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Paper Code : IT-705B

CONTROL SYSTEM

Time Allotted: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for *any ten* of the following: 1×10=10

(i) The transfer function of a system is its

(a) square response (b) step response

(c) ramp response (d) impulse response

(ii) The initial slope of the Bode plot for a transfer function having a simple zero at the origin is

(a) –20 dBb\decade (b) 20 dBb\decade

(c) –10 dBb\decade (d) 10 dBb\decade

(iii) Derivative feedback control

(a) increases rise time. (b) increases overshoot.

(c) decreases steady stady state error. (d) None of these

(iv) A system is critically damped. If the gain of the system is increased the system will behave as

(a) underdamped (b) overdamped

(c) no effect of gain (d) undamped

(v) If the bandwith of a control system is increased, the noise in the system will be

(a) increased (b) decreased

(c) no effect (d) zero

(vi) The electrical resistance is analogous to
(a) viscous damper
(b) spring constant
(c) mass
(d) None of these

(vii) If the characteristic equation of a system is $s^2 + 8s + 25 = 0$, then the system will be
(a) undamped
(b) overdamped
(c) underdamped
(d) critically damped

(viii) Nyquist stability criterion requires polar plot of
(a) closed loop transfer function.
(b) open loop transfer function.
(c) forward path transfer function.
(d) None of these

(ix) The phase shift of $G(s) = 1/s^2$ is
(a) $-90°$
(b) $90°$
(c) $180°$
(d) $-180°$

(x) Presence of non-linearity in a control system tends to introduce
(a) transient error
(b) instability
(c) steady state error
(d) All of these

(xi) In terms of Bode plot the system is stable if
(a) PM=GM.
(b) PM & GM both are positive.
(c) PM & GM both are negative.
(d) PM is negative but GM is positive.

(xii) If the system has multiple poles on the imaginary axis then the system is
(a) stable
(b) unstable
(c) marginally stable
(d) None of these

(xiii) An increase in damping ratio
(a) increase rise time
(b) decrease rise time
(c) do not effect the rise time
(d) None of these

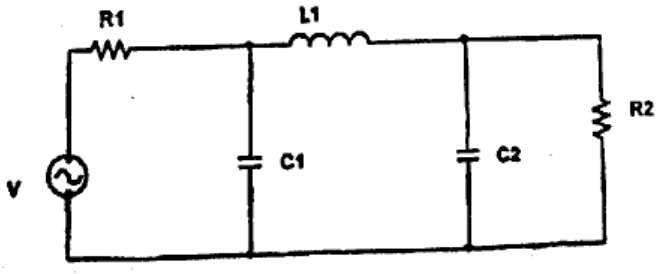
Group – B

(Short Answer Type Questions)

Answer *any three* of the following questions. 5×3=15

2. Show how the use of negative feedback in control system reduces the sensitivity of the system with parameter variations and also how improves the stability of the system. 2+3=5

3. Obtain the state model of the network shown below:



4. A unity feedback system has
$G(s) = 100/s(s+4)$ & $r(t) = 5t$
Determine: (a) the steady state error (b) the value of k to reduce the error by 8%. 2+3=5

5. Describe all signal flow graph terminologies. **http://www.makaut.com**

6. Define the following terms: (a) rise time (b) peak time (c) % peak overshoot (d) settling time

Group – C

(Long Answer Type Questions)

Answer *any three* of the following questions. 15×3=45

7. (a) What are the angle and magnitude conditions for root locus?

(b) Draw the root locus plot for the control system having the open loop transfer function with unity feedback.
$G(s) = K/s(s+1)(s^2+2s+2)$

(c) Determine the value of K at the point on the root locus where the damping factor $\xi = 0.5$. 3+9+3=15

8. (a) Define the terms: (i) Gain margin, (ii) Phase margin, (iii) Gain crossover frequency, (iv) Phase crossover frequency.

(b) Sketch the Bode plot for the system having open loop transfer function
$G(s) = 10(1+0.1s)/s^2(S+1)(s+0.5)$
From the plot determine the stability of the system. **http://www.makaut.com** 4+11=15

9. (a) State & explain the Nyquist criterion for studying stability of a control system.

(b) A unity feedback control system has open loop transfer function
$G(s) = K/s(s^2+s+4)$
Draw the Nyquist plot and hence investigate the stability of the system for various values of K.

(c) What are the advantages of Nyquist plot? 3+7+5=15

10. (a) Write down the advantages and disadvantages of state space techniques.

(b) Obtain the state transition matrix from non homogeneous state equation of a LTI control system and list the properties of it. **http://www.makaut.com**

(c) Determine the transfer matrix for a system whose A, B, C matrices are
$A = \begin{bmatrix} 1 & -2 \\ 4 & -5 \end{bmatrix}$ $B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ and $C = [1\ 0]$ 5+5+5=15