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

Question Paper Code: 94302

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2023

Fourth Semester

Electrical and Electronics Engineering

19UEE402 – Control Systems

(Regulations 2019)

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. If an impulse response of a system is e^{-5t}, what would be its transfer function? CO2-App

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

4. Transfer function of a system is used to calculate which of the following? CO2-U

   (a) The order of the system (b) The time constant

   (c) The output for any given input (d) The steady state gain

5. Phase margin of a system is used to specify which of the following? CO2-R

   (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_____ CO2- U

(a) Resonant peak. (b) Band width (c) corner frequency (d) Resonant frequency

7. Technique is not applicable to nonlinear system? CO3- R

(a) Nyquist Criterion (b) Quasi linearization

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

8. Addition of zeros in transfer function causes which of the following? CO3- U

(a) Lead-compensation (b) Lag-compensation

(c)Lead-lag compensation (d) None of the above

9. A set of variables describes the state of the system is called CO4- U

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

10. State space analysis is applicable to CO4- R

(a) Linear system (b) Non linear system

(c) MIMO (d) All of these

PART – B (5 x 2= 10 Marks)

11. What are the electrical and mechanical time constants of an electric motor? CO1- U

12. Explain the effect of PI controller on the system performance. CO2- U

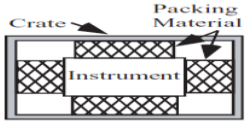
13. What is gain cross over frequency CO2- R

14. Explain the necessary and sufficient condition for stability. CO2- U

15. Consider system given by Y(s) / U(s) = (s+3) / (s^3+3s+2). Obtain state space representation in controllable form. CO4 -App

PART – C (5 x 16= 80Marks)

16. (a) A packing crate was designed to protect a fragile instrument during shipment. Assuming that thepacking material can be modeled as an ideal linear spring of stiffness, *k*, in parallel with an ideallinear damper, *b*, and that the instrument of mass, *m*, the system can be modeled as shown in Figure. CO1- App (16)

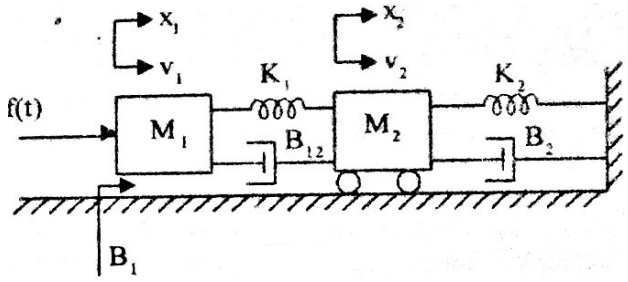


(a) Develop the free body diagram of the above system

(b) Derive the differential equation for the system.

Or

(b) 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. CO1- App (16)



17. (a) The Unity feedback system is characterized by a open loop transfer function G(s)=K/S(S+10). Determine the gain K. So that this system will have a damping ratio of 0.5 for this value of K, settling time, peak overshoot, peak time of the system for unit step input. CO2- App (16)

Or

(b) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K(s+9)}{s(s^2+4s+11)}$. Sketch the root locus of the system. CO2- App (16)

18. (a) Construct the Bode plot for the following transfer function and obtain the gain and phase cross over frequencies whose CO2- App (16)

$$G(s) = \frac{20}{s(1+3s)(1+4s)}$$

Or

(b) Construct the Polar plot for the following transfer function and obtain the gain margin and phase margin whose CO2- App (16)

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

19. (a) Construct Routh array and Analyze the stability of the system whose characteristic equation is $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. Also determine the number of roots lying on right half of S-plane, left half of s-plane and on imaginary axis. CO2- App (16)

Or

(b) For a certain system, $G(s) = \frac{0.025}{s(1+0.5s)(1+0.05s)}$. Design a suitable lag compensator to give, velocity error constant = $20sec^{-1}$ and phase margin = 40°. CO3- C (16)

20. (a) Examine whether the system described by the following state equation is completely state controllable and observable. CO4- Ana (16)

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

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

Or

(b) The transfer function of a control system is given by CO4- App (16)

$$\frac{Y(s)}{U(s)}=\frac{(s+2)}{(s^3+9s^2+26s+4)}$$

Develop state space representation of a system