X/K/TY

Reg. No: 24BBLOV04

Final Assessment Test – November 2025

VIT
Vellore Institute of Technology

Course: **BEEE303L - Control Systems**

Class NBR(s): **1035** Slot: **C2+TC2**

Time: **Three Hours** Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

General Instruction: Normal, Semilog and Polar graph sheets are to be provided

COs	CO Statements
CO1	Formulate mathematical models of the physical systems.
CO2	Analyze the system performance in time and frequency domains.
CO3	Determine the stability of linear time invariant system in time and frequency domains.
CO4	Design compensators and controllers to meet the performance specifications.
CO5	Perform state space analysis and design state feedback control.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1.a) Determine C/R for the block diagram given in Fig. 1 **CO1 BL3**

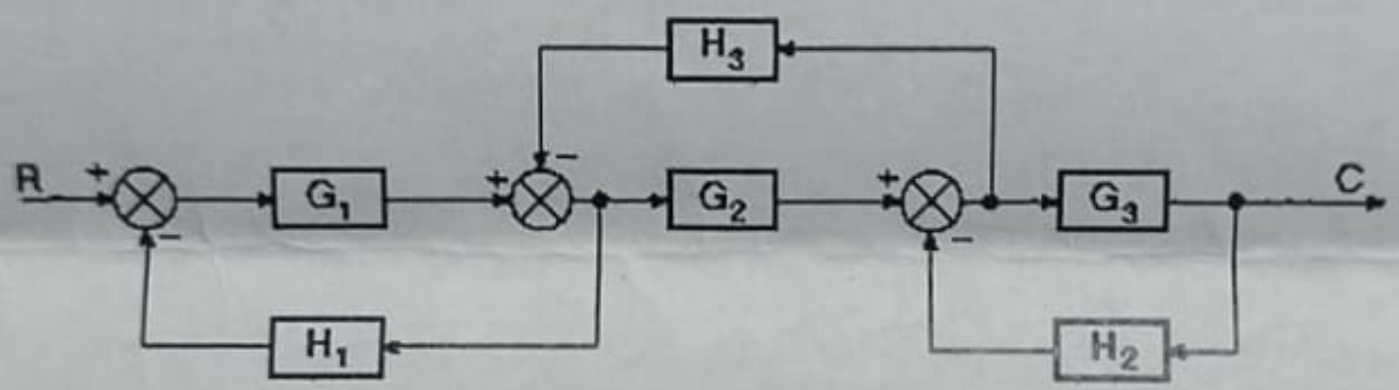

Fig. 1

OR

1.b) Determine the transfer function relating C and R for the diagram shown in Fig. 2. Use Mason's gain formula. **CO1 BL3**

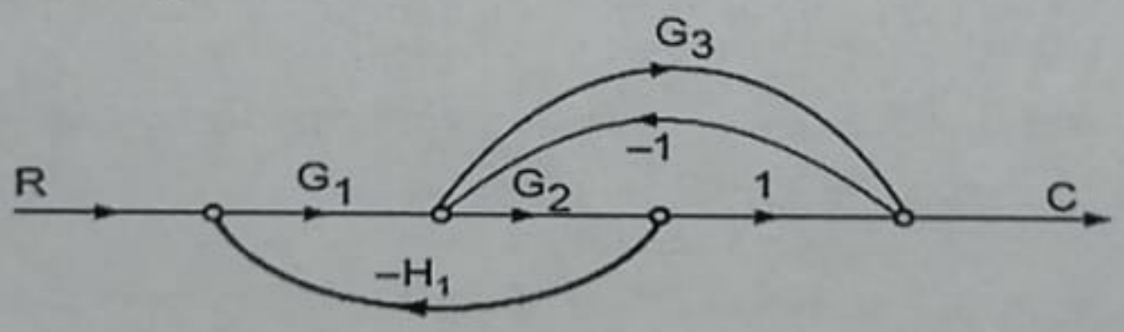

Fig. 2

2. Determine the transfer function of a field controlled d.c. motor relating angular shift in the shaft and the input field voltage. **CO1 BL3**

3. A unity feedback system is characterized by an open loop transfer function $G(s) = K/(s(s+20))$. Determine the gain K so that the system has a damping ratio of 0.6 for this value of K. Calculate rise time, peak time, settling time and peak overshoot for the unit step input. **CO1 BL3**

4. a) A closed loop control system with unity feedback has the forward loop transfer function given by [5] CO1 BL3

$G(s) = \frac{K(2s+1)}{s(5s+1)(1+s^2)}$, if an input of $r(t) = 1+6t$ is applied to the system.

Determine the value of K for the steady state error to be less than 0.1.

b) The closed loop transfer function of a control system is given by [5]

$$\frac{C(s)}{R(s)} = \frac{2(s-1)}{(s+2)(s+1)}$$

For the unit step input what is the output?

5. Determine the stability of a system whose overall transfer function is given below. CO2 BL3

$$\frac{C(s)}{R(s)} = \frac{2s+5}{s^5+1.5s^4+2s^3+4s^2+5s+10}$$

If the system is found unstable, how many roots it has with positive real part?

6. The transfer function of a unity feedback control system is given by CO2 BL3

$$G(s) = \frac{K}{s(s+2)(s+4)}$$

Sketch the root locus and determine the value of K for sustained oscillations in output.

7.a) Construct Bode plot for the system whose open loop transfer function is given below and determine (i) the gain margin (ii) the phase margin (iii) the closed loop stability. CO3 BL3

$$G(s)H(s) = \frac{4}{s(1+0.5s)(1+0.08s)}$$

OR

7.b) Sketch polar plot for the unity feedback system with open loop transfer function is given below and determine (i) the gain margin (ii) the phase margin (iii) the closed loop stability. CO3 BL3

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

8. Investigate the stability of the system with transfer function CO3 BL3

$G(s)H(s) = \frac{50}{(s+1)(s+2)}$ using Nyquist stability criterion.

9. The open loop transfer function of a unity feedback control system is given by CO4 BL3

$(s) = \frac{K}{s(1+0.5s)(1+0.2s)}$. It is desired that

i) For a unit ramp input the steady state error of the output be less than 0.125.

ii) The PM ≥ 30° and (iii) the GM ≥ 10 db

iii) Design a suitable lag compensation network.

10. Is the following system completely state controllable and completely observable? CO5 BL3

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -24 & -26 & -9\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u, \qquad y = \begin{bmatrix}2 & 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

⇔⇔⇔ X/K/TY ⇔⇔⇔