Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

A Constituent Institution of Manipal University

FIFTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER EXAMINATIONS, DEC - 2017

SUBJECT: MODERN CONTROL THEORY [ICE 3101]

Duration: 3 Hour Max. Marks:50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A List the advantages of state space analysis 2

1B Derive a state model for the armature controlled DC servomotor. 3

1C For the translational mechanical system shown in Fig. Q1C, select the minimal state variables and find the state model in physical variable form. Take x_1 displacement as the output. 5

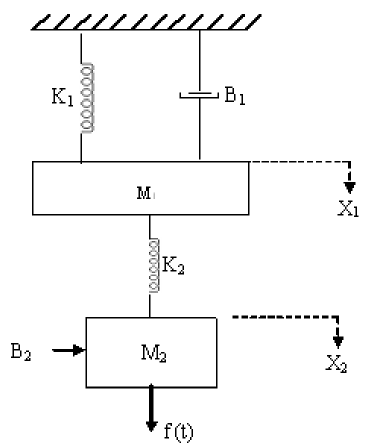

Fig. Q1C

2A Check the controllability and observability of the system given below using any one method. 2

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 10\\ 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u; \quad y=\begin{bmatrix}0 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

2B Given A=$\begin{bmatrix} -3 & 2 \\ 0 & -1 \end{bmatrix}$.Compute e^{At} using Cayley Hamilton method. 3

2C A system is described by the transfer function $G(s) = \dfrac{s^2 + 4s + 4}{s^3 + 5s^2 + 4s}$, develop a state model in i) phase variable form ii) diagonal or Jordan form iii) Draw the state diagram for both the cases. 5

3A Find the Z transform of $Cos\ \omega t$ 2

3B Determine whether the following system is stable, unstable or marginally stable. 3

$y(k+2)+0.5y(k+1)+0.06y(k) = (-0.5)^k$

3C A system is described by the equation 5

$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$, the system is initially at $x(0) = \begin{bmatrix} 1 & 0 \end{bmatrix}^T$. Find the states for any time t,

(i) with no input ii) with unit step input.

4A State initial and final value theorems in discrete domain 2

4B Determine the stability of the discrete time system whose characteristic equation is given by $F(z) = z^5 + z^4 + 2z^2 + z + 1$ 3

4C Design an observer for the process given by 5

$G(z) = \dfrac{2}{(z+1)^2}$. The design specifications of the observer is critically damped with $\omega_n = 0.4\ rad/\sec$ and T=1 sec.

5A List the properties of Lyapunov function 2

5B A continuous time system is described by the state model 3

$\dot{x}(t) = \begin{bmatrix} 0 & \omega \\ -\omega & 0 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ \omega \end{bmatrix} u(t)$, discretize the given continuous time system.

5C Consider the following system $\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -0.5 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$ Determine the stability of the origin of the system by Lyapunov method 5