Total No. of printed pages = 9

END SEMESTER EXAMINATION – 2021

Semester : 5th

Subject Code : CAI-501

CONTROL SYSTEMS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Instructions :

(i) *All* questions of PART–A are compulsory.

(ii) Answer any *five* questions from PART–B.

PART – A

Marks – 25

1. Fill in the blanks : 1×12=12

   (a) The Equivalent analogy of Mass in electrical voltage system is _____.

   (b) The first Time Constant of a system is also denoted as _____ percentage of the full scale Output.

[Turn over

(c) The steady state error value of LAG for a Ramp input signal to a First order system is _____.

(d) Two loops are said to be non-touching only if no common _____ exists between them.

(e) In signal flow graph, the product of all _____ gains while going through a forward path is known as 'Path gain'.

(f) The steady state error for a unit step input for a Type 0 system is _____.

(g) The type 2 system has _____ at the origin.

(h) In Routh Hurwitz criteria the closed loop transfer function is unstable if there is a _____ change in first column of the RH Table.

(i) The number of root loci approaching infinity zeroes is determined by the _____.

(j) The impulse response of $G(s) = (s)/(s+1)$ is _____.

(k) A system with no open pole at the origin of the s plane is a _____ system.

(l) _____ feedback systems are used in Control systems.

2. **Multiple Choice Questions :** 1×13=13

(a) The Laplace transform of e^{-2t} sin 2t is

(i) $4/(s+2)^2 + 4$

(ii) $4/s^2 + 4$

(iii) $2/s^2 + 4s + 8$

(iv) $2/s^2 + 4$

(b) A system having transfer function G(s)= 1/2(s+0.5) is subjected to a Unit Step Input.

The Steady State value of the output is

(i) 1 (ii) 2

(iii) $\frac{1}{2}$ (iv) 1/10

(c) The Transfer function is defined as

(i) The ratio of Input to Output

(ii) The ratio of Output to Input

(iii) The ratio of Laplace Transform of Input to Laplace transform of Output

(iv) The ratio of Laplace transform of Output to Laplace Transform of Input.

(d) The Error detector Element in a Control system gives

(i) The sum of reference signal and feedback signal

(ii) The sum of reference signal and error signal

(iii) The difference of reference signal and feedback signal

(iv) The difference of reference signal and output signal

(e) The Velocity error coefficient as s -> 0, is given by

(i) Lim G(s)H(s) (ii) Lim s G(s)H(s)

(iii) Lim 1/G(s)H(s) (iv) Lim s/G(s)H(s)

(f) The location of the closed loop conjugate pair of pole on jw axis indicates that the system is

(i) Stable

(ii) Unstable

(iii) Marginally Stable

(iv) Critically Stable

(g) The zeroes of Characteristics Equation are same as

(i) Closed loop zeroes

(ii) Closed loop poles

(iii) Open Loop zeroes

(iv) Open Loop poles

(h) The number of sign changes in Routh Hurwitz Table in the first column element denotes

(i) The number of Poles in Left hand side of s–plane

(ii) The number of Zeroes on the Imaginary axis (jw axis)

(iii) The number of Roots in Right hand side of s-plane

(iv) The number of Poles and Zeroes in Right hand side

(i) The response of a system whose $\zeta = 0$ is termed as a

(i) Critical damping

(ii) Oscillatory with decreasing amplitude

(iii) Over damped

(iv) Oscillatory (Sustained Oscillation)

(v) Oscillatory with increasing amplitude

(j) The root loci of a branch originates from a pole at the value of K

(i) One

(ii) Infinity

(iii) Zero

(iv) None of the above

(k) An element that stores kinetic energy of rotational motion is

(i) Inertia (ii) Damper

(iii) Torsional spring (iv) Mass

(l) Zero initial conditions means that the system is

(i) Working with zero stored energy

(ii) Working with zero reference signal

(iii) At rest and no energy is stored in any of its component

(iv) None of above

(m) The Type 2 system is tested for steady state error analysis with

(i) Step input

(ii) Ramp input

(iii) Acceleration input

(iv) Impulse input.

PART – B

Marks – 45

3. Sketch the Root Loci of Open Loop transfer function given by 9

$$G(s)\,H(s) = K/s(s+2)(s+4)$$

4. (a) Discuss the range of values of **K** for the system to be stable

$$G(s) = K\,(s+13)/\,s(s+3)(s+7)\ ;\ H(s) = 1.$$ 6

(b) Define Kp, Kv, Ka. 3

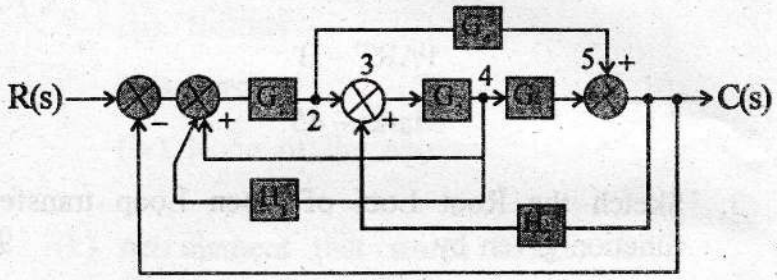
5. Write short notes on

(a) Comparision between Open Loop and Close Loop. 4

(b) Field Controlled DC Servo Motor. 5

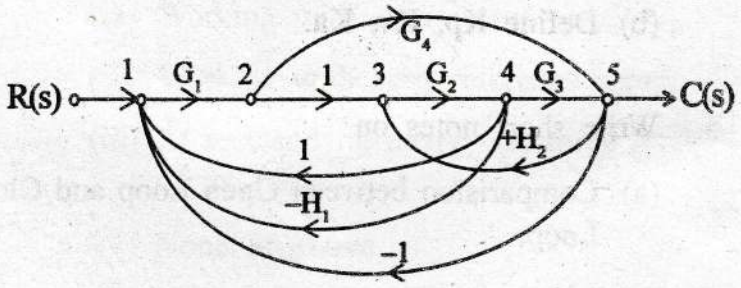
6. Reduce the Block Diagram and find the overall transfer function of the system.

Find the overall transfer function C(s)/R(s). 9



Note : Summator block 1 has its inputs fromi) R(s) + signal and 2) C(s).

7. Find the transfer function C(s)/R(s) of the signal flow graph using Mason's gain formula. 9



8. (a) Derive the Transfer function X0(s)/X1(s). 6

(b) Draw the equivalent electrical network. 3