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

Control System – II

P. Pages : 3 **NRT/KS/19/3543**

Time : Three Hours *0248* 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 whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. Derive the TRANSFER FUNCTION of RC passive LEAD NETWORK. Draw its BODE PLOT. Determine the frequency at which maximum phase lead 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. Discuss different types of compensators. **6**

3. a) A system is described by –

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

i) Comment on the stability of the system **2**

ii) Obtain the MODAL MATRIX, hence find the diagonal matrix. **7**

b) Write the significance of the following. **4**
i) State Transition Matrix.
ii) Canonical State Model.

OR

4. A linear time invariant system is represented by the following non – homogeneous state equation –

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

where u is unit step function.
Find :

a) State Transition Matrix by CALEY HAMILTON THEOREM. **6**

b) Inverse of STM at t = 1 – sec. **2**

c) 10^{th} power of STM. **2**

d) The solution of state vector assuming **3**

$x^T(0) = [1\ 0]$

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

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

Comment on the stability of the system and design a feedback controller so that the eigen values of the closed loop system are at $-2, -1 \pm j1$.

b) Define and give the significance of the following – **4**

i) Controllability ii) Observability

OR

6. a) The transfer function is given by – **10**

$$\frac{Y(s)}{U(s)} = \frac{s+2}{s^2+2s+1}$$

i) Construct the state model in PHASE VARIABLE FORM.

ii) From the phase variable form obtained in 'Part – i', check the controllability and observability.

b) Explain GILBERT'S TEST of controllability and observability. **3**

7. a) For a unity feedback second order system shown in 'fig. 7 (a)'. **8**

i) Show that $ISE(J) = \frac{1}{w_n}\left(\xi + \frac{1}{4\xi}\right)$

ii) Find the value of ξ which minimizes ISE.

iii) Find maximum value of ISE.

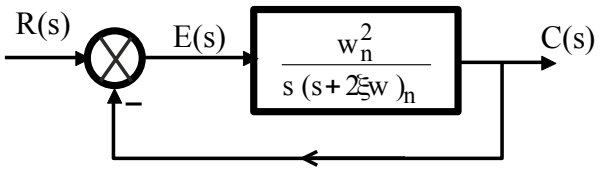

Fig. 7(a)

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

OR

8. a) For a unity feedback control system with $G(s) = K / s$, find the value of K such that the following performance Index is minimized. **9**

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

Assume unit step input and λ is a positive constant.

b) Mention the different types of optimal control problems. **4**

9. a) Derive the describing function of amplifier with dead zone with input – output characteristics shown in 'Fig. 9. (a)'. **10**

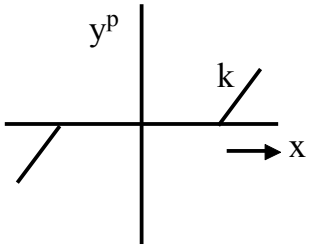

Fig. 9(a)

b) Compare the describing function and phase plane method for the analysis of non – linear control system. **4**

OR

10. Write short note on **any two.**

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

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

c) DELTA method to construct the phase trajectories. **7**

11. a) "A continuous time stable system becomes conditionally stable system when converted into sampled data control system". Explain the statement with unity feedback system having '$G(s) = K/S$'. **7**

b) Check the stability of the following characteristics equation by JURY'S TEST. **7**

$$F(Z) = 2Z^4 + 7Z^3 + 10Z^2 + 4Z + 1 = 0$$

OR

12. a) For the sampled data control system shown in 'fig. 12 (a)' find the output response 'C(K)' if r (t) is a unit – step input. **9**

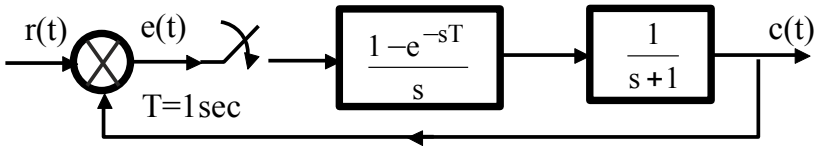

Fig. 12(a)

b) Explain the operation of SAMPLERS AND HOLD DEVICES. State and explain SHANON'S SAMPLING THEOREM. **5**

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