Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER • 2014

Subject Code: 160304 **Date: 28-05-2014**

Subject Name: Bio Medical Control Theory

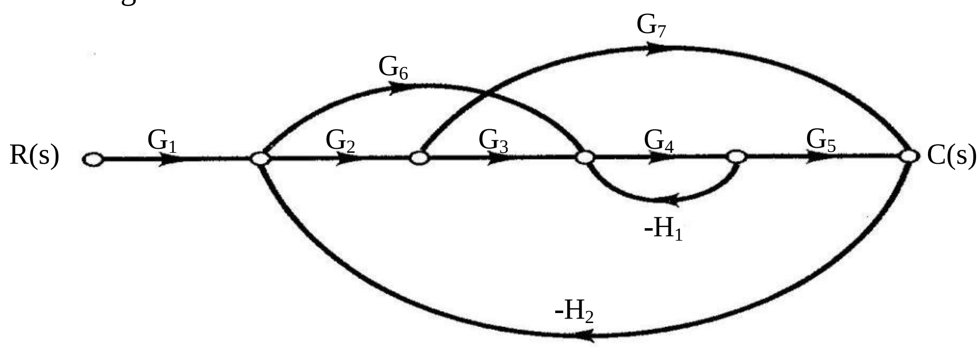
Time: 10:30 am - 01:00 pm **Total Marks: 70**

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**

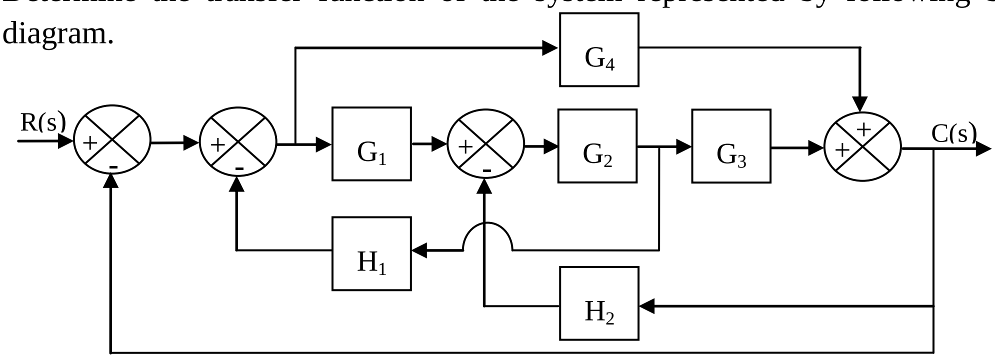
(b) Obtain the closed-loop transfer function C(s)/R(s) of below given system by use of Mason's gain formula. **07**



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

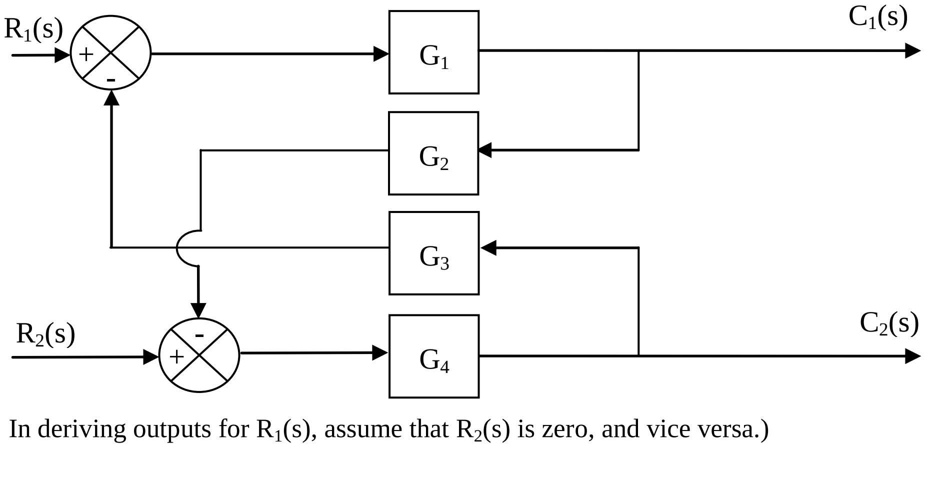
$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

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



OR

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



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

Q.3 **(a)** Define below given terminologies with proper equations. **10**

i. Rise Time(t_r)
ii. Peak Time(t_p)
iii. Peak Overshoot (M_p)
iv. Settling Time (t_s)
v. Steady-state Error (e_{ss})

(b) Write Mason's Gain formula & explain it with an appropriate example. **04**

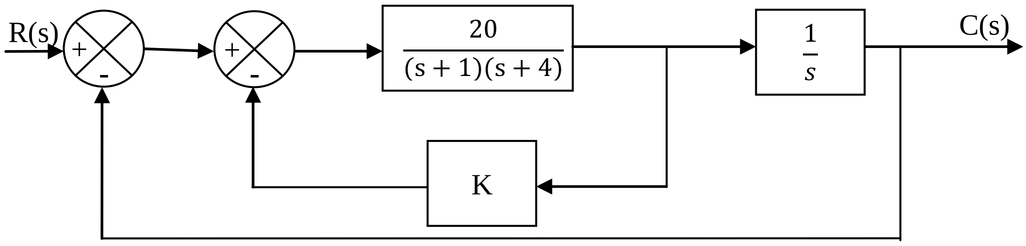
OR

Q.3 **(a)** Define below given terminologies for signal flow graph. **10**

i. Node
ii. Branch
iii. Input Node
iv. Output Node(or sink)
v. Path
vi. Forward Path
vii. Loop
viii. Non-touching Loop
ix. Forward path gain
x. Loop Gain

(b) Draw the response for Under damped, Critically damped & Over damped systems. **04**

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



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

OR

Q.4 **(a)** A control system has the open loop transfer function as given below. **10**

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

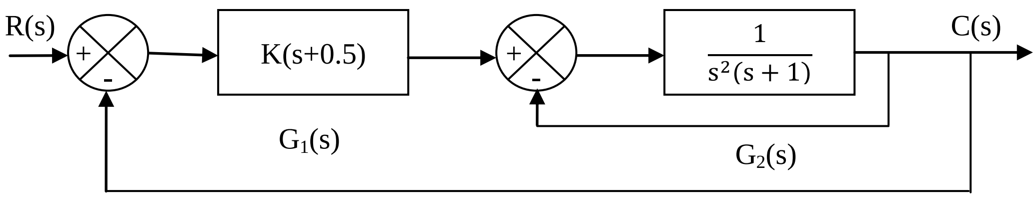
Plot its root-loci as k varies from zero to ∞ with a = 2 & b = 10. Also calculate the value of k for the largest damping ratio of the Oscillatory mode.

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

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

b) G(s) = $\frac{1}{s\,(0.1s+1)}$

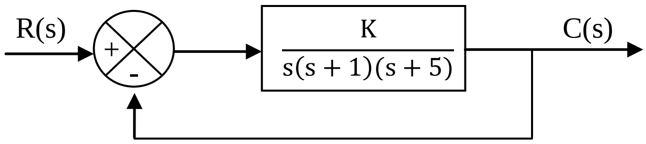
Q.5 **(a)** Consider the control system shown in Figure. Using the inverse polar plot, determine the range of gain K for stability. **07**



(b) Discuss Routh's stability criteria for below given characteristic equation. **07**
$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$

OR

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



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

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