

Total No. of Questions : 12]

SEAT No.:

P1376



[Total No. of Pages : 3

May - June - 2012

[4164]-503

B.E. (Electrical)

CONTROL SYSTEM - II
(2008 Pattern) (Sem. - I)

Time : 3 Hours]

[Max. Marks : 100

Instructions to the candidates:

- 1) Answer any three questions from each section.
- 2) Answers to the two sections should be written in separate books.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
- 6) Assume suitable data, if necessary.

SECTION - I

- Q1) a) Derive transfer function of lag network. [8]
b) The open loop transfer function of a unity feedback control system is given below :

$$G(s) = \frac{2000}{s(s+20)}$$

and phase margin $> 45^\circ$. Determine the parameters of phase lead network to be used for this work using Bode plot. [10]

OR

- Q2) a) Derive transfer function of lead network. [8]
b) Design a phase lag compensation for a feedback control system having following open loop transfer function.

$$G(s)H(s) = \frac{800}{s(1+0.005s)(1+0.001s)}$$

and phase margin is 40° . [10]

- Q3) a) Derive Caley-Hamilton theorem for the determination of state transition matrix. [8]
b) Evaluate the STM by Laplace inverse method. [8]

$$A = \begin{bmatrix} -1 & 1 \\ 0 & 2 \end{bmatrix}$$

P.T.O.

OR

- Q4)** a) Give important properties of state transition matrix. [8]
 b) For a given system obtain eigen values, eigen vectors, modal matrix and STM. [8]

$$A = \begin{bmatrix} 0 & 1 \\ -3 & 4 \end{bmatrix}$$

- Q5)** a) Test controllability and observability for [8]

$$A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$$

$$C = [1 \quad 0 \quad 2]$$

- b) Explain controllability and observability using Kalman's test. [8]

OR

- Q6)** a) State and output equations of a system are [8]

$$\dot{x}_1 = -4x_1 + x_2$$

$$\dot{x}_2 = -5x_1 + u$$

$$y = x_1$$

Design observer gain vector such that observer poles are located at $S_1 = -10$ $S_2 = -20$

- b) Explain effect of pole-zero cancellation on controllability and observability of the system. [8]

SECTION - II

- Q7)** a) Compare PI, PID controller by working principle, illustration, advantages and disadvantages. Also explain effect of those on system performance. [8]
 b) Explain Ziegler Nichols rules for tuning of PID controller. [8]

OR

- Q8)** a) Explain design of PID controller in time domain. [8]
 b) A unity feedback control system has the following time domain specifications $\omega_n = 2.5$ rad/sec $\xi = 0.8$

$$\text{Forward path transfer function } G(s) = \frac{4.5}{(s+3)(s+5)}$$

Design a PI controller for the system. [8]

- Q9) a)** Explain the following nonlinearities in the system. [8]
- Saturation.
 - Dead zone.
 - Back lash.
 - Non linear spring.
- b) Explain describing function of ON-OFF relay with dead zone. [8]

OR

- Q10) a)** Explain the following peculiar nonlinear characteristics present in nonlinear system. [8]
- Frequency-Amplitude dependence.
 - Jump resonance.
 - Limit cycle.
 - Soft and Hard excitation.

- b) A unity feedback system of $G(s) = \frac{0.833}{s(0.5s+1)(0.33s+1)}$ having ideal relay in forward path transfer function with maximum amplitude $M = \pm 1$. Apply describing function method to determine stability. Calculate amplitude and frequency of limit cycle if available. [8]

- Q11) a)** Explain isocline method for constructing phase plane trajectory. Compare it with delta method. [10]
- b) Explain in the sense of Liapunov stability. [8]
- Stability.
 - Asymptotic stability.
 - Asymptotic stability in large.
 - Instability.

OR

- Q12) a)** Explain the terms : [8]
- Phase plane.
 - Phase plane plot.
 - Phase plane trajectory.
 - Phase plane portrait.
- b) Examine stability by selectively proper Liapunov function for the system. [10]

$$\dot{x}_1 = -x_1 - 2x_2$$

$$\dot{x}_2 = -x_1$$

