G 1426 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2016

Sixth Semester

Branch : Electrical and Electronics Engineering

EE 010 603—CONTROL SYSTEMS (EE)

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 *marks.*

1. Write a note on servomotors.
2. What are gain margin and phase margin ? Explain.
3. What are minimum phase and non-minimum phase systems ? Explain.
4. Realize lead compensator using Operational Amplifier. What is its transfer function ?
5. What is transportation lag ? Explain.

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 *marks.*

6. Write a note on polar plots.
7. What is meant by principle of argument ?
8. State and explain Nyquist stability criterion.
9. What is meant by similarity transformation ? Explain.
10. What are controllability and observability ? Explain.

(5 × 5 = 25 marks)

Part C

Answer **all** *questions.*
Each question carries 12 *marks.*

11. The open loop transfer function of a unity feedback system is given by $G(s) = \frac{1000}{s(1+0.1s)(1+0.001s)}$. Determine the phase-crossover frequency, Gain cross-over frequency, GM and PM.

Or

Turn over

12. Sketch the polar plot for the transfer function $\frac{100}{s(s+2)(s+4)(s+8)}$. Find whether the system is stable or not. Find the G.M. and P.M. also.

13. For a unity feedback system, $G(s) = \frac{4(s^2+10s+100)}{s^2(s+3)(s^2+6s+10)}$. Find the step, ramp and parabolic error coefficients.

Or

14. Using Nyquist stability criterion, determine the range of K for stability :

$$G(s)H(s) = \frac{K(1+2s)}{s(s+1)(s^2+s+1)}.$$

15. Design a suitable compensator using root locus technique for a system with open loop transfer function $G(s) = \frac{K}{s(s+1)(s+4)}$ so that $K_v \geq 5 \text{ sec}^{-1}$, damping ratio = 0.5 and settling time = 10 sec.

Or

16. The open loop transfer function of a unity feedback system is $G(s) = \frac{K}{s(s+1)}$. Design a lead compensator to meet $K_v = 12 \text{ sec}^{-1}$ and phase margin = 40°.

17. Diagonalize the matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$.

Or

18. Find a state model for the differential equation :

$$\frac{d^3C(t)}{dt^3} + 6\frac{d^2C(t)}{dt^2} + 11\frac{dC(t)}{dt} + 6C(t) = 4u + \frac{du(t)}{dt}.$$

19. Show that eigen values remain stationary under similarity transformation.

Or

20. (a) Find the state transition matrix for the system $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -1 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u.$

(b) Check the controllability and observability of the system :

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -2 & -3 & -4\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}1 & 0\\ 0 & 1\\ -1 & 1\end{bmatrix}u$$

$$Y=\begin{bmatrix}0 & 1 & -1\\ 1 & 2 & 1\end{bmatrix}[X].$$

(5 × 12 = 60 marks)