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Question Paper Code : 80340

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Fourth Semester

Electronics and Communication Engineering

EC 6405 — CONTROL SYSTEM ENGINEERING

(Common to Mechatronics Engineering and Medical Electronics Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Provide Semilog sheet, Polar graph and ordinary graph sheet)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a control system?

2. List the basic elements of translational mechanical systems.

3. Specify the time domain specifications.

4. What is meant by steady state error?

5. State the significance of Nichol's plot.

6. What is series compensation?

7. Define BIBO stability.

8. What is dominant pole?

9. List the main properties of a state transition matrix.

10. State sampling theorem.

PART B — (5 × 16 = 80 marks)

11. (a) Write the differential equations governing the mechanical rotational system shown in figure 11.(a). Draw the Electrical equivalent analogy circuits (current and voltage). (16)

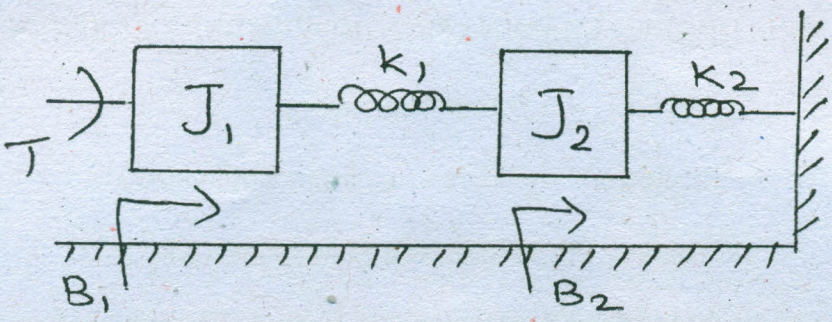

Figure 11.(a)

Or

(b) (i) Reduce the block diagram shown in figure 11(b) (i) and find C/R. (12)

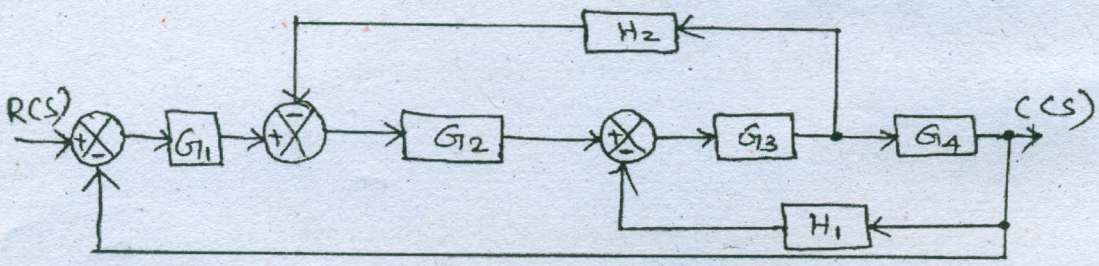

Figure 11(b) (i)

(ii) Compare open loop and closed loop control system. (4)

12. (a) Derive the time domain specifications of a second order system subjected to a step input. (16)

Or

(b) (i) For a unity feedback control system, the open loop transfer Function is $G(s)=[10(s+2)]/[s^2(s+1)]$, find (12)

(1) the position, velocity, acceleration error constants.

(2) the steady state error when $R(s)=(3/s)-(2/s^2)+(1/3s^3)$.

(ii) State the effect of PI & PD compensation on the system performance. (4)

13. (a) The open loop transfer function of a unity feedback system is given by $G(s)=1/[s(1+s)^2]$. Sketch the polar plot and determine the gain and phase margin. (16)

Or

(b) (i) Write down the procedure for designing Lag compensator using Bode plot. (12)

(ii) State about Parallel feedback compensation. (4)

14. (a) (i) State Nyquist stability criterion and explain the three situations while examining the stability of the linear control system. (8)

(ii) Construct R-H criterion and determine the stability of a system representing the characteristic equation

$S^5+S^4+2S^3+2S^2+3S+5=0$. Comment on location of the roots of the characteristics equation. (8)

Or

(b) With neat steps write down the procedure for construction of root locus. Each rule give an example. (16)

15. (a) A discrete time system is described by the difference equation $y(k+2)+5y(k+1)+6(yk)=u(k)$

$Y(0)=y(1)=0$ and $T=1$ sec, Determine

(i) State model in canonical form

(ii) State transition matrix. (16)

Or

(b) (i) Check the controllability of the system by Kalman's test whose state model is given as,

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 0\\ 0 & +2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 2\\ 0\end{bmatrix}u;\ y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}. \quad (8)$$

(ii) Write detailed notes on Sampler and hold circuits. (8)
