A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: U4302

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 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. If a signal is passed through an integrator, it _____the amplitude of noise signal. CO1-U

   (a)Enhances (b) Reduces (c) Stabilizes (d) Factorizes

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. The damping ratio of system is 0.5 and the natural frequency of oscillation is 10rad/sec. Calculate the settling time for 2% error CO3-App

   (a) 0.4 sec (b) 0.6 sec (c) 0.7 rad /sec (d) 0.8 sec

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. Which one of the following applications software's is used to obtain an accurate root locus for? CO1-U

   (a) LISP (b) MATLAB (c) dBase (d) Oracle

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

(a) Nyquist Criterion (b) Quasi linearization

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

9. Which mechanism in control engineering implies an ability to measure the state by taking measurements at output? CO1-U

(a) Controllability (b) Observability (c) Adaptability (d) Differentiability

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. Explain Mason's gain formula. CO1-U

12. Compare steady state and transient response. CO1-U

13. Explain the gain cross over frequency CO1-U

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

15. Define Controllability. CO1-U

PART – C (5 x 16= 80 Marks)

16. (a) Write the differential equations governing the mechanical system shown in figure.1 and develop the transfer function CO2-App (16)

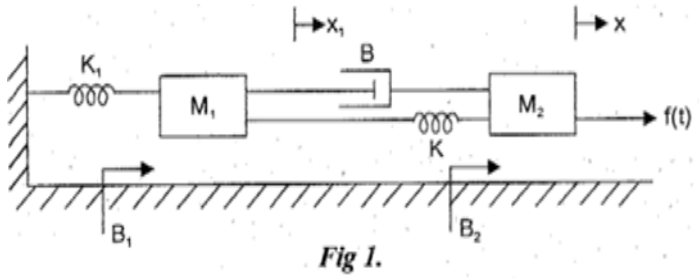
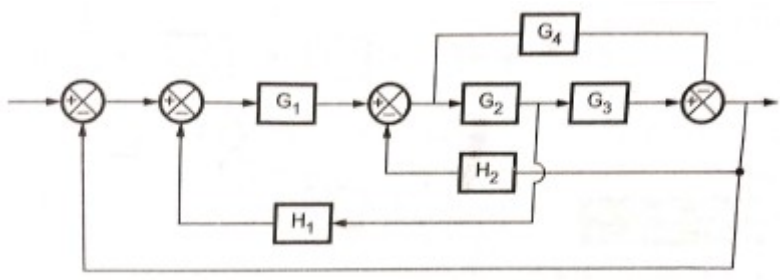


Fig 1.

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) For a unity feedback control system the open loop transfer function, $G(s) = \frac{10(s+2)}{s^2(s+1)}$ Find CO3-App (16)

i) The position, velocity and acceleration error constants,

ii) The steady state error when the input is R(s)

where $R(s) = \frac{3}{2} - \frac{2}{s^2} + \frac{1}{3s^3}$

Or

(b) A unity feedback control system is characterized by the following open loop transfer function G(s)=(0.4s+1)/s(s+0.6).Determine its transient response for unit step input and sketch the response .Evaluate the maximum overshoot and the corresponding peak time. CO3-App (16)

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

G(s)=20/(s(1+3s)(1+4s))

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)=1/(s(1+s)(1+2s))

19. (a) Construct Routh array and Examine the stability of the system whose characteristic equation is $S6+2S5+8S^4+12S^3+20S^2+16S+16=0$. Also determine the number of roots lying on right half of S-plane, left half of s-plane and on imaginary axis. CO3-App (16)

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) The state space representation of a system is given by CO3-App (16)

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}-2 & 1 & 0\\ 0 & -3 & 1\\ -3 & -4 & -5\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u$$

$$Y=\begin{bmatrix}0 & 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Develop the Transfer function.

Or

(b) i) Develop the state model of the system described by the following transfer function. $y(s)/u(s)=5/s^3+6s+7$ CO3-App (16)

ii) Develop the state transition matrix for the state model whose system matrix A is given by

$A=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$