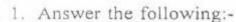
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(3 Hours)

[Total Marks :80

N.B.: (1) Question no. 1 is compulsory.

- (2) Attempt any three questions from remaining five questions.
- (3) Assume suitable data if needed.



- (a) Explain the need of compensator.
- (b) State advantages of modern control over traditional entrol system.
- (c) Obtain transfer function using state model.

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \mathbf{u}, \quad \dot{\mathbf{Y}} = \begin{bmatrix} 1 & 0 \end{bmatrix} \mathbf{x}.$$

- (d) Derive the transfer function of lead compensator
- 2. (a) Construct state models of the following

(i)
$$T(S) = \frac{S+2}{S^3 + 5S^2 + 6S + 7}$$

(ii)
$$\frac{d^3y}{dt^3} + 5\frac{d^2y}{dt^2} + 7\frac{dy}{dt} + 4y = 3\frac{du}{dt} + 4w$$

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- (b) Explain design steps of lag compensator using root locus.
- 3. (a) A unity feedback type 2 system with $G(S) = \frac{K}{S^2}$. It is desired to Compensate the system so as to meet the following transient specifications.

$$t_s \le 4 \sec$$

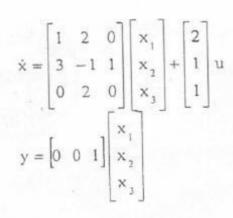
(b) State controllability and observability. Check following system is controllable or observable?

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \mathbf{u}$$

$$\mathbf{y} = \begin{bmatrix} 3 & 4 & 1 \end{bmatrix} \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \end{bmatrix}$$

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The desired poles are -4, $-3\pm j$

- (b) Find STM where, $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ and obtain homogeneous response when initial conditions $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$
- 5. (a) For the plant $G(S) = \frac{10(S+10)}{S(S+3)(S+12)}$ Give steps to be used to design the phase variable feedback gain to yield 5% over shoot and peak time 0.3 sec. Find the state feedback gain vector.
 - (b) A unity feedback system with an open loop T.F. $G(S) = \frac{k}{S(S+1)}$ where $K_v = 12 / \sec \Phi_m = 40^0$ Design suitable compensator.
- 6. (a) Explain design steps for lead compensator using bode plot.

 (b) Design PID controller for the system $G(S) = \frac{K}{S(S+1)(s+2)}$ Determine compensated block $G_c(S)$

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Correction:



Following line is not printed in first line of of second page of QP 5696. Read as follows:

Q. 4. (a) Design state observer for the system which is given as:

Query Update time: 07/12/2015 04:05 PM