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

Control System - II

P. Pages : 3 **KNT/KW/16/7459**

Time : Three Hours Max. Marks : 80

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 wherever necessary.
9. Illustrate your answers wherever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. Derive the TRANSFER FUNCTION of ELECTRICAL LEAD NETWORK. Determine the frequency at which maximum phase lag is obtained. **13**

OR

2. a) State the comparison between lag and lead compensating network. **7**

b) Explain the necessity of COMPENSATOR in control system compare feedback compensation and series compensation. **6**

3. A series R-L-C circuit with $R = 2\Omega$, $L = 1H$ & $C = 1F$ is switched across a battery with input voltage $v_i = 10$ - volt, as shown in 'Fig. 3'. **14**

i) Obtain STM for the system

ii) Using the STM from 'PART-i', find i (t).

iii) Obtain the inverse of STM at t = 1-sec.

Consider the R-L-C series circuit is under initially relaxed condition.

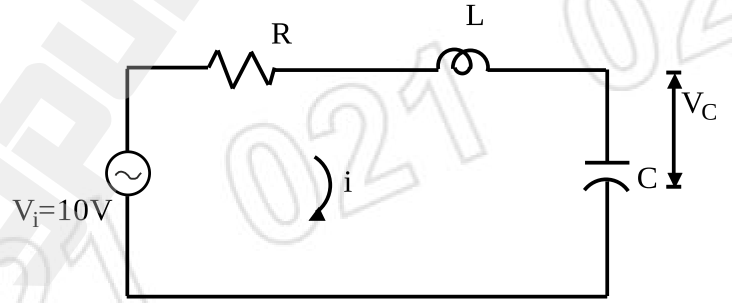

Fig. 3

OR

4. a) Obtain JORDON's CANONICAL form if- **7**

$$[A] = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -5 & -4 \end{bmatrix}$$

b) Explain: **4**

i) Canonical variables ii) Phase variables

c) State the advantages of state variable feedback design over the classical design technique. **3**

5. a) A control system is represented by the following state model: **9**

$$\dot{\underline{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \underline{x} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \underline{u}$$

Design a 'FEEDBACK CONTROLLER' so the eign values of the closed loop system are at $-2, -1 \pm j1$.

b) Define controllability and observability. Explain GILBERTS TEST OF controllability for diagonal form of matrix. **4**

OR

6. a) For the system governing the following equation, find controllability and observability. **7**

$$\ddot{y} + 2\frac{dy}{dt} + y = \dot{u} + u.$$

Given : $x_1 = y$ and $x_2 = \dot{y} - u$.

b) Given: **6**

$$\dot{\underline{x}} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} \underline{x} + \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} \underline{u}$$

Find conditions on b_1, b_2 and b_3 such that the system is CONTROLLABLE.

7. a) The closed loop transfer function for disturbance input n (t). **8**

$$\frac{C(S)}{N(S)} = \frac{S(S+\alpha)}{S^2 + \alpha s + 10}$$

Determine 'α' so that ISE due to disturbance signal is minimized. Also obtain minimum value of ISE.

b) State and prove 'PARSEVAL's THEOREM'. **5**

OR

8. a) A unity feedback system with $G(S) = \frac{K}{S}$, Find 'K' which minimizes the performance index- **8**

$$J = \int_0^\infty \left[e^2 + \lambda(\ddot{e})^2\right] dt$$

Assume r (t) = 1.

b) Give different types of optimal control problems. **5**

9. a) Derive the describing function of amplifier with dead zone with input-output characteristics is shown in 'Fig. 9 (a)'. **9**

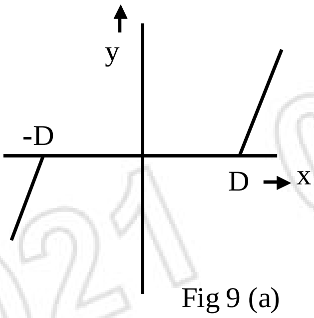

Fig 9 (a)

b) Write the assumptions made in the describing function analysis. **5**

OR

10. Write short notes on:

a) Phenomenon of 'JUMP RESONANCE' in the behaviour of non-linear element. **7**

b) Stability analysis of describing function method. **7**

11. a) "A continuous time stable system becomes conditionally stable system when converted into sampled data control systems". Explain the statement with unity feedback system having '$G(S)=\frac{K}{S}$'. **6**

b) Explain SHANON's SAMPLING THEOREM'. **3**

c) Explain the significance of 'SAMPLER AND HOLD DEVICE'. **4**

OR

12 a) Find the unit step response for the first order temperature control system shown in 'Fig. 12 (a)'. **8**

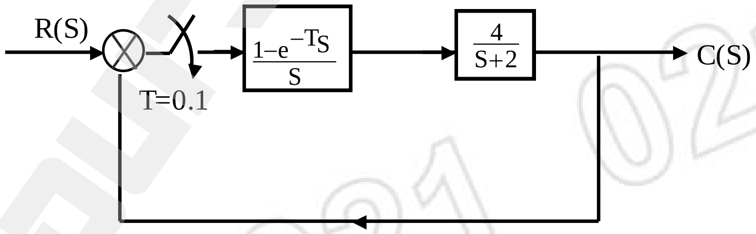

Fig. 12 (a)

b) Solve linear differential equation & determine output y (k). **5**

$y(k+1)+2y(k)=\delta(k);\ y(0)=0.$

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