(68) No. of Printed Pages: 03

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 = -6, 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]
$Y_2 = G_1Y_1 + G_3Y_3$, $Y_3 = G_4Y_1 + G_2Y_2 + G_5Y_3$, $Y_4 = G_6Y_2 + G_7Y_3$

(PTO)

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

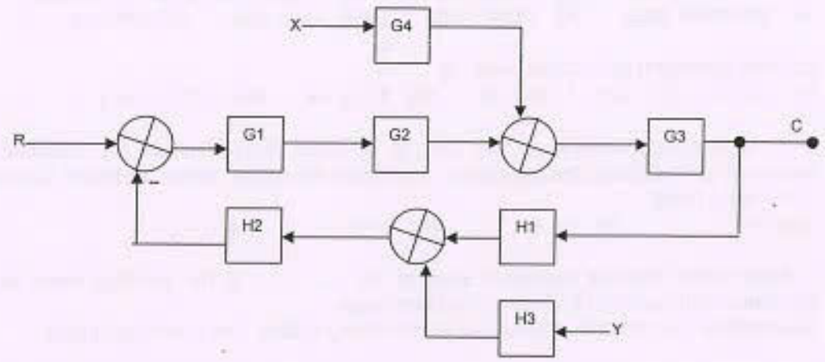
(g) Find the natural frequency and damping ratio for the system with transfer function. [2]

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

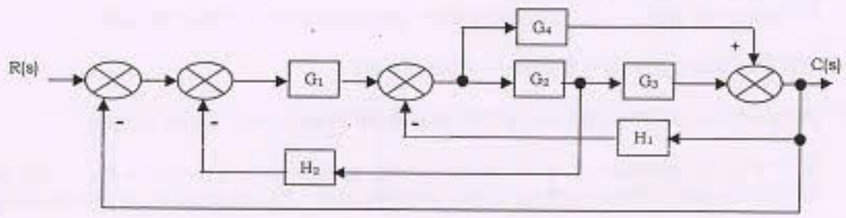
(h) Write the conditions to determine number of branches, from poles and zeros in Root Locus method. [2]

(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]



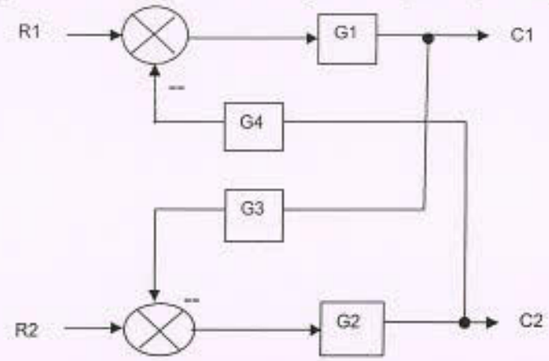
(b) Reduce the given block diagram to its canonical form and hence obtain the equivalent transfer function. [6]



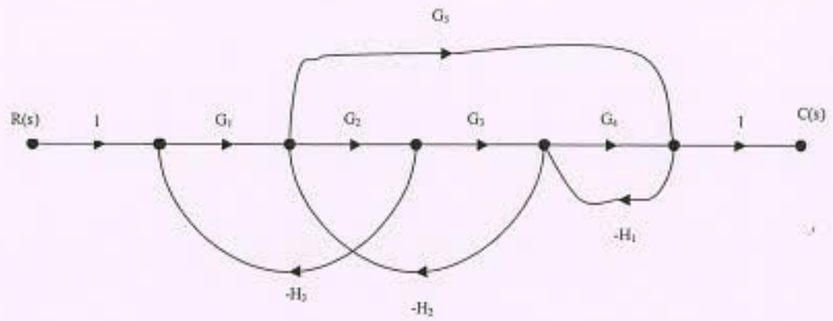
OR

(PTO)

(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

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

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

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]

Q6. (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]

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