Total No. of printed pages = 9

END SEMESTER EXAMINATION – 2019

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 : 11×1=11

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

   (b) The roots of characteristic equation are the _____ of a transfer function.

[Turn over

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

(d) The equivalent analogy of friction in electrical force voltage system is _____.

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

(f) _____ is a preferred choice as a control component for error detection.

(g) The Laplace transform of impulse function is _____.

(h) If there are two poles on the right side of s plane, then the system is _____.

(i) Steady state error is a measure of system _____.

(j) The asymptotes of a root locus crosses at the real axis of the s plane and is termed as _____.

(k) As K is increased from 0 to ∞, each branch of root locus originates at _____.

2. Choose the correct answer : 1×10=10

(a) The Laplace transform of $e^{+2t} \sin 3t$ is

(i) $3/(s-2)^2+9$ (ii) $3/s^2+9$

(iii) $3/s^2+4s+9$ (iv) $3/(s+2)^2-9$

(b) 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.

(c) 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

(d) The steady state response of a system is dependant

(i) System poles (ii) Inputs applied

(iii) Both (i) and (ii) (iv) None of these

(e) 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

(f) The roots of characteristics equation are same as

(i) Closed loop zeroes

(ii) Closed loop poles

(iii) Open loop zeroes

(iv) Open loop poles

(g) The system has a translational motion, means

(i) Body moves along a random path

(ii) Body moves along a straight path

(iii) Body rotates about its fixed axis

(iv) None of the above

(h) The STEP input is mathematically defined as

(i) Zero level at $t < 0$, Magnitude is ∞ at $t > 0$

(ii) Zero level at $t < 0$, Magnitude is A at $t > 0$

(iii) Zero level at $t < 0$, Magnitude is t at $t > 0$

(v) None of the above

(i) The initial slope of the bode plot for a transfer function having one pole at the origin is

(i) – 10 db/decade (ii) 10 db/decade

(iii) + 20 db/decade (iv) –20 db/decade

(j) The crossing of the gain of the bode plot crosses "0" db axis determines the

(i) Natural frequency

(ii) Phase margin

(iii) Gain margin

(iv) Corner frequency.

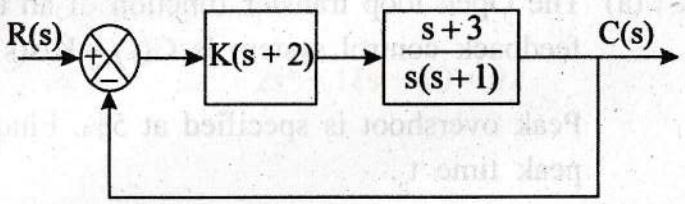
3. Match the following : 1×4=4

Conditions	Damping Constants
(i) Oscillatory (Sustained Oscillation)	(a) 0.5
(ii) Critical damping	(b) 2
(iii) Oscillatory with decreasing amplitude	(c) 0
(iv) Over damped	(d) 1

PART – B

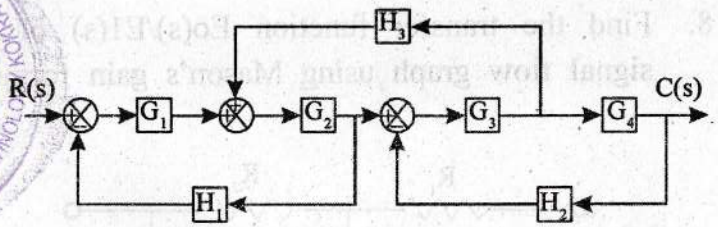
Marks – 45

4. Sketch the Root Loci of Open Loop transfer function. 9



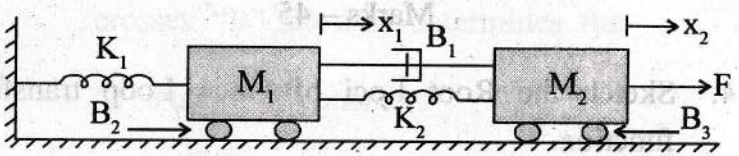
5. Reduce the Block Diagram. 9

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



6. (a) For the mechanical system, write down the equations of motion. 4½+4½=9

(b) Draw the equivalent electrical circuit.

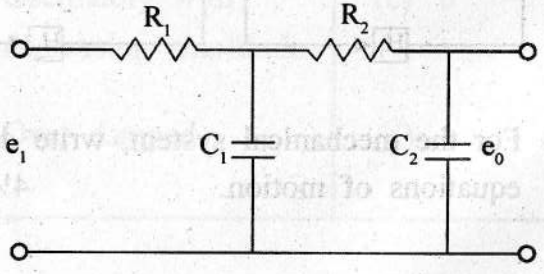


7. (a) The Open loop transfer function of an unity feedback control system is $G(s) = K/s(s + 2)$

Peak overshoot is specified at 5%. Find the peak time t_p.

(b) A thermometer requires 1 minute to indicate 98% of the response to a step input. Assuming the thermometer to be a first order system, find the Time constant. 4½+4½=9

8. Find the transfer function Eo(s)/E1(s) of the signal flow graph using Mason's gain formula 9



9. Write down the step by step method to draw a Root locus diagram. 9

10. (a) Draw the neat sketch of a Bode plot $G(s) = 20(s + 2)/s(s + 0.05)$ 4½

(b) Comment on the Stability of the characteristic equation 4½

$s^5 + s^4 + 2s^3 + 2s^2 + 11s + 10 = 0.$