

Code: 9A02803

R09

B.Tech IV Year II Semester (R09) Advanced Supplementary Examinations June/July 2016

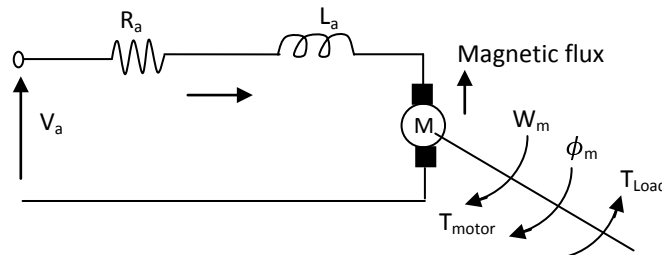
MODERN CONTROL THEORY
(Electrical & Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

- 1 (a) Explain the concepts of state, state variables, state model and state diagram with suitable examples.
- (b) Consider the system shown below for the D.C motor.



Obtain the state space model. Obtain its state diagram and also the block diagram.

- 2 Convert the following state model into the Jordan canonical form and then comment on controllability and observability.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u(t)$$

$$z(t) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix}$$

- 3 A single input system is described by the following state equation:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 0 & 1 & -3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \\ x_3(t) \end{bmatrix} + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u(t)$$

Design a state feedback controller which will give closed loop poles at $-1 \pm 2j, -6$.

- 4 (a) What is a describing function? Explain how an element with dead-zone can be analyzed using describing function method.
- (b) Write short notes on Jump response.
- 5 (a) Explain the method of phase plane analysis of non-linear system.
- (b) Write short notes on singular points.
- 6 Define the stability in sense of Lyapunov. Discuss briefly about all the methods of constructing Lyapunov functions for non-linear systems.
- 7 Explain the following:
 - (a) Minimum fuel problem.
 - (b) Output regulator problem.

- 8 (a) What is the variable and paint problem? Discuss the generalized boundary condition.

- (b) Explain the term linear quadratic regulator.