

SARDAR PATEL UNIVERSITY

EXAMINATION – 2012, SEMESTER - I
 PS01CINS03 - PRINCIPLES OF CONTROL SYSTEMS
 Wednesday, 5 – 12 – 2012, Time: 10:30 am to 1: 30 pm

Total Marks: 70

Note: Figures to the right indicate maximum marks.

Q1. Multiple Choice Questions-

- (a) A system is said to be when its response to input as well as behavior to external disturbance is unpredictable. [1]
 (i) Linear (ii) Nonlinear (iii) Deterministic (iv) Stochastic
- (b) For block diagram reduction purpose, blocks which are connected in Series get algebraically. [1]
 (i) subtracted (ii) added (iii) multiplied (iv) divided
- (c) A node having incoming and outgoing branches in signal flow graph is called as [1]
 (i) feedback loop (ii) chain node (iii) path gain (iv) self loop
- (d) Laplace transform of function $\cos \omega t$ is [1]
 (i) $\omega / (s^2 + \omega^2)$ (ii) $1 / (s + a)$ (iii) $1 / (s - a)$ (iv) $s / (s^2 + \omega^2)$
- (e) In time response analysis, real part of complex roots controls the amplitude while imaginary part controls the frequency of damped oscillation where condition satisfied is (ξ is damping ratio) [1]
 (i) $\xi = 0$ (ii) $\xi > 1$ (iii) $\xi = 1$ (iv) $0 < \xi < 1$
- (f) A linear time invariant system is said to be if for bounded input its output oscillates with constant frequency and amplitude. [1]
 (i) unstable (ii) critically stable (iii) conditionally stable (iv) absolutely stable
- (g) The locus of closed loop poles obtained when the system gain 'K' is varied from 0 to ∞ is called as [1]
 (i) Direct Root Locus (ii) Nyquist plot (iii) Bode plot (iv) Inverse Root Locus
- (h) The plot obtain by joining the points which are tips of vector $M\angle\phi$ for various values of ω , starting from 0 to ∞ is known as: [1]
 (i) Root locus plot (ii) Ruth Hurwitz plot (iii) Nyquist plot (iv) Polar plot

Q2. Short answer type questions — attempt any 7

- (a) Write equations for sensitivity of closed loop and open loop control system [2]
- (b) Sketch block diagram of an air-conditioning system of a car where the driver sets the desired interior temperature on a dash board panel. List advantages of closed loop. [2]
- (c) Determine the transfer function, if impulse response is $e^{-2t}\sin 3t$. [2]
- (d) A system has poles at $s = -8$, $s = -3$ and zero at $s = -2$, represent it on s-plane and write transfer function for it. [2]
- (e) Draw the signal flow graph for the given system equations: [2]
 $Y_2 = G_1 Y_1 + G_3 Y_3$, $Y_3 = G_4 Y_1 + G_2 Y_2 + G_5 Y_3$, $Y_4 = G_6 Y_2 + G_7 Y_3$

(P.T.O.)

(f) Determine stability of given characteristic equation by Hurwitz method, $s^3 + s^2 + s + 4 = 0$ [2]

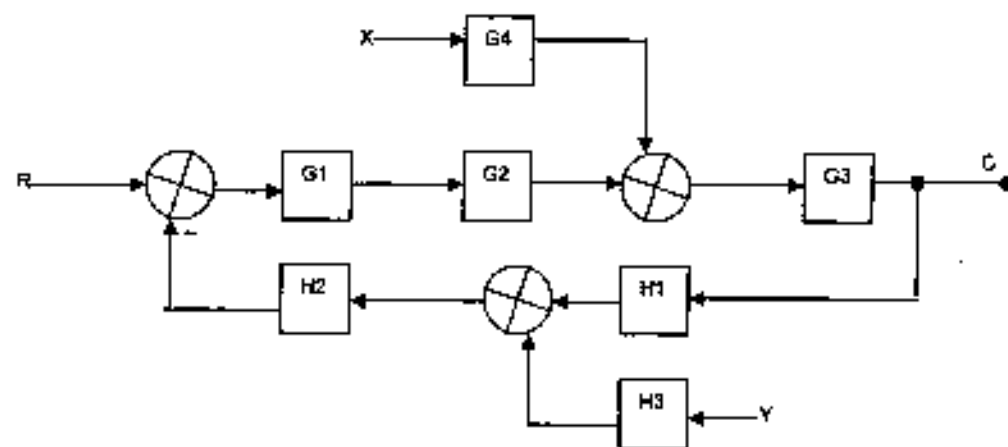
(g) Find the natural frequency and damping ratio for the system with transfer function. [2]

