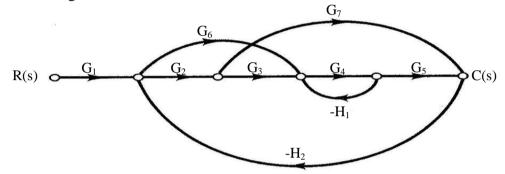
## **GUJARAT TECHNOLOGICAL UNIVERSITY** BE - SEMESTER-VI • EXAMINATION – SUMMER • 2014

Subject Code: 160304 Subject Name: Bio Medical Control Theory Time: 10:30 am - 01:00 pm Date: 28-05-2014

**Total Marks: 70** 

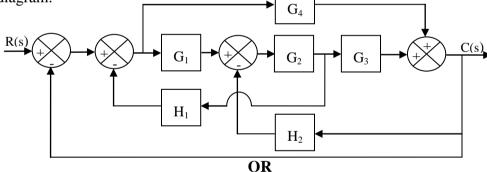
- Instructions:
  - 1. Attempt all questions.
  - 2. Make suitable assumptions wherever necessary.
  - 3. Figures to the right indicate full marks.
- Q.1 (a) Give difference between close loop & open loop control system with example. 07
  - (b) Obtain the closed-loop transfer function C(s)/R(s) of below given system by use 07 of Mason's gain formula.



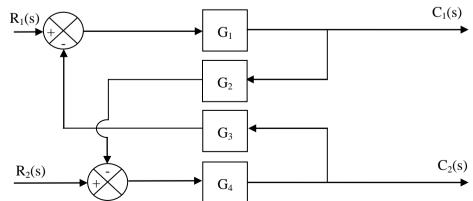
Q.2 (a) Obtain a state-space equation and output equation for the system defined by 07

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

(b) Determine the transfer function of the system represented by following block 07 diagram.



(b) Figure shows a system with two inputs and two outputs. Derive  $C_1(s)/R_1(s)$ , 07  $C_1(s)/R_2(s)$ ,  $C2(s)/R_1(s)$  &  $C_2(s)/R_2(s)$ .

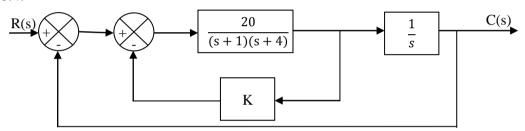


(Hint: In deriving outputs for  $R_1(s)$ , assume that  $R_2(s)$  is zero, and vice versa.)

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Q.3	<b>(a)</b>	Define below given terminologies with proper equations.				10
		i.	Rise Time(t <sub>r</sub> )	iv.	Settling Time (t <sub>s</sub> )	
		ii.	Peak Time(t <sub>p</sub> )	v.	Steady-state Error $(e_{ss})$	
		iii.	Peak Overshoot (M <sub>p</sub> )			
	<b>(b)</b>	Write	Write Mason's Gain formula & explain it with an appropriate example.			
		OR				
Q.3	<b>(a)</b>	Define below given terminologies for signal flow graph.				10
		i.	Node	vi.	Forward Path	
		ii.	Branch	vii.	Loop	
		iii.	Input Node	viii.	Non-touching Loop	
		iv.	Output Node(or sink)	ix.	Forward path gain	
		v.	Path	х.	Loop Gain	
	<b>(b)</b>	Draw the response for Under damped, Critically damped & Over damped 04				04

Q.4 (a) Consider the system shown in Figure. Draw a root-locus diagram. Then determine 10 the value of k such that the damping ratio of the dominant closed-loop poles is 0.4.



(b) Explain Series compensation, Parallel compensation, Feedback compensation & 04
Load compensation techniques with proper example.

OR

Q.4 (a) A control system has the open loop transfer function as given below.

$$G(s).H(s) = \frac{k(s+a)}{s^2(s+b)}$$
 with b>a

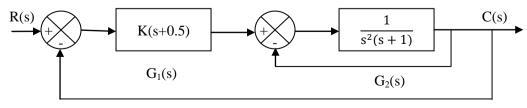
systems.

Plot its root-loci as k varies from zero to  $\infty$  with a = 2 & b = 10. Also calculate the value of k for the largest damping ratio of the Oscillatory mode.

(b) Determine the position, velocity & acceleration error constants for the feedback 04 control system with unity feedback whose open loop transfer function are

a) 
$$G(s) = \frac{1}{s (0.5s+1)(0.2s+1)}$$
  
b)  $G(s) = \frac{1}{s (0.1s+1)}$ 

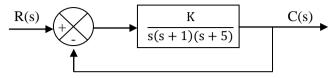
Q.5 (a) Consider the control system shown in Figure. Using the inverse polar plot, 07 determine the range of gain K for stability.



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(b) Discuss Routh's stability criteria for below given characteristic equation.  $S^{6} + 2S^{5} + 8S^{4} + 12S^{3} + 20S^{2} + 16S + 16 = 0$ 

Q.5 (a) Obtain the phase and gain margins of the system shown in figure for the two 07 cases, where K = 10 and K = 100 with the help of bode plot. Also discuss about the stability of same system with both gain.



(b) i. The characteristic equation for a feed back control system is given by  $\mathbf{07}$  $\mathbf{S}^3 + 20k.\mathbf{S}^2 + 5\mathbf{S}^2 + 10\mathbf{S} + 15 = 0.$ 

Determine the range of k for which the system is stable.

ii. For the unity feedback system having open loop transfer function

$$G(s) = \frac{k(s+2)}{s(s^3 + 7s^2 + 12s)}$$

Determine the system "TYPE" and error constant  $K_p$ ,  $K_v$ ,  $K_a$ .

\*\*\*\*\*

07