Total No. of Questions : 12]

SEAT No. : ____

P1721

[Total No. of Pages :4

[4859]-69
B.E. Electrical
CONTROL SYSTEMS-II
(2008 Course) (Semester-I) (403145)

Time : 3 Hours] ***[Max. Marks :100***

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q10, Q.11 or Q.12.***
3) ***Figures to the right indicate full marks.***
4) ***Use of calculator is allowed.***
5) ***Assume suitable data if necessary.***

SECTION-I

Q1) a) Draw electrical network & derive Transfer Function of Lag-lead compensation network & show its pole zero configuration. **[8]**

b) Design Lead compensation for the system having OLTF

$$G(s)H(s) = \frac{25}{s(0.5s+1)(0.016s+1)}$$ & PM around 42° **[10]**

OR

Q2) a) Explain steps to be taken to design lead network by Bode plot approach. **[8]**

b) Design a suitable lag compensator for the following unity feedback system:

G(s)=K/S(1+2S); such that Phase margin is 40° and steady state error for ramp input is 0.2. **[10]**

P.T.O.

Q3) a) Define and explain the terms: Eigen values, Eigen vectors, Diagonalisation and Vander Monde Matrix. **[8]**

b) The state equation of the system is given by: **[8]**

$$\dot{X}(t) = \begin{bmatrix} -2 & 0 \\ 1 & -1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) .$$

Determine the following:

i) STM & ii) State equation for unit step input under zero initial condition.

OR

Q4) a) Obtain the solution for homogeneous state equation & State properties of STM. **[8]**

b) For the given system obtain eigen values, eigen vectors, modal matrix & diagonal matrix

$$A = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$$ **[8]**

Q5) a) Define controllability & Observability. Explain any one method to determine it. **[8]**

b) Determine the state controllability and observability of the following system:

$$A = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -3 & 2 \\ 0 & 0 & -8 \end{bmatrix}; \; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}; \quad C = [1 \;\; 0 \;\; 1] .$$ **[8]**

OR

Q6) a) What is the need of state observer? Explain design of full order state observer. **[8]**

b) For a given system

$$A=\begin{bmatrix}0 & 15\\ 0 & 1\end{bmatrix};\ B=\begin{bmatrix}0\\ 1\end{bmatrix};\ C=[0\ \ 2]$$

Determine observer gain matrix Ke such that S_1, S_2= -2 ± j3 are Eigen values of observer gain matrix. **[8]**

SECTION-II

Q7) a) Explain PID controller with its characteristics, applications & its effect on system performance. **[8]**

b) For a unity feedback system $G(s)=\dfrac{6.63K}{s(s+1.71)(s+100)}$, design a PID controller to meet following specifications. Mp=25%, ts=2 sec and kv=20. **[8]**

OR

Q8) a) Explain Zigler-Nichol method for tuning of PID controller. **[8]**

b) Wrtie short note on design specifications in time domain and frequency domain. **[8]**

Q9) a) Name the various peculiar features exhibited by the non-linear systems which are not found with linear systems and explain any two such features. **[8]**

b) Derive the Describing function for Saturation non-linearity. **[8]**

OR

Q10)a) Compare the advantages and disadvantages of the Describing function method and the phase plane method for the analysis of non-linear control system. **[8]**

b) A system with

$$G(s) = \frac{50}{s(s+1)(s+2)}$$ includes ideal relay with output equal to ∓ 1 unit. Determine the amplitude and frequency of limit cycle by Describing function method. **[8]**

Q11)a) Describe briefly the two methods of determining time from phase plane trajectory. **[8]**

b) Determine the kind of Singularity, find the characteristic equation and draw phase portrait for the following differential equation. **[10]**

$$x\cdot\cdot + 3x\cdot + 3x = 0$$

OR

Q12)a) Explain Liapunav's second method and Liapunav's stability theorem. **[6]**

b) Explain whether following quadratic form of system is positive definite or not using Sylverster's criterion.

$$V(x) = 8X_1^2 + X_2^2 + 4X_3^2 + 2X_1X_2 - 4X_1X_3 - 2X_2X_3 .$$ **[6]**

c) Explain terminologies used for Scalar function: **[6]**

Positive definite, Negative definite, Positive semi definite, Negative semi definite with one example each.

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