B.E. (Electrical (Electronics & Power) Engineering) Seventh Semester (C.B.S.)

Control System – II

P. Pages : 3 | **NRJ/KW/17/4598**

Time : Three Hours | Max. Marks : 80

* 0 4 5 6 *

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. a) Compare feedback and cascade compensation? **6**

b) Compare lag and lead compensating network. **7**

OR

2. a) Derive transfer function of an electrical lead network. Determine the frequency at which maximum phase lead is obtained. Draw its BODE PLOT. **9**

b) Justify the selection of lead compensator for improving the transient performance of the system. **4**

3. a) Find the state transition matrix using Laplace transform method when. **7**

$$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}.$$

b) The state equation of system are given by **7**

$$\dot{x}_1 = 4x_1 + x_2 - 2x_3 + u$$

$$\dot{x}_2 = x_1 + 2x_2 + u$$

$$\dot{x}_3 = x_1 - x_2 + 3x_3$$

$$y = x_1$$

obtain Jordan's canonical form.

OR

4. a) A system represented by state equation. **7**

$$\dot{x}(t) = A \cdot x(t).$$

The response to $x(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $x(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$

and $x(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $x(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

Determine the system matrix A.

b) A linear time invariant system is described by the following state model. **7**

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} u$$

$$y = x_1 = [1 \quad 0 \quad 0] x_1.$$

Transform this state model into canonical state model.

5. The open loop system is describe by **13**

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

1) Comment on stability of the open loop system.
2) Is it possible to stabilise the system by using state feedback.
3) If the answer to part 2 is yes design state feedback controller so as system should have setting time of 4 sec and % overshoot of 16.2% to a unit step input.
4) Draw block diagram of the system with feedback.

OR

6. a) Find the condition on b_1, b_2, c_1, c_2 such that the system is controllable as well as observable. **7**

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} x + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} u$$

$$y = [c_1 \quad c_2] x.$$

b) Explain Kalman and Gilbert's test for controllability and observability. **6**

7. a) Consider feedback system shown in fig. Q. 7. a. the output is required to track the unit step input. Determine the value of α that minimizes ISE & find the minimum value of ISE. **7**

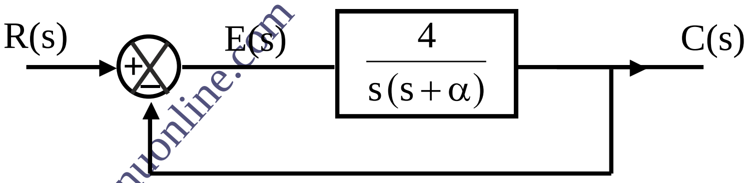

Fig. Q. 7 (a)

b) State and prove Parseval's theorem. **6**

OR

8. Determine optimal values of the parameter K_1 and K_2. Such that the performance index. **13**

$$J = \int_0^\infty \left(e^2 + 0.25u^2\right) dt$$

is minimized for system shown in fig Q.8.

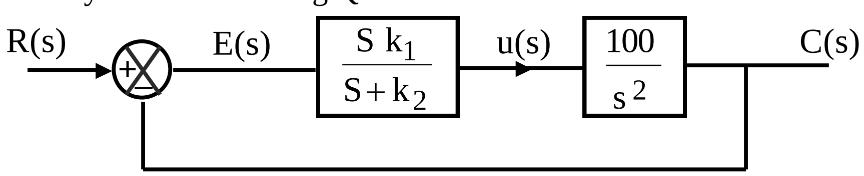

Fig : Q 8

Also comment on the stability of close loop system with these optimal parameter.

9. a) Explain Jump Resonance for the spring. **7**

b) Explain procedure for the construction of phase trajectory using delta method. **6**

OR

10. Drive the describing function of the element whose input-output characteristics in shown in fig. Q. 10. Show that the required describing functions equal the sum of the describing functions of relay with dead-zone and amplifier with dead-zone. **13**

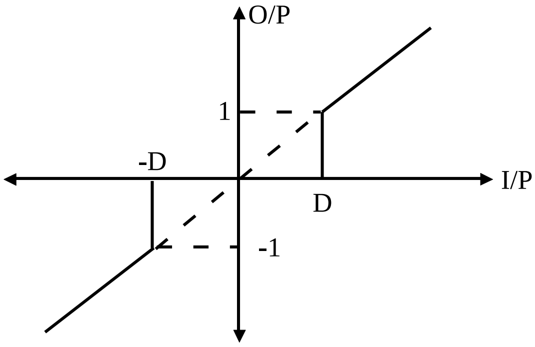

Fig 10

11. a) The discrete time system is described by. **7**

y (k + 2) – 5y (k+1) + 6y (k) = u (k) & (ck) = 2y (k).
Assume y (0) = 0; y (1) = 1, u (k) = 1
for $k \geq 0$
= 0 for k < 0
find output y (k) and sequence generated.

b) The characteristic equation of sample data system is given by **7**

$$z^3 - 0.5z^2 + 2.49z - 0.496 = 0$$

Comment on the stability of sampled data system and obtains the distribution of z-roots in z-plane.

OR

12. A sample data control system is describe by following difference equation. **14**

$$y(k+2) + 5y(k+1) + 3y(k) = r(k+1) + 2r(u).$$

1) Find transfer function.
2) Find state model.
3) Obtain characteristics equations in both the cases and check stability.
4) Comment on controllability and observability.

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