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

Question Paper Code: U4302

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2024

Fourth Semester

Electrical and Electronics Engineering

21UEE402 – CONTROL SYSTEMS

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The output is said to be zero state response because ______conditions are made equal to zero CO1-U

   (a) Initial (b) Final (c) Steady state (d) Impulse response

2. In a signal flow graph, nodes are represented by small _____ CO1-U

   (a) Circles (b) Squares (c) Arrows (d) Pointers

3. (S+2)(S+1)/S2(S+3)(S+4) is a ________. CO3-App

   (a) Type- 0 (b) Type -1 (c) Type -2 (d) Type – 3

4. If an impulse response of a system is e^{-5t}, what would be its transfer function? CO3-App

   (a) 1/ s – 5 (b) 1/ s + 5 (c) (s+1) / (s+5) (d) (s^2 - 5s)/ (s-5)

5. Phase margin of a system is used to specify which of the following? CO1-U

   (a) Frequency response (b) Absolute stability

   (c) Relative stability (d) Time response

6. The frequency at which the two asymptotic meet in a magnitude plot is called¬¬ CO1-U

   (a) Resonant peak. (b) Band width

   (c) Corner frequency (d) Resonant frequency

7. Consider the loop transfer function K(s+6)/(s+3)(s+5) In the root locus diagram the centroid will be located at: CO1-U

   (a) -4 (b) -1 (c) -2 (d) -3

8. Technique is not applicable to nonlinear system? CO1-U

(a) Nyquist Criterion (b) Quasi linearization

(c) Functional analysis (d) Phase-plane representation

9. A set of variables describes the state of the system is called CO1-U

(a) Input variables (b) Output variables (c) State variables (d) None of these

10. State space analysis is applicable to CO1-U

(a) Linear system (b) Nonlinear system

(c) MIMO (d) All of these

PART – B (5 x 2= 10 Marks)

11. When defining the transfer function, what happens to the initial conditions of the system? CO1-U

12. Determine the type and order of the system G(s) H(s)=10(S+3)/S^2(S+4) CO2-App

13. Explain the gain cross over frequency CO1-U

14. Define the breakaway point and breaking point CO1-U

15. Consider system given by Y(s) / U(s) = (s+3) / (s^3+3s+2). Obtain state space representation in controllable form. CO3-App

PART – C (5 x 16= 80 Marks)

16. (a) Write the differential equations governing the mechanical system shown in figure. Construct the force – voltage and force – current electrical analogous circuits and verify by writing mesh and node equations. CO2-App (16)

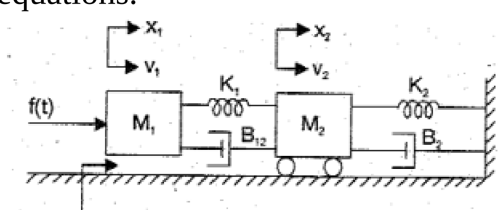
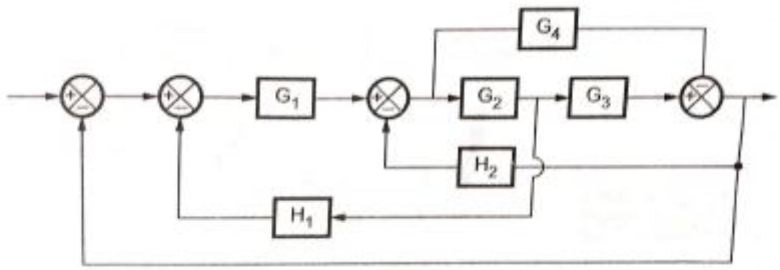


Fig 1.

Or

(b) Using block diagram reduction techniques find closed loop transfer of the system whose block diagram shown in figure. CO2-App (16)



17. (a) The open loop transfer function of unity feedback system is given by G(s) =K/S(ST+1),where K and T are positive constants. By what factor the amplifier gain K be reduced, so that the peak overshoot of unit step response of the system is reduced from 75% to 25% CO3-App (16)

Or

(b) A unity feedback control system has an amplifier with gain KA=10 and gain ratio ,G(s)=1/s(s+2) in the feed forward path.A derivative feedback ,H(s)=sKo is introduced as a minor loop around G(s) .Determine the derivative feedback constant ,Ko so that the system damping factor is 0.6. CO3-App (16)

18. (a) Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies. CO3-App (16)

$$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$$

Or

(b) Construct the Polar plot for the following transfer function and obtain the gain margin and phase margin whose CO3-App (16)

$$G(s) = \frac{1}{s(1+s)(1+2s)}$$

19. (a) Construct Routh array and Examine the stability of the system represented by the characteristics equation, CO3-App (16)

i) $S^5+4S^4+2S^3+2S^2+3S+5=0$.

ii) $S^5+4S^4+8S^3+8S^2+7S+4=0$

Comment on the location of the roots of characteristics equation.

Or

	(b)	Sketch the Root locus of the system, whose open loop transfer function is G(s)=(K)/(S(S+2)(S+4))	CO3-App	(16)
20.	(a)	Examine controllability and observability of the following state models.	CO5-Eva	(16)

$$A = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} \; B = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \; C = \begin{bmatrix} 1 & -1 \end{bmatrix}$$

$$A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} B = \begin{bmatrix} 1 & 0 \\ 1 & 2 \\ 2 & 1 \end{bmatrix} C = \begin{bmatrix} 1 & 1 & 2 \\ 3 & 1 & 5 \end{bmatrix}$$

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -1 \end{bmatrix} B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

Or

	(b)	Consider a unity feedback system with open loop transfer function G(s)=K/s(s+8). Design a lead compensator to meet the following specifications. % peak overshoot 9.5% Natural frequency of oscillations ωn =12rad/sec Velocity error constant, K_v>=10	CO5-Eva	(16)