Name:

Enrolment No:

UPES

End Semester Examination, December 2023

Course: Control System Engineering **Semester: I**

Program: M.Tech Robotics Engineering **Time : 03 hrs.**

Course Code: ECEG7025 **Max. Marks: 100**

Instructions: Attempt all the questions. Assume any missing data. Read all the instructions carefully

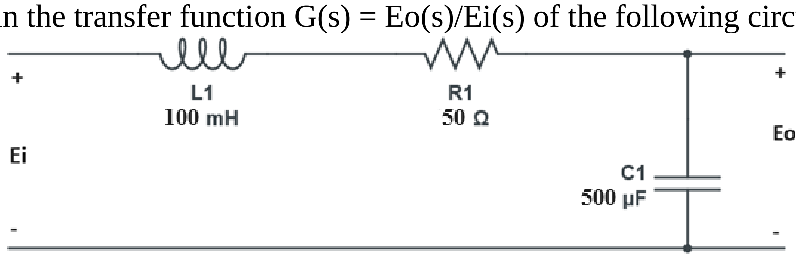
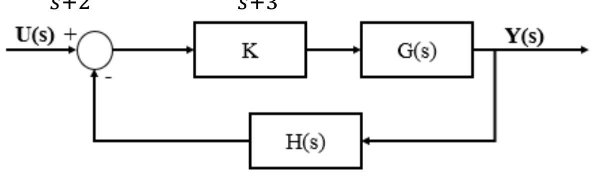
SECTION A

(5Qx4M=20Marks)

S. No.		**Marks**	**CO**
Q 1	Define transfer functions in the context of control systems. How are they used to represent the relationship between input and output?	**4**	**CO1**
Q 2	Explain the fundamental principles of feedback control systems. How do they contribute to stability and performance in engineering applications?	**4**	**CO1**
Q 3	Differentiate between linear and nonlinear systems with suitable examples.	**4**	**CO1**
Q 4	Explain the advantages of state-space modeling when dealing with multivariable systems.	**4**	**CO2**
Q 5	Discuss the concept of the region of convergence (ROC) in Z-transform analysis.	**4**	**CO3**

SECTION B

(4Qx10M= 40 Marks)

Q 6	Obtain the transfer function G(s) = Eo(s)/Ei(s) of the following circuit. 	**10**	**CO1**
Q 7	Evaluate the closed loop transfer function of the following system and comment on its stability. Where, $G(s) = \frac{1}{s+2}$, $H(s) = \frac{1}{s+3}$ and K=2. 	**10**	**CO2**
Q 8	Obtain the controllable state space form of the system G(s) represented by the following transfer function.	**10**	**CO3**

	$G(s) = \dfrac{1}{s^2 + 4s + 3}$		
Q 9	Comment on the system controllability represented in the state space form as $$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 2 & 2 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$	**10**	**CO3**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	Determine the state transition matrix for the given system. Additionally, calculate the poles of the system and provide an assessment of the system's stability. $$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$	**20**	**CO2**
Q 11	Determine the following for the system G(s) represented by the following transfer function. $G(s) = \dfrac{s^2 + 7s + 10}{s^3 + 13s^2 + 30s}$ a) Obtain the open loop poles and zeros of plant G(s) b) Obtain the closed loop poles and zeros of the plant G(s) with negative unity gain feedback. c) Evaluate the root-locus of the plant G(s) Or Calculate the state feedback gain for pole placement, aiming to position the desired poles at s = -2 and s = -3. $$\dot{x}(t) = \begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u(t)$$	**20**	**CO3**