Code: 9A02803

$\boxed{\textbf{R09}}$

B.Tech IV Year II Semester (R09) Advanced Supplementary Examinations June/July 2016
MODERN CONTROL THEORY
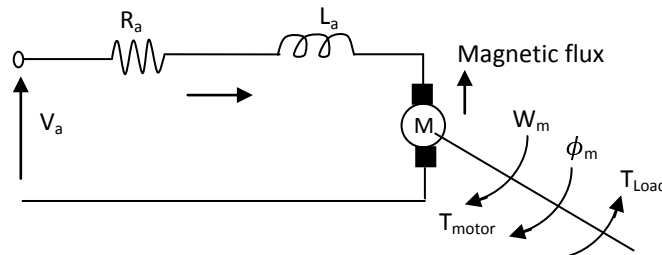(Electrical & Electronics Engineering)

Time: 3 hours   Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks
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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 $-1 \pm 2, -6$.

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

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