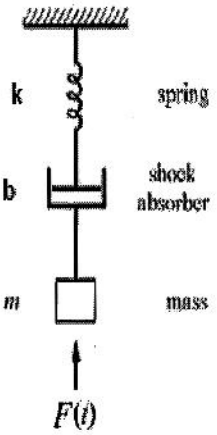
Find out the matrices A and B in the state space form.

iii) 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) 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 %.

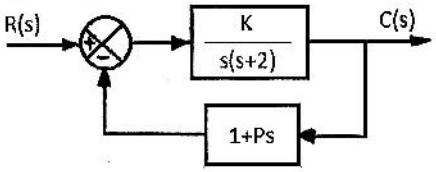
2. i) Derive the mathematical model of a position control DC servo system. **9+6=15**

ii) Write the electrical analogous of the following mechanical system.



PART - I

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) The System Matrix, A of an L.T.I system is **8+7**

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

ii) Determine the state-transition matrix

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

$B = [1 \quad 0]^T$, $C = [10 \quad 1]$

5. Write short notes on (any two). **2x7.5**

i) Solution of homogeneous State-equation

ii) Potentiometers

iii) Synchros

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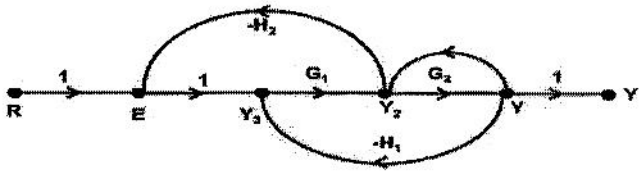
No. of Questions	PARTII	Marks
	Answer any three. ***Two marks reserved for neatness and well organized answers.***	
1.(a)	Explain Masson's gain formula.	6
(b)	Determine the overall gain of the system using SFG shown in figure below.  	10
2. (a)	Define stable, unstable and marginally stable system.	6
(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 $G(s) = \frac{K(s+1)}{(s-1)(s+2)(s+4)}$ Sketch the Root Locus of the system on a graph paper. Find the range of K for stability.	16
4.	A system having the open loop TF as $G(s)H(s) = \frac{K(s+20)}{(s+1)(s+2)(s+10)}$ Construct the BODE plot for K=10. Determine GM, PM, ω_{gc}, ω_{pc}. Comment on stability.	16

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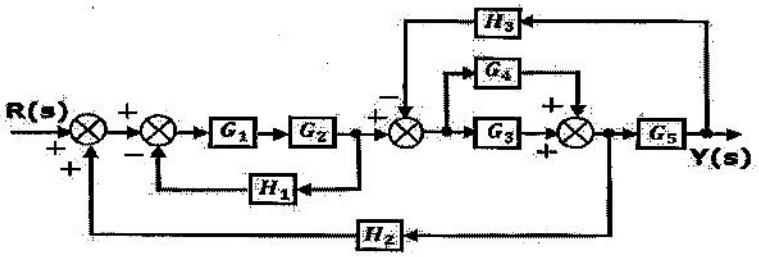
No. of Questions	PARTII	Marks
5.(a)	Using block diagram reduction technique, find the closed loop transfer function for the block diagram shown below. 	10
(b)	Use Routh's Criterion to determine the number of roots of the following equation which lie in the right half of s-plane. $s^6 + s^5 + 2s^4 + s^3 + 2s^2 + 5s + 6 = 0$	6