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Question Paper Code: 41541

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

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. Which of the following system is not an example of closed loop system?

   (a) Traffic light controller
   (b) Action of human being in walking
   (c) Home heating system
   (d) DC motor speed control

2. 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

3. 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) $\frac{2\omega_n}{\xi}$

4. The Laplace transform of unit parabolic signal is

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

5. Consider the following:
   1. Phase margin 2. Gain margin 3. Maximum overshoot 4. Bandwidth
   Which of the above are the frequency domain specifications required to design a control system?

(a)1 and 2 only (b)1 and 3 only
(c) 1, 3 and 4 only (d)1, 2 and 4 only

6. In polar plot the radial lines represent the

   (a) Frequency (b) magnitude (c) gain margin (d) phase angle

7. If the poles of a system lie on the imaginary axis, the system will be

   (a) stable (b) unstable
   (c) marginally stable (d) Conditionally stable

8. 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

9. Number of ___________ in a state diagram of discrete time system is equal to number of state variables.

   (a) integrators (b) state variables
   (c) phase variables (d) unit delay

10. The state variable approach is applicable to

    (a)Only linear time in-variant systems
    (b)Linear time in-variant as well as time varying systems
    (c)Linear as well as non linear systems
    (d)All type of systems

PART - B (5 x 2 = 10 Marks)

11. Define transfer function.

12. List the test signals used to find the time response in control systems.

13. Show the polar plot of $G(s) = \frac{1}{s^2(1+sT_1)(1+sT_2)(1+sT_3)}$.

14. State the Nyquist stability criterion.

15. List the properties of state transition matrix.

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)

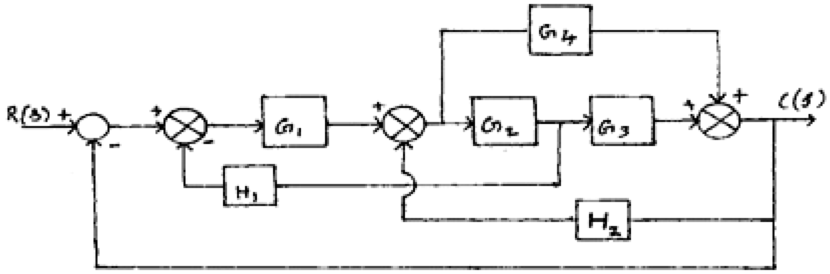

Figure 1

Or

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

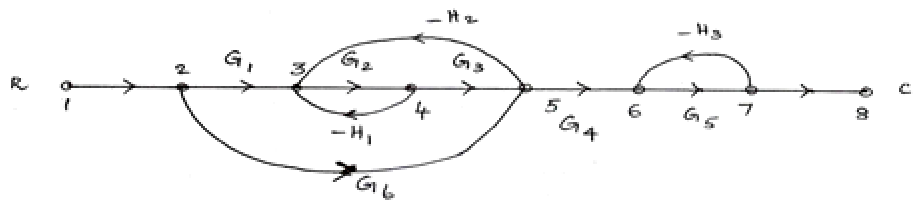

Figure 2

17. (a) (i) The unit step response of a system is given as $C(t) = \frac{5}{2} + 5t - \frac{5}{2}e^{-2t}$. Find the open loop transfer function of the system. (8)

(ii) Derive the output response of the first order system for step input. (8)

Or

(b) (i) A certain negative feedback control system has the following forward path transfer function $G(s) = \frac{K}{s(s+1)}$. The feedback path has the following transfer function $H(s) = 1 + K_h(s)$. Determine the value of K and K_h so that the maximum overshoot for unit step input is 0.2 and it occurs at time t=1 sec. With these values of K and K_h determine the rise time and setting time. (8)

(ii) The forward path transfer function of a unity feedback type-1, second order system has a pole at -2. The nature of gain K is so adjusted that damping ratio is 0.4. Find the Steady state error when the input is $r(t) = 1 + 4t$. (8)

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

Or

(b) Sketch the bode plot for the following transfer function and determine the system gain k for ω_{gc} to be 5 *rad/sec*.

$$G(s) = \frac{ks^2}{((s+0.2s)(s+0.02s))} \qquad (16)$$

19. (a) (i) The open loop transfer function of a closed loop system with unity feedback is $G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. By applying the Routh criterion, discuss the stability of the closed loop system as a function of K. Determine the values of K which will cause sustained oscillations in the closed loop system and also find the corresponding oscillation frequencies. (8)

(ii) The characteristic polynomial of a system is $s^7 + 5s^6 + 9s^5 + 9s^4 + 4s^3 + 20s^2 + 36s + 36 = 0$ Determine the location of roots on the S-Plane and hence the stability of the system. (8)

Or

(b) Construct the root locus of the system whose open loop transfer function $G(s) = \frac{K}{s(s+2)(s+4)}$. Determine the value of K so that the damping ratio of the closed loop system is 0.5. (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)
