CVM UNIVERSITY

M.Sc. (INSTRUMENTATION & CONTROL) Semester-I Examination-2021

Friday, 26th February – 2021

2:00 PM to 4:00 PM

101390103: PRINCIPLES OF CONTROL SYSTEMS

Total Marks: 60

Note: (1) Attempt all questions.
(2) Figures to the right indicate marks.

Q1. Answer the following multiple choice questions. **(08)**

(a)

(1) Which control system senses environmental changes as well as internal disturbances?
(a) time variant (b) time invariant (c) open loop (d) closed loop

(2) The graphical representation of the variables of set of linear algebraic equations representing the system is called as:
(a) block diagram (b) signal flow graph (c) transfer function (d) all

(3) When the system has two complex conjugate poles, it is :
(a) over damped (b) un damped (c) critically damped (d) under damped

(4) Velocity error coefficient is associated with ……input.
(a) step (b) ramp (c) parabolic (d) impulse

(5) The graphical method in which movement of poles in the s - plane is sketched when Gain is varied from "0 to ∞" is
(a) Bode plot (b) Nyquist plot (c) Polar plot (d) Root Locus

(6) The ..... of linear system can be determined from the locations of closed loop poles in s- plane.
(a) gain (b) root locus (c) stability (d) frequency

(7) The frequency at which the magnitude of the closed loop response is 3dB down from its zero frequency value.
(a) Bandwidth (b) resonant peak (c) cut off frequency (d) gain margin

(8) Which servomotor has less stability problems?
(a) ac (b) dc (c) bc (d) ec

(b) Answer the following (Fill in the blanks and True or False) **(08)**

(1) A system in which output is dependent on input but controlling action is totally independent of the output is known as …….. control system.

(2) The ……is defined as the time taken for the step response to go from 10% to 90% of the final value.

(3) If for a system, the poles are present in the imaginary axis and are non-repetitive in nature, then it is said to be a.....

(4) If 's' is replaced by 'j ω' to convert it to frequency domain, the method is…....

(5) Sensitivity for open loop system is infinity. (True / False)

(6) If the parabolic input with type 2 is used, the steady state error will be 0. (True / False)

(7) If the damping ratio = 0, the system is undamped. (True / False)

(8) 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 Polar Plot. (True / False)

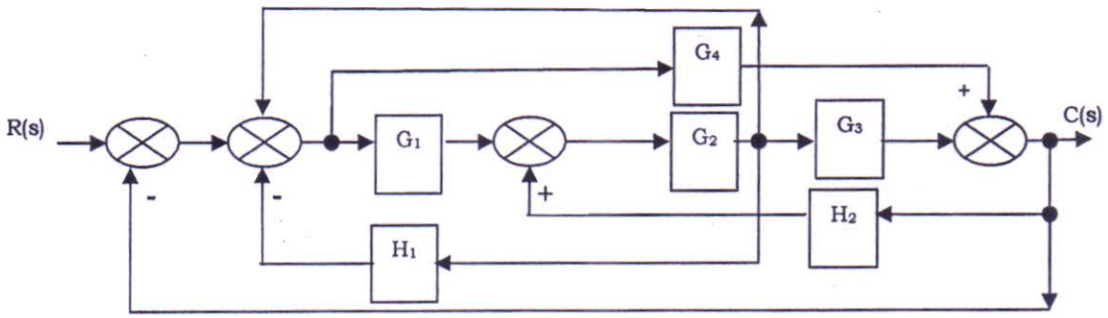
Q2. Attempt any Six of the following. **(12)**

(1) Define Control system and list different types of it.
(2) Draw the signal flow graph for the given system equations:
$Y_2 = G_1Y_1 + G_3Y_3$, $Y_3 = G_4Y_1 + G_2Y_2 + G_5Y_3$, $Y_4 = G_6Y_2 + G_7Y_3$
(3) Draw the equivalent mechanical system for the set of equations given as:
Node1: $F = K_1 (X_1 - X_2)$
Node 2: $0 = K_1 (X_2 - X_1) + M_2 s^2 X_2 + K_2 X_2 + B_2 s X_2$
(4) Determine the transfer function, if impulse response is $e^{-2t}\sin 3t$.
(5) Find the natural frequency and damping ratio for the system with transfer function

$$G(s)H(s) = \frac{36}{s^2 + 4.8s + 36}$$

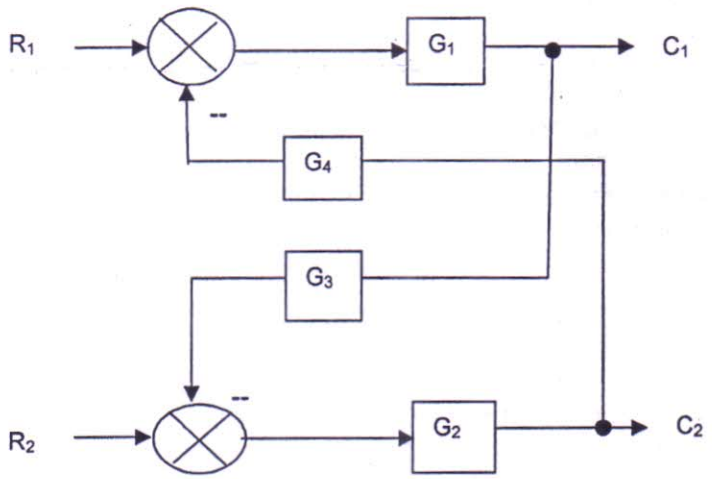
(6) Using Routh's array determine the stability of a system: $s^3 + 6s^2 + 11s + 6 = 0$
(7) What are the requirements of good Servo motor?
(8) What are the limitations of Lead Compensation?

Q3. Convert the block diagram to Signal flow graph and using Mason's gain formula obtain transfer function C(s) / R(s) of the system shown below. **(08)**



OR

Q3. List block diagram reduction rules. Obtain the expression for C_1 and C_2 for the given multiple input multiple output system. **(08)**



Q4. Find K_p, K_v, K_a and steady state error for a system with open loop transfer function: **(08)**

$$G(s)H(s) = \frac{10(s+2)(s+3)}{s(s+1)(s+4)(s+5)},$$ Where input is $r(t) = 3 + t + t^2$

OR

Q4. (i) Obtain the solution of given differential equation: $\frac{d^2y}{dt^2}+5\frac{dy}{dt}+6y=12e^t$ **(05)**

where y(0+) = 0 & y'(0+) = 6

Q4. (ii) A torque, T N.m is applied to a shaft having a moment of intertia J . Kg. m^2 and coefficeint of viscous ffriction of f N.m / (rad / sec) produces an angular shift of θ rad. Obtain a transfer function relating θ and T. **(03)**

Q5. Examine the stability by Routh's criterion for **(08)**

$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Show roots on s plane.

OR

Q5. Sketch the rough nature of Root locus for a unity feedback system following appropriate steps: **(08)**

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

Q6. Derive an equation for transfer function of an armature controlled DC motor. Draw the block diagram. **(08)**

OR

Q6. Draw the Bode plot for a unity feedback control system having function: **(08)**

$$G(s)=\frac{80}{s(s+2)(s+20)}$$

Write advantages of Bode plot.

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