Reg. No. : | | | | | | | | | | |

Question Paper Code: 44051

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Fourth Semester

Electronics and Instrumentation Engineering

14UEI401 - CONTROL ENGINEERING

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Three blocks with gains of 4, 6, and 8 are connected in parallel. The total gain of the arrangement is

   (a) 18 (b)196 (c)32 (d) 52

2. In force-voltage analogy, spring constant is analogous to

   (a) Voltage (b) Reciprocal of capacitance
   (c) Capacitance (d) Charge

3. The Laplace transform of unit parabolic signal is

   (a) 1 (b) $1/s^3$ (c) $1/s^2$ (d) s

4. The steady state error of a type -1, second order system to a unit ramp input is

   (a) $2\xi\omega_n$ (b) $\frac{\omega_n}{2\xi}$ (c) $\frac{2\xi}{\omega_n}$ (d) $\frac{2\omega_n}{\xi}$

5. Phase margin of a system is used to specify which of the following?
   (a) Frequency response (b) Absolute stability
   (c) Relative stability (d) Time response

6. Gain margin of a second order system is___________

(a) 1 (b) 0 (c) ∞ (d) lies between 0 and 1

7. Normal Routh array indicates

(a) Non zero elements in the first column (b) Row of all zeros
(c) First column element of the row is zero (d) Row of all ones

8. A technique which gives quick transient and stability response

(a) Root locus (b) Bode (c) Nyquist (d) Nichols

9. ___________ is called state transition matrix.

(a) e^{At} (b) $1/e^{At}$ (c) A^k (d) $1/A^k$

10. $\frac{dx}{dt} = Ax(t) + Bu(t)$ is called the

(a)System Matrix (b)Input Matrix
(c)State Transition Matrix (d) Output Equation

PART - B (5 x 2 = 10 Marks)

11. Write the Mason's gain formula.

12. The open loop transfer function of a unity feedback control system $G(s) = \frac{10}{s+1}$.
Calculate the steady state error due to unit step input signal.

13. State the stability requirements in time and frequency domains.

14. The characteristics equation of a system is given by $3s^4 + 10s^3 + 5s^2 + 2 = 0$. Conclude the stability of the system.

15. Define controllability and observability.

PART - C (5 x 16 = 80 Marks)

16. (a) Determine the transfer function $\frac{C(s)}{R(s)}$ of the system shown in Figure. 1. (16)

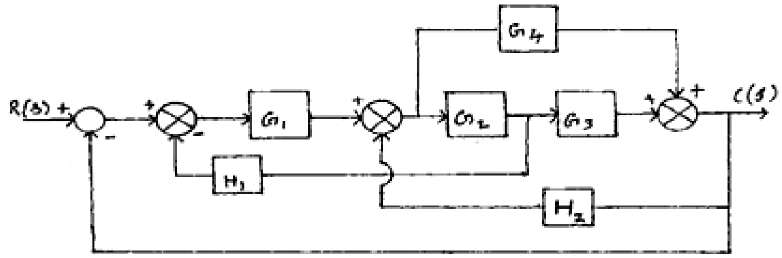

Figure 1

Or

(b) Determine the transfer function *C (s) / R (s)* of the system shown in Figure. 2. (16)

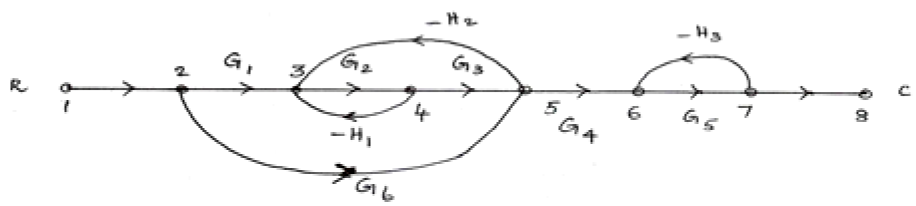

Figure 2

17. (a) Consider a unity feedback system with a closed loop transfer function $C(s)/R(s) = (Ks+b)/(s^2+as+b)$. Determine the open loop transfer function G(s). Show that the steady state error with unit ramp input is given by (a-k)/b. (16)

Or

(b) (i) Derive the following time domain specifications of a second order system.

(1) rise time (2) settling time (8)

(ii) For a unity feedback control system, the open loop transfer function $G(s) = \frac{10(s+2)}{(s^2\ (s+1))}$. Find the static error constants. (8)

18. (a) Explain the design procedure involved in the design of lag compensator. (16)

Or

(b) Construct the Bode Plot for the following transfer function and determine the gain margin & Phase margin. $G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$. (16)

19. (a) Using Routh criterion determine the stability of the system represented by the characteristics equation $s^5+4s^4+8s^3+8s^2+7s+4=0$. Comment on the location of the roots of characteristics equation. (16)

Or

(b) Determine the stability of a system, whose characteristics equation is given by $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Also find the number of roots lying in the LHS, RHS and imaginary axis of s-plane. (16)

20. (a) For a system represented by state equation $\dot{X}(t) = AX(t)$ .The response is $X(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ and $X(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ Determine the system matrix A and state transition matrix. (16)

Or

(b) Determine the canonical state model of the system, whose transfer function is $T(s) = \frac{2(s+5)}{((s+2)(s+3)(s+4))}$. ` (16)

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