$$G(s) = \frac{36}{s^2 + 4.2s + 36}$$

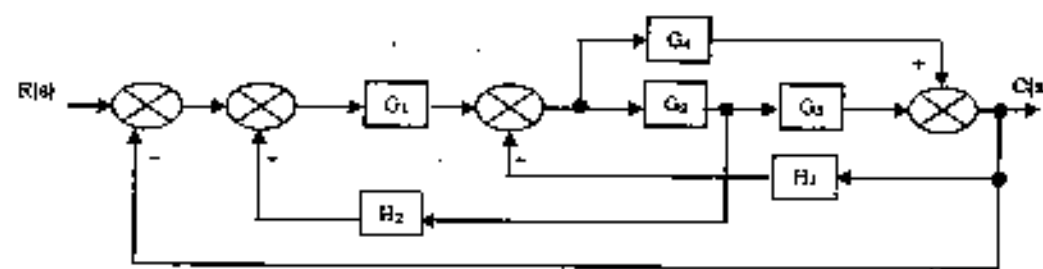
(h) Write the conditions to determine number of branches, from poles and zeros in Root Locus method. [2]

(i) List different methods through which frequency response is generally plotted? [2]

Q3. (a) Use block diagram reduction technique and hence obtain the transfer function: C / R , C / X , C / Y and find total C of system. [6]



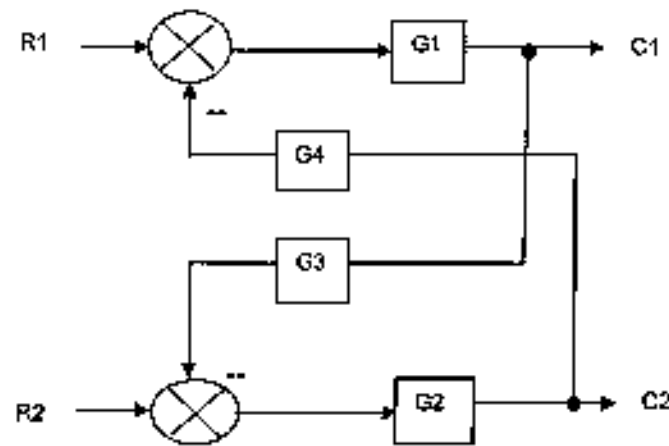
(b) Reduce the given block diagram to its canonical form and hence obtain the equivalent transfer-function. [6]



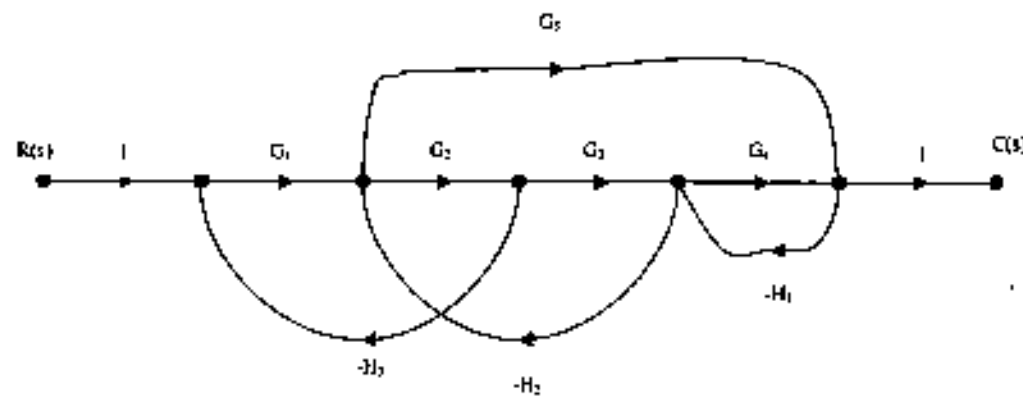
OR

(p50)

- (b) Obtain the expression for C1 and C2 for the given multiple input multiple output system. [6]



- Q4. (a) Find the overall transfer function by using Mason's gain formula for signal flow graph. [6]



- (b) Explain how potentiometers can be used in DC and AC motor control systems. [6]

OR

- Q4. (b) Obtain the solution of given differential equation: where $y(0+) = 0$ & $y'(0+) = 6$ [6]

$$\frac{d^2 y}{dt^2} + 5 \frac{dy}{dt} + 6y = 12e^t$$

- Q5. (a) Examine the stability by Routh's criterion for $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. [6]

- (b) Sketch Time response graph neatly and define each term of Transient response specifications. Find Delay time (T_d), and Settling time (T_s) for given transfer function. [6]

$$G(s) = \frac{100}{s^2 + 15s + 100}$$

OR

- (b) Discuss different types of Stability of a system. [6]

- Q8. (a) Write the General steps to solve the problem on Root Locus. [6]

- (b) Sketch the rough nature of Root locus for a unity feedback system having $G(s) = K / s(s + 4)(s + 2)$. [6]

OR

- (b) Define the terms Gain margin and Phase margin and explain Polar plot and M - ϕ plot. [6]
