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

Control Engineering

P. Pages : 2 **NIR/KW/18/3610**

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. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. Semi log, polar & simple graph paper should be available.

1. a) For a system having $G(s) = \frac{15}{(s+1)(s+3)} H(s) = 1$. Determine: (i) Characteristic equation, (ii) Error constants, (iii) Steady state Error for unit ramp input. **7**

b) For a system having $G(s) = \frac{20}{(s+2)(s+3)}, H(s) = 1$, Determine: (i) Type of the system, (ii) Order of the system, (iii) Steady state error for unit step input, (iv) Steady state error for unit parabolic input. **6**

OR

2. a) For a system having $G(s) = \frac{40}{s(0.2s+1)}, H(s) = 1$, Determine: error of the system when it is subjected to an input $r(t) = 3 + 4t$. **7**

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

3. a) A unity feedback system has $G(s) = \frac{k(s+1)}{s^2 (s+1)(s+5)}$ using Routh's method, find range of k for the closed loop system to be stable. **7**

b) Write down the difference between Routh's and Hurwitz methods on the basis of their advantages and disadvantages. **6**

OR

4. a) Find stability of the system whose characteristic equation is **7**

$$5s^6 + 8s^5 + 12s^4 + 20s^3 + 100s^2 + 150s + 200 = 0$$

b) What are the methods of frequency response analysis? Explain need of Analysis. **6**

5. a) Plot the root locus for the following system with unity feedback **10**

$$G(s) = \frac{k}{s(s+1)(s+4)(s+5)}.$$

b) State advantage and disadvantages of Root Locus. **4**

OR

6. A feedback system has $G(s) = \frac{15(s+1)}{(1+2s)(1+0.1s)(1+0.02s)}$, $H(s) = 1$. Draw Bode plot comment on stability. **14**

7. Sketch Nyquist plot for the system with $G(s)H(s) = \frac{10(s+3)}{s(s-1)}$. Comment on close loop stability. **13**

OR

8. Sketch the polar plot for the T. F, $G(s)H(s) = \frac{60}{s(s+4)(s+6)}$. Estimate GM and PM. **13**

9. For the feedback control system $G(s)H(s) = \frac{40}{(s+4)(s^2+2s+2)}$. Find gain margin and stability using Nyquist plot. **13**

OR

10. Write short notes on : **13**

1) Mapping theorem.
2) Lead Compensation.
3) PID Controller.

11. a) Find the T.F. for the system given as : **7**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

$$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Also find the poles of the system.

b) Test the controllability and observability of the following system. **7**

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

and $Y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

OR

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

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

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

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