C 47615 (Pages 3)

Name.........................

Reg. No......................

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2008

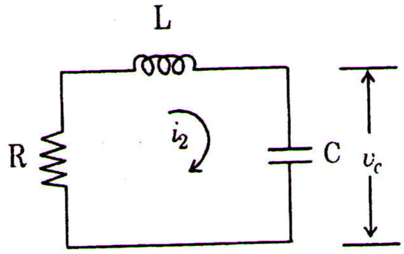
EE 04 603—CONTROL SYSTEMS—I

Time : Three Hours | Maximum : 100 Marks

Answer **all** *questions.*

Part A

I. (a) Write the state space representation for the following electrical network :—



(b) Find the state transition matrix for :

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -6x_1 - 5x_2.$$

(c) Define z-transform. Find the z-transform of $x(n) = \left(\frac{1}{2}\right)^n u(n)$.

(d) What is Jury's stability test ? Explain.

(e) What is meant by minimum phase system and non-minimum phase system ? Explain.

(f) What is meant by relative stability ? Explain.

(g) Explain the limitations of phase lead networks.

(h) Draw the block diagram of a lead compensation circuit and explain.

(8 × 5 = 40 marks)

Part B

II. (a) (i) The system equations are given by :

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

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(t).$$

Find the transfer function of the system.

(12 marks)

Turn over

(ii) Explain the advantages of state space techniques. (3 marks)

Or

(b) (i) Compute the state transition matrix for $\begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$. (10 marks)

(ii) Explain the properties of state transition matrix. (5 marks)

III. (a) (i) Figure below shows the block diagram of a sampled data system. Determine the closed-loop transfer function of the system for a sampling period of 0.1 second.

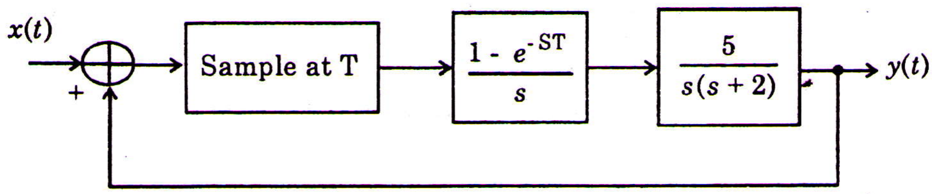


Fig. 2.

(10 marks)

(ii) Explain zero and first order hold system. (5 marks)

Or

(b) (i) Derive the expression for bilinear transformation. (6 marks)

(ii) Find the sample response of the system having difference equation

$$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n)$$

using z-transform.

(9 marks)

IV. (a) Sketch the Nyquist plot and determine the stability of a unity feedback control system :

$$G(s) = \frac{K}{(1 + sT_1)(1 + sT_2)}.$$

(15 marks)

Or

(b) Sketch the root locii for the system having open loop transfer function $G(s) = \frac{k(s+1)}{s^2(s+3.6)}$.

(15 marks)

V. (a) (i) Explain the design procedure for phase-lead compensation network. (5 marks)

(ii) Consider a lag-lead network defined by

$$G(s) = \frac{k\left(s + \frac{1}{T_1}\right)\left(s + \frac{1}{T_2}\right)}{\left(s + \frac{B}{T_1}\right)\left(s + \frac{1}{BT_2}\right)}.$$

show that at frequency $w = \frac{1}{\sqrt{T_1 T_2}}$ the phase angle of $G(w)$ becomes zero.

(10 marks)

Or

(b) Design a suitable lag compensating network for $G(s) = \frac{K}{s(1 + 0.1s)(1 + 0.2s)}$ to meet velocity constat = 30 ; Phase margin $\geq 40°$.

(15 marks)

[4 × 15 = 60 marks]