Government College of Engineering, Aurangabad

(An Autonomous Institute of Government of Maharashtra)

ME ELECTRICAL (EMD)Examination

End Sem Examination Nov 2016

EE643 Modern Control Systems

Time: Three Hours Date: 2 DEC 2016 *Max. Marks: 60*

"Verify the course code and check whether you have got the correct question paper"

Instructions:

1. *All questions are compulsory*
2. *Figures to the right indicate full marks*
3. *Assume suitable data if necessary & state it clearly*
4. *Use of non programmable calculator is allowed*

Q.1 Solve any six (6x8=48M)

a. Convert the state and output equations to transfer function.

$$\dot{x} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

b. Define controllability. Determine whether system

$$\dot{X} = AX + Bu = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & -1 \\ -2 & -4 & -5 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$ is controllable.

c. Derive the equation for state transition matrix. State the properties of State Transition Matrix.

d. . A second order linear system is described by

$\dot{x} = -3x_1 + x_2 + u$

$\dot{x}_2 = -x_1 - x_2 + u$ Find out state transition matrix.

$y = x_1 + x_2$

e. Design full state observer for the system

$$\dot{x}(t) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 1 & -2 & -1 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$ The desired pole locations are s=-1+j1, -1-j1,-2.

$$y = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} x$$

f. Find the state model for the system with transfer function in cascade form and draw signal flow graph.

$$C(s)/R(s) = \frac{24}{(s+2)(s+3)(s+4)}$$

g. Compare state space approach with transfer function approach.Determine the stability of the system described by the following equation:

$\dot{x} = Ax$

$$A = \begin{bmatrix} -1 & -2 \\ 1 & 4 \end{bmatrix}$$

h. Explain the rationale of cascade control system with an example and explain why it provides better response than a simple feedback.

Q.2 Solve any two (6x2=12M)

a. Write a short note on Model Reference Adaptive controller.

b. Explain minimum energy, minimum time problem, and minimum fuel problem

c. Write short notes on Jump resonance and Limit Cycle