C **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code:R4302

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Fourth Semester

Electrical and Electronics Engineering

R21UEE402 - CONTROL SYSTEMS

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5Marks)

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. 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) $(s^2 - 5s)/ (s-5)$

3. 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

4. Consider the loop transfer function K(s+6)/(s+3)(s+5). In the root locus diagram the centroid will be located at: CO3- App

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

5. Which among the following is a unique model of a system? CO1- U

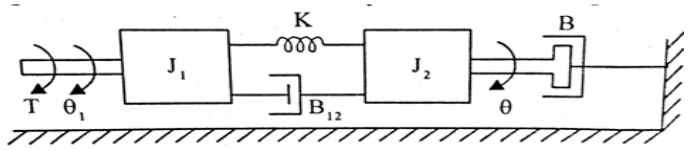
   (a) Transfer function (b) State Variable (c) Both a&b (d) None of these

PART – B (5 x 3= 15 Marks)

6. State Mason's gain formula. CO1- U
7. Determine the type and order of the system G(s)=35(s+4)/s(s+2)(s+5). CO2- App
8. Sketch the polar plot of the function $G(S) =1/S(S+T_1)(1+ST_2)$. CO3- App
9. Explain the necessary condition for stability. CO1- U
10. Define Controllability. CO1- U

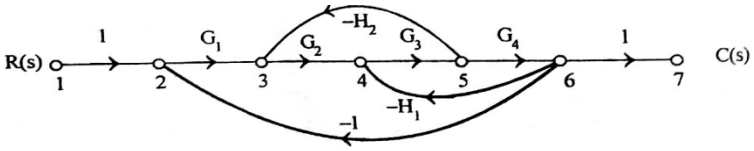
PART – C (5 x 16= 80 Marks)

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



Or

(b) Build the overall gain C(s)/R(s) for the signal flow graph shown in figure. CO2-App (16)



12. (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)

13. (a) Analyze the Bode plot for the given transfer function by determining the magnitude and phase response, and identifying the gain and phase crossover frequencies, while discussing their implications for system stability and performance. CO4-Ana (16)

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

Or

(b) Construct the polar plot for the following transfer function and find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. Analyze its stability CO4-Ana (16)

$$G(s) = \frac{(1+0.2s)(1+0.025s)}{s^2(1+0.005s)(1+0.001s)}$$

14. (a) A unity feedback control system has an open loop transfer function. Sketch the root locus $G(s) = \frac{K}{S(S^2+4S+13)}$ CO3-App (16)

Or

(b) Sketch the Root locus of the system, whose open loop transfer function is $G(s) = \frac{K}{S(S+2)(S+4)}$ CO3-App (16)

15. (a) Design a lag compensator for a unity feedback system with open loop transfer function G(s)= k / s(2s+1) to satisfy the following specifications. CO6-Cre (16)

a. Velocity error constant K_v>=0.2
b. Phase margin =40°

Or

(b) Design a lead compensator for a unity feedback system with open loop transfer function G(s)= k / s(s+1)(s+5) to satisfy the following specifications. CO6-Cre (16)

(i) Velocity error constant K_v>=50
(ii) phase margin is >=20°