B.E. (Aeronautical Engineering) Semester Seventh (C.B.S.)

Control Engineering

P. Pages : 3 **KNT/KW/16/7526**

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. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) The open loop T. F. of a unity feedback system is given by $G(s) = \frac{40}{s(0.2s+1)}$. **6**

Determine the error series for i/p r(t)=3+4t.

b) The system equation is **7**

$$\frac{d^2y}{dt^2}+4\frac{dy}{dt}+8y=8x$$

Find time domain specification for unit step i/p.

OR

2. a) Measurement conducted on servo mechanism show the system response to be **7**

$$c(t)=1+0.2\,e^{-60t}-1.2\,e^{-10t}$$

when subjected to unit step i/p.

i) Obtain the expression for closed loop T.F.

ii) Determine undamped natural frequency & damping ratio of the system.

b) Derive an expression for rise time for second order underdamped unity feedback control system. **6**

3. a) Define stability & its types. Also explain Hurwitz criterion & its limitation. **7**

b) Explain the following term. **6**

i) Absolute stability.

ii) Conditional Stability.

iii) Relative stability.

OR

4. Draw the root locus for the system **13**

$$G(s)\cdot H(s)=\frac{K}{s(s+3)(s+6)}.$$

Obtain the value of 'K' when ξ = 0-6 from root locus. Determine the value of 'K' for marginal stability & critical damping.

5. **14**

Given $G(s)=\dfrac{170\left(\dfrac{s}{10}+1\right)}{s\left(1+\dfrac{s}{1.75}\right)\left(1+\dfrac{s}{60}\right)}.$

Draw the open loop Bode diagram. Determine the gain crossover frequency, gain margin, phase margin, Determine the stability of closed loop system.

OR

6. a) For a second order system with unity feedback $G(s)=\dfrac{200}{s(s+8)}$. Find the frequency domain specification. **7**

b) What are the methods of frequency response analysis ? & Explain in short "Need of domain analysis". **7**

7. a) State the Nyquist stability criterion in its most general form. **6**

b) Sketch the polar plot of **7**

$$G(s)=\frac{w_n^2}{s^2+2\xi w_n s+w_n^2}$$

What will be the effect of ξ.

OR

8. a) $GH(s)=\dfrac{1}{s(s+1)}$ Decide the stability using Nyquist path. **9**

b) Explain the P.I. controllers (P.I.) **4**

9. a) Write the procedure for the design of phase lag compensator. **6**

b) What is the phase lead-Lag compensator ? Derive the expression for the T.F. of phase lead compensator. **7**

OR

10. a) Briefly describe the compensation & need for the same. **6**

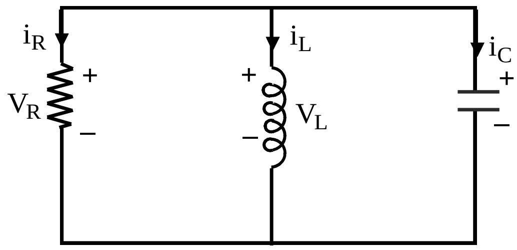
b) Derive the T.F. of passive RC lag network. **7**

11. a) Determine the system T.F. using the following state equation. **7**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u$$

$$y = [1 \quad 2] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

b) Obtain the state equation for the zero i/p n/w shown in fig. below. **7**



OR

12. a) Obtain the phase variable state model for a system described by the differential equation. **7**

$$\frac{d^3 y(t)}{dt^3} + 5\frac{d^2 y(t)}{dt^2} + \frac{dy(t)}{dt} + 2y(t) = u(t).$$

b) Obtain the T.F. of a system from its model. **7**

****