Reg. No. :

Question Paper Code: 44522

B.E. / B.Tech. DEGREE EXAMINATION, DEC 2021

Fourth Semester

Electronics and Communication Engineering

14UEI422–LINEAR CONTROL ENGINEERING

(Regulation 2014)

Duration: Threehours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. An element which stores potential energy?

   (a) mass (b) spring (c) damper (d) none of these

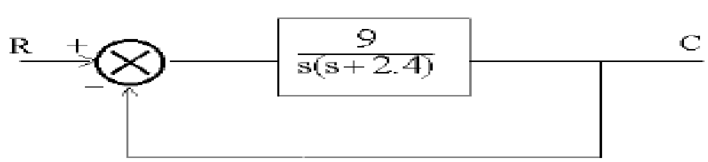
2. Which of the following is an open loop control system

   (a) Field controlled D.C. motor (b) Ward leonard control
   (c) Metadyne (d) Stroboscope

3. The steady-state error of a feedback control system with an acceleration input becomes finite in a

   (a) Type 0 system (b) Type 1 system
   (c) Type 2 system (d) Type 3 system

4. Considering the unity feedback system of Fig.2, the settling time of the resulting second order system for 2% tolerance band will be



   (a) 3.33 (b) 4.5 (c) 2.25 (d) 2.84

5. If the Nyquist plot of the loop transfer function G(s)H(s) of a closed-loop system encloses the (−1, j0) point in the G(s)H(s) plane, the gain margin of the system is

(a) zero (b) greater than zero
(c) less than zero (d) infinity

6. Which of the following is the time domain method of determining stability of a control system

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

7. The equation $2S^4 + S^3 + 3S^2 + 5S + 10$ has _________ number of roots in the left half of s–plane.

(a) One (b) Two (c) Three (d) Four

8. Consider the following statements regarding root loci:

1. All root loci start from the respective poles of G(s) H(s).
2. All root loci end at the respective zeros of G(s) H(s) or go to infinity.
3. The root loci are symmetrical about the imaginary axis of the s-plane.

On these statements:

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct
(c) 1 and 3 are correct (d) 2 and 3 are correct

9. The state space approach is applicable to the control systems which are

(a) Time variant (b) Time invariant (c) Both (a) and (b) (d) None of these

10. The advantage of state space model is

(a) Applicable for linear and non-linear system
(b) Applicable for only linear system controllable
(c) Applicable for time invariant system only
(d) Applicable for continuous –time system only

PART - B (5 x 2 = 10 Marks)

11. Write Masons Gain formula

12. Define steady state error.

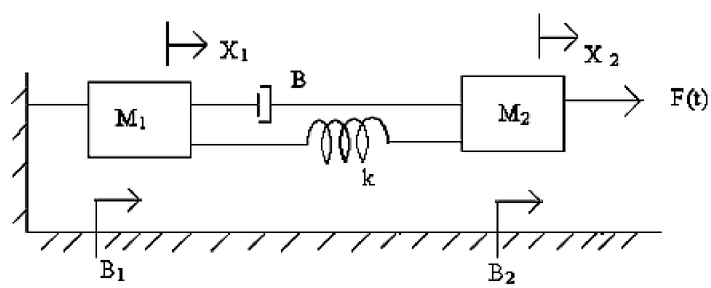
13. List out the frequency domain specifications.

14. How the roots of characteristic equation are related to stability?

15. State the reason for using state space analysis rather than using transfer function method.

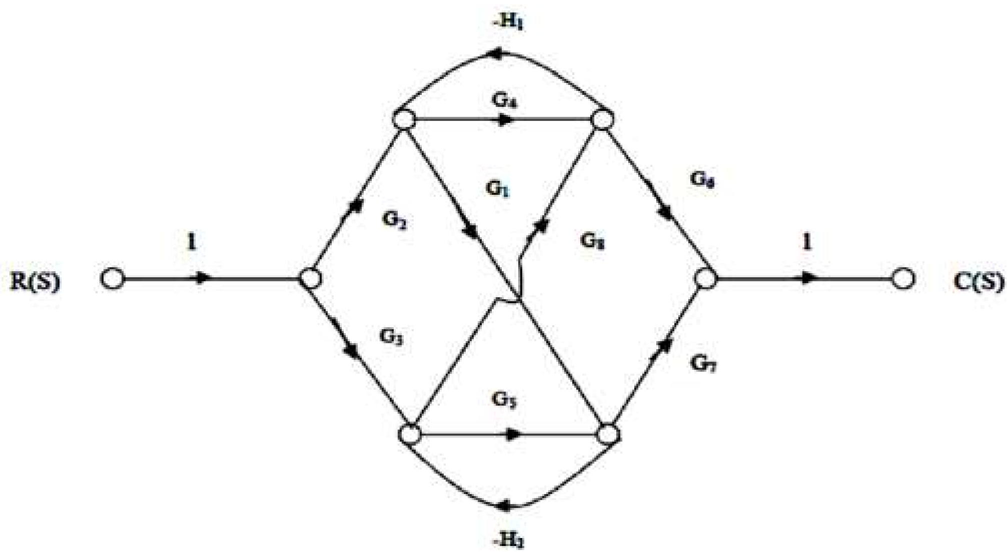
PART - C (5 x 16 = 80 Marks)

16. (a) Write the differential equations governing the Mechanical system shown in figure and determine the transfer function. (16)



Or

(b) Evaluate the overall gain of the system whose signal flow graph is shown in figure (16)



17. (a) A unity feedback systems has $G(s)=\frac{1}{s(1+s)}$. The input to the system is described by $r(t)=4+6t+2t^3$. Find the generalized error coefficients and steady state error. (16)

Or

(b) The open loop transfer function of a servo system with unity feedback system is $G(s) = \frac{10}{s(0.1s+1)}$.Evaluate the static error constants of the system. Obtain the steady state error of the system when subjected to an input given by the polynomial r(t) = a0+a1t +a2 /2 t2. (16)

18. (b) Consider the unity feedback system having an open loop transfer function G(s)= $\frac{K}{s(1+0.5s)(1+4s)}$. Sketch the polar plot and find the value of K so that

(i) gain margin is 20db and (ii) phase margin is 30^0. (16)

Or

(b) The open loop transfer function of a unity feedback system is $G(s) = \frac{400}{s(s+2)(s+10)}$.

Sketch the Polar plot and determine the Gain margin and Phase margin. (16)

19. (a) (i) For the characteristic equationF(s)= $s^6 + s^5 - 2s^4 - 3s^3 - 7s^2 - 4s - 4$. Find the number roots falling in the right half and left half of the s-plane. (8)

Or

(b) The open loop transfer function of a unity feedback system is given by G(s)= $\frac{K}{s(s+1)(s^2+2s+2)}$. Sketch the root locus of the system. (16)

20. (a) Explain sampling theorem and Sample & Hold operation in detail (16)

Or

(b) Find the state controllability for the systems represented by the state equation

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u$$ (16)