Sub Code: MEET-102 **ROLL NO.**

Model Question Paper

COURSE: M.TECH. **BRANCH**: ELECTRICAL ENGINEERING

SEMESTER: 1 . **SUBJECT**: ADVANCED CONTROL SYSTEM

Duration: 3:00 hrs **Max marks: 100**

Note: Attempt all questions.

1. **Attempt any four parts of the following.** **5x4 = 20**

   A. Discuss how modern control system is different from conventional control system.
   B. Illustrate necessary and sufficient conditions for arbitrary pole placement.
   C. Write short notes on full order and reduced order state observer.
   D. Linearize the nonlinear equation z = xy in the region $5 \leq x \leq 7$, $10 \leq y \leq 12$. Find the error if linearized equation is used to calculate the value of z when x = 5, y = 10.
   E. Discuss the effects of addition of the observer on a closed – loop system.
   F. Explain the importance of Z-transform in discrete time control system.

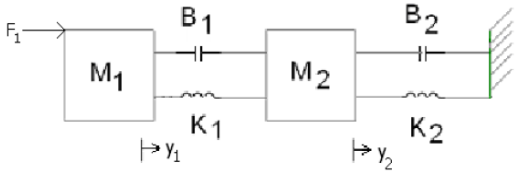
2. **Attempt any two parts of the following.** **10x2=20**

   A. Decide which method is better for stability criterion, amongst Liapunov's method and Popov's method.
   B. Explain robust control system with illustration of Robust stability and Robust Performance.
   C. Obtain state transition matrix $\acute{O}(t)$ of following system using Laplace Transform approach

$$\begin{matrix}\dot{x}_1 \\ \dot{x}_2\end{matrix} = \begin{matrix}0 & 1 \\ -2 & -3\end{matrix} \begin{matrix}x_1 \\ x_2\end{matrix}$$

3. Attempt any two parts of the following. **10x2=20**

   A. Obtain the state model of mechanical system shown in figure



   B. Consider the system below

$$A = \begin{matrix}0 & 0 & 0 \\ 3 & 2 & 0 \\ 1 & 1 & 1\end{matrix}, B = \begin{matrix}0 & 0 \\ 1 & 0 \\ 0 & 1\end{matrix}, C = \begin{matrix}1 & 2 & 0 \\ 0 & 0 & 1\end{matrix}$$

   Express into the observable form.

   C. Discuss the importance of ordinary differential equation on Modern control system theory.

4. Attempt any two parts of the following. 10x2=20

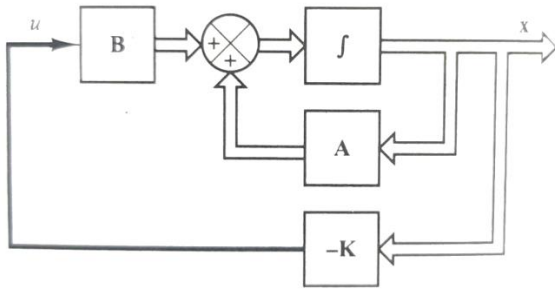
A. Consider the system and Transform system into controllable canonical form

$$\dot{X} = \begin{matrix} -1 & 0 & 1 \\ 1 & -2 & 0 \\ 0 & 0 & -3 \end{matrix} X - \begin{matrix} 0 \\ 0 \\ 1 \end{matrix} U \text{ and output } y = \begin{matrix} 1 & 1 & 0 \end{matrix} X$$

B. Obtain State Space equation in Phase variable form for following differential equation

$$2\frac{d^3y}{dt^3} + 4\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 8y = 10u(t)$$

C. Consider the regulator system shown below



The plant is given by $\dot{x} = Ax + Bu$

Where $A = \begin{matrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{matrix}$, $B = \begin{matrix} 0 \\ 0 \\ 1 \end{matrix}$, The system uses the state feedback control **u = -Kx.**

Let us choose the desired closed-loop poles at s = -2 + j4, s = -2 - j4, s = -10

Determine the state feedback gain matrix **K**.

5. Attempt any two parts of the following. 10x2=20

A. Illustrate the first order condition (Maximum Principle) in optimum control theory to solve the problems.

B. Consider the system

$$\dot{x} = Ax + Bu$$
$$Y = Cx$$

Where $= \begin{matrix} 0 & 20.6 \\ 1 & 0 \end{matrix}$, $B = \begin{matrix} 0 \\ 1 \end{matrix}$, $C = \begin{matrix} 0 & 1 \end{matrix}$

Observed state feedback is such that u = -KẊ. Design a full order state observer. Assume that the desired eigen values of observer matrix are μ_1 = -10, μ_2 = -10.

C. Discuss the jury criterion used for determining stability of discrete system.