Total No. of printed pages = 9

END SEMESTER EXAMINATION, NOVEMBER-2018

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 :

1. *All* questions of PART – A are compulsory.
2. Answer any *five* questions from PART – B.

PART – A

Marks – 25

1. Fill in the blanks : 1×10=10

   (a) The number of poles at the _____ gives the TYPE of a transfer function.

   (b) The number of poles gives the _____ of a transfer function.

[Turn over

(c) The corner frequencies for a given transfer function are :

$G(s)\,H(s) = 20\,(s + 0.25)/(s + 0.5)\,(s + 10)$

$\omega =$ _____ due to a zero.

(d) A minimum phase transfer function has poles and zeroes located on the _____ side of "s" plane.

(e) The characteristic equation of a system is given below :

$(s + 2)\,(s + 3)\,(s^2 + 2s + 2)$.

Determine the Dominant Roots _____.

(f) The Bode plot is a plot of magnitude and also _____ versus frequency on the log scale.

(g) The equivalent analogy of mass in electrical voltage system is _____.

(h) The first time constant of a system is also denoted as _____ percentage of the full scale output.

(i) _____ are a preferred choice as a control component for error detection.

(j) The steady state value of LAG for a Ramp input signal to a first order system is _____.

2. Multiple choice : 10×1=10

(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) ½ (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 feed-back 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 $s \to 0$ 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 roots 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 initial slope of the Bode plot for a transfer function having no poles at the origin is :

(i) – 10 db/decade (ii) 10 db/decade

(i) 0 db/decade (iii) 20 db/decade

(j) The frequency at which the magnitude of the Bode plot crosses "0" db axis is termed as :

(i) Natural frequency

(ii) Phase crossover frequency

(iii) Gain crossover frequency

(iv) Corner frequency

3. Match the following : 5×1=5

(i) Oscillatory (Sustained oscillation)	(a) $\zeta < 1$
(ii) Critical damping	(b) $\zeta > 1$
(iii) Oscillatory with decreasing amplitude	(c) $\zeta = 0$
(iv) Over damped	(d) $\zeta = 1$
(v) Oscillatory with increasing amplitude	(e) ζ = un-defined.

PART – B

Marks – 45

4. A closed loop control system is given by open loop gain, $G(s) = K/s(s+6)$, feedback gain $H(s) = = 0.2$, damping ratio $\zeta = 0.7$. 1×3=3

Determine the value of K to satisfy the above condition and calculate the settling time, peak time, maximum overshoot. 3×2=6

5. Sketch the Root Loci of open loop transfer function given by 1×9=9

$G(s)\,H(s) = K(s+3)/s(s+2)$

6. Discuss the root location of the polynomial and comment on its stability :

(a) $s^7 + 4s^6 + 5s^5 + 2s^4 + 4s^3 + 16s^2 + 20s + 8 = 0$. 1×5=5

(b) $s^5 + s^4 + 2s^3 + 2s^2 + 11s + 10 = 0$. 1×4=4

7. Construct the Bode plot for a unity feedback control system having

$G(s) = 2000/s(s+1)(s+100)$. 1×6=6

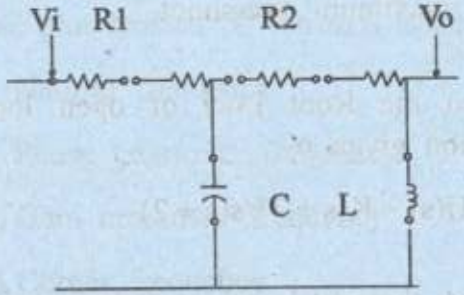
Calculate the phase margin, gain margin, cross-over frequency. 3×1=3

8. Write short notes on :

   (a) Comparison between open loop and close loop 1×4=4

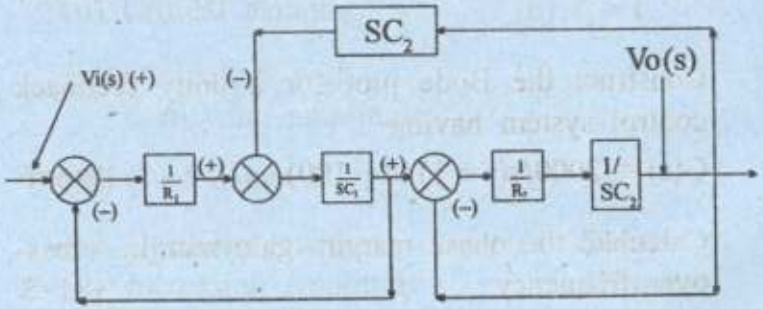
   (b) Field controlled DC servo motor. 1×5=5

9. Find the transfer function of the two looped network using Masons gain formula. 1×9=9



10. Reduce the block diagram and find the overall transfer function of the system.

    Find the overall transfer function Vo(s)/Vi (s). 1×9=9



11. Explain feedback control and discuss its effect on

    (a) Overall gain

    (b) External disturbances 3×3=9

12. Find the transfer function C(s)/R(s) of the signal flow graph using Mason's gain formula. 1×9=9