# GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, ODISHA, GUNUPUR
## (GIET UNIVERSITY)

B. Tech (Fourth Semester - Regular) Examinations, April – 2025

**23BELPC24002/23BEEPC24002 – Control Systems**

(EE/EEE)

Time: 3 hrs Maximum: 60 Marks

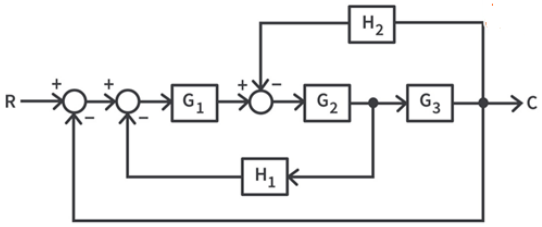
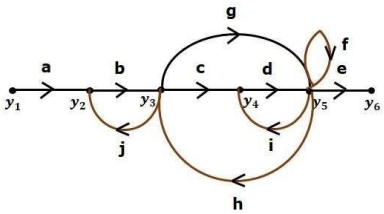
**Answer ALL questions**

**(The figures in the right hand margin indicate marks)**

**PART – A** **(2 x 5 = 10 Marks)**

| | | CO # | Blooms Level |
|---|---|---|---|
| Q.1. | Answer ***ALL*** questions | | |
| a. | What do you mean by time constant of a system? | CO2 | K1 |
| b. | What is Signal Flow Graph (SFG) in control system? State Mason's Gain formula. | CO1 | K1 |
| c. | What are angle and magnitude conditions in root locus? | CO3 | K1 |
| d. | What do you mean by Breakaway point in root locus? How can they be determined? | CO3 | K1 |
| e. | Why negative feedback is preferred in control system? | CO1 | K2 |

**PART – B** **(10 x 5 = 50 Marks)**

| | | Marks | CO # | Blooms Level |
|---|---|---|---|---|
| | Answer ***ALL*** the questions | | | |
| 2. a. | Determine overall transfer function C/R using block diagram reduction technique.   | 5 | CO1 | K3 |
| b. | The forward path gain of unity feedback control system is G(S) = $\frac{144}{S(S+12)}$. Determine the natural frequency, frequency of damped oscillations, maximum overshoot, peak time, rise time and settling time. | 5 | CO2 | K2 |
| | (OR) | | | |
| c. | Determine the overall transfer function T(s) of the system using Mason' Gain Formula.   | 5 | CO1 | K3 |
| d. | Explain the working principle of an open-loop and closed-loop control systems with suitable examples. Discuss the advantages and disadvantages of open-loop systems. | 5 | CO1 | K2 |
| 3.a. | What are time domain specifications and define each of them. | 5 | CO2 | K1 |
| b. | For unity feedback system having G(s ) = $\frac{10(5+1)}{S^2\,(S+2)(S+10))}$ . Determine (i) Type of the system (ii) Steady state error for the input as $(1 + 4t + t^2/2)$ | 5 | CO2 | K2 |
| | (OR) | | | |

| | | | | | |
|---|---|---|---|---|---|
| c. | The open loop transfer function of a servo system with unity feedback is G(s)= $\frac{20}{S(0.1S+1)}$ . Evaluate the static error constants and obtain steady-state error of the system when subjected to $r(t) = 2 + 3t + 4t^2$ | 5 | CO2 | K2 |
| d. | Given a second-order system with transfer function G(s)= $\frac{25}{S^2+6S+25)}$ . Determine the peak time, and settling time (2% criterion) of the system. | 5 | CO2 | K2 |
| 4.a. | The characteristic equation of a system is $s^4 + s^3 + s + 0.5 = 0$. Using Routh's criterion determine (i) Number of roots in the left half of S-plane (ii) Number of roots in the right half of S-plane. Number of roots on the imaginary axis | 5 | CO3 | K3 |
| b. | The transfer function of a unity feedback control system is given by G(s)= $\frac{K}{S(S+2)(S+4)}$ . Draw the root locus plot and hence determine (i) The value of K such that the output response will become sustained oscillations. (ii) The value of K such that the system will be absolutely stable. | 5 | CO3 | K4 |
| | (OR) | | | |
| c. | State and explain Routh's Stability Criterion. Derive the Routh array for a general nth-order polynomial and explain the conditions for stability. Discuss how special cases such as a zero in the first column or an entire row of zeros are handled. Illustrate your answer with a suitable example. | 5 | CO3 | K3 |
| d. | Sketch the complete root locus plot of the following system having G(S)H(S)= $\frac{K}{S(S+1)(S+3)}$. Investigate the stability. | 5 | CO3 | K4 |
| 5.a. | Sketch the polar plot for the transfer function G(S) = $\frac{1}{S^2(S+10)}$ | 3 | CO4 | K2 |
| b. | Construct the Bode plot on a semilog graph paper for a unity feedback system, whose open loop transfer function is given by G(s) = $\frac{10}{S(1+S)(1+0.02S)}$. From the Bode plot determine (i) Gain & Phase crossover frequency (ii) GM, PM and stability of the closed loop system | 7 | CO4 | K4 |
| | (OR) | | | |
| c. | Draw the polar plot for the system $G_2$(s ) = $\frac{5}{S(S+2)(S+10))}$ | 3 | CO4 | K2 |
| d. | A certain unity feedback control system is given by G(s)= $\frac{K}{S(1+S)(1+0.1S)}$ . Draw the Bode-Plot of the above system, Determine the value of K so as to have (i) Gain Margin=15 db (ii) Phase Margin= $40^0$ | 7 | CO4 | K4 |
| 6.a. | Define Nyquist Stability Criterion. | 2 | CO4 | K1 |
| b. | Draw the Nyquist Plot for the system whose open loop transfer function is G(s)H(S) = $\frac{20}{S(S+2)(S+10)}$. Investigate the stability. | 8 | CO4 | K4 |
| | (OR) | | | |
| c. | Consider a type 0, 3rd order system G(s )H(s) = $\frac{10}{(1+S)(1+0,4S)(1+0.1S))}$. Investigate the stability using Nyquist stability criteria. | 6 | CO4 | K4 |
| d. | What do you mean by Gain Margin, Phase Margin, Gain crossover frequency and Phase Crossover frequency of a system? | 4 | CO4 | K1 |

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