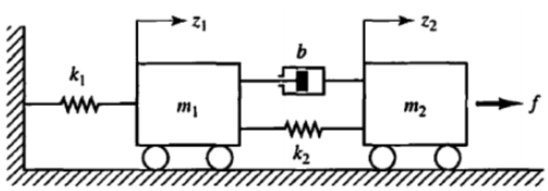
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIFTH SEMESTER B. TECH (ELECTRONICS AND INSTRUMENTATION)
PROCTORED ONLINE END SEMESTER EXAMINATION Feb. 22
SUBJECT: Modern Control Theory (ICE - 3153)

TIME: 9.20AM to 10.35 AM **DATE:19.02.22** **MAX MARKS 20**

Note: Answer All questions.

1	A	Using Silvester's Interpolation formulae obtain state transition matrix of the given system. $\dot{x}(t)=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}x(t)+\begin{bmatrix}0\\ 1\end{bmatrix}u(t)$	3 M
	B	Design state feedback control law for the given regulatory system using Ackermann's formula, $\dot{x}(t)=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}x(t)+\begin{bmatrix}0\\ 1\end{bmatrix}u(t)$ and $y = [1 \quad 0]x(t)$; The desired poles are at -5 & -5	4 M
	C	Assuming minimal state variables, derive the state space model for the following system. z_1 and z_2 are two outputs of the system.  Fig. Q1. C	3 M
2	A	Define Lyapunov's linearization theorem. For the following systems, investigate whether the origin is stable, asymptotically stable or unstable. (1) $\dot{x}_1 = -2x_1 + x_1^3;\quad \dot{x}_2 = -x_2 + x_1^2;\quad \dot{x}_3 = -x_3$ (2) $\dot{x}_1 = -x_1;\quad \dot{x}_2 = -x_1 - x_2 - x_3 - x_1x_3;\quad \dot{x}_3 = (x_1+1)x_2$	5 M

	B	For the nonlinear system given below use a quadratic Lyapunov function candidate to show that the origin is asymptotically stable. $\dot{x}_1 = -x_2 - x_1(1 - x_1^2 - x_2^2); \quad \dot{x}_2 = x_1 - x_2(1 - x_1^2 - x_2^2)$	3 M
	C	With an example explain the concept of Lyapunov's direct method for stability definition.	2 M