C 14820 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION DECEMBER 2010

EC 2K 601—CONTROL SYSTEMS

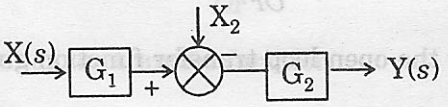
Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

1. (a) Draw the canonical form of closed loop control system and write its transfer function.

(b) Find the output of the block diagram given :



(c) What are the effects of adding a open loop pole to the root locus and system.

(d) Draw the circuit diagram for the lead compensation network.

(e) Comment on mapping between s-plane and z-plane.

(f) State BIBO Stability Criterion.

(g) Explain Diagonalisation.

(h) Discuss the state space representation of discrete time systems.

(8 × 5 = 40 marks)

Part B

2. (a) Determine the time response specifications and expression for output of unit step input to a system having the system equation as follows :

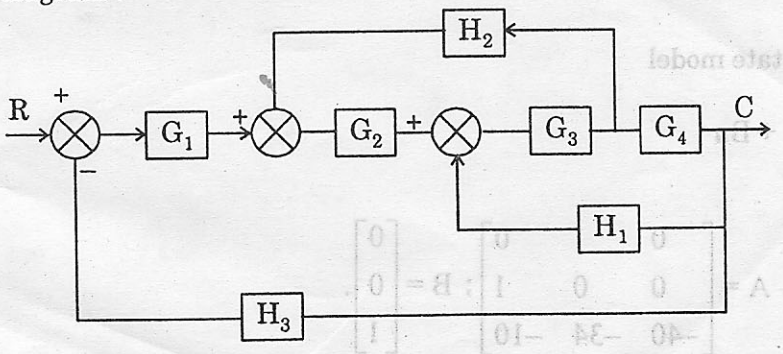
$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 16y = 9x$$

Assume zero initial conditions.

(15 marks)

Or

(b) Explain the rules for block diagram reduction and hence find the transfer function for the following diagram :–



(15 marks)

Turn over

3. (a) Construct bode plot for the system whose Open loop transfer function is given below and determine.

(i) the gain margin.

(ii) the phase margin.

$$G(s)H(s) = \frac{4}{s(1+0.5s)(1+0.08s)}.$$

(15 marks)

Or

(b) Draw the Nyquist plot for the open loop transfer function given below and comment on the closed loop stability.

$$G(s)H(s) = \frac{2.2}{s(s+1)(s^2+2s+s)}.$$

(15 marks)

4. (a) (i) What is the condition for z-transform to exist ? (5 marks)

(ii) What are the properties of region of convergence ? (5 marks)

(iii) Find the DFT of the sequence $x(n) = \{1, 1, 0, 0\}$. (5 marks)

Or

(b) A unity feedback system oscillates with a frequency of w = 2 rad / sec. The open loop transfer function is given by $G(s) = \frac{k(s+1)}{s^3 + Q s^2 + 2s + 1}$. The system has poles at $1\,jw$ and no poles on right half of s-plane. Use Routh Hurwitz criterion to find the value of 'a' and 'k'.

(15 marks)

5. (a) Consider a state model

$$\dot{X} = AX + Bu$$

where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -40 & -34 & -10 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$.

(i) Show that the eigen values of A are $-3 \pm j1, -4$.

(ii) Suggest a suitable transformation matrix m so that :

$$M^{-1} AM = A \begin{bmatrix} -3 + j1 & 0 & 0 \\ 0 & -3 + j1 & 0 \\ 0 & 0 & -4 \end{bmatrix}$$

(15 marks)

Or

(b) A discrete-time system has the transfer function :

$$T(z) = \frac{4z^3 - 12z^2 + 13z - 7}{(z-1)^2 (z-2)}.$$

Determine the state model of the system in :

(i) phase variable form.

(ii) Jordan canonical form.

(15 marks)

(4 × 15 = 60 marks)