Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2024

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

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

Course Code: ECEG7045 **Max. Marks: 100**

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

SECTION A

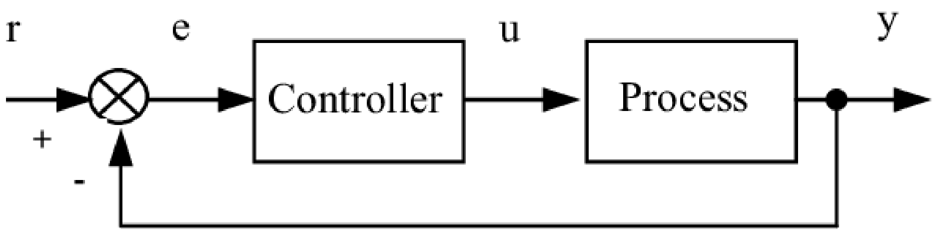
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Illustrate advantages of modern control system over classical control system?	**4**	**CO1**
Q 2	Explain linear quadratic controller? List its advantage over the PID controller.	**4**	**CO2**
Q 3	List the various representations of the classical control system. List the advantages of each representation.	**4**	**CO2**
Q 4	Name the model based and model free controllers. Identify their output type and feedback nature?	**4**	**CO1**
Q 5	Determine the system poles of the represented in the state space form as $$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}2 & 0\\ 0 & 3\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}u(t)$$	**4**	**CO3**

SECTION B

(4Qx10M= 40 Marks)

S. No.		Marks	CO
Q 6	Explain absolute and relative stability with suitable example? **Or** Determine the value of K based on Routh stability criterion for which the system is stable whose characteristic equation is given as $s^4 + 2s^3 + 3s^2 + s + K = 0$s	**10**	**CO2**
Q 7	Comment on the system controllability represented in the state space form as $$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}0 & 1\\ 4 & 3\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}u(t)$$	**10**	**CO3**
Q 8	How do the Proportional, Integral, and Derivative components of a PID controller replicate certain behavioral aspects? Do these components inherit any intrinsic model properties, or do they simply reproduce the desired control behavior?	**10**	**CO3**
Q 9	Consider the LQR controller used in the diagram for regulating a home temperature control process. Provide insights on the following:	**10**	**CO1**

<table>
<tr><td></td><td>a) Identify if the controller functions as a feedback or feedforward system.
b) Specify the physical quantity being monitored.
c) Evaluate whether the controller is model-based or model-free.
d) If the plant is substituted with a model, what conclusions can be drawn? In which situations could this be beneficial?

</td><td></td><td></td></tr>
<tr><td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td></tr>
<tr><td>Q 10</td><td>Obtain the state transition matrix for the given system. Additionally, calculate the poles of the system and provide an assessment of the system's stability.
$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 3 \end{bmatrix} u(t)$$</td><td>20</td><td>CO2</td></tr>
<tr><td>Q 11</td><td>Obtain the transfer function representation of the system from the given state-space model. Calculate the poles and zeros of the system and analyze its stability.
$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = [\,0\ 1\,] \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + 0u(t)$$
Or
Explain the State feedback control. Calculate the state feedback gain for pole placement, aiming to position the desired poles at s = -2 and s = -3.
$$\dot{x}(t) = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix} x(t) + \begin{bmatrix} 2 \\ 2 \end{bmatrix} u(t)$$</td><td>20</td><td>CO3</td></tr>
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