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

Question Paper Code: 44501

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

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. Static error co-efficients are used as a measure of the effectiveness of closed loop systems for specified ________ input signal.

   (a) acceleration (b) velocity
   (c) position (d) all the above

4. Which of the following characteristics does it have, the given closed loop transfer function $\frac{C(s)}{R(s)} = \frac{121}{s^2 + 132s + 121}$ of a system

   (a) Over damped system and setting time 1.1s
   (b) Under damped system and setting time 0.6s
   (c) Critically damped system and setting time 0.8s
   (d) Under damped system and setting time 0.707s

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. At the gain cross over frequency, ω=5 rad/s, $\angle G(j\omega)H(j\omega) = -170^{\circ}$. The phase margin is

   (a) -10º (b) 10º (c) -170º (d) 170º

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. A technique which gives quick transient and stability response

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

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

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

10. __________ is called state transition matrix.

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

PART - B (5 x 2 = 10 Marks)

11. Write the Mason's gain formula.

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

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. 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)

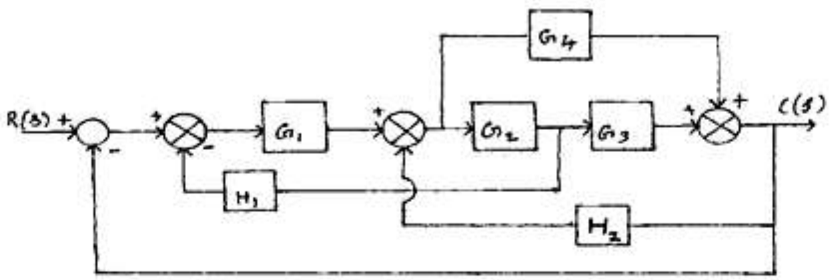

Figure 1

Or

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

(16)

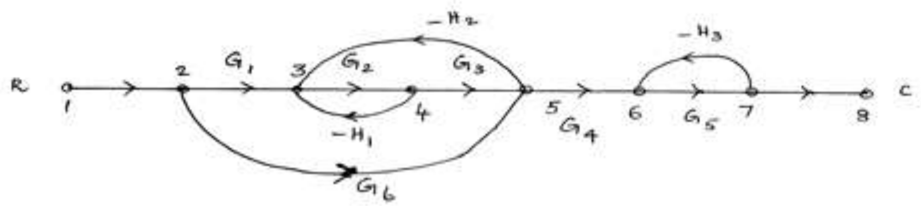

Figure 2

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) Design a phase lead compensator for the system shown in fig. to satisfy the following specifications (i) the phase margin of the system ≥45° (ii) steady state error for a unit ramp input ≤ 1/15 (iii) the gain cross over frequency of the system must be less than 7.5 rad/sec. (16)

Or

(b) A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(1+2s)}$.

Design a suitable lag compensator so that phase margin is 40^o and steady state error for ramp input is less than or equal to 0.2. (16)

19. (a) Sketch the root locus of the system whose open loop transfer function is G(s) = K/S(S+2)(S+4). Find the value of K so that the damping ratio of closed loop system is 0.5. (16)

Or

(b) 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. (16)

20. (a) The transfer function of a control system is given by $\frac{Y(s)}{U(s)} = \frac{s^2+3s+4}{s^3+2s^2+3s+2}$.

Obtain a state model. (16)

Or

(b) 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)