C 28736 (Pages : 2) Name.....

Reg. No.....



**SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION**
**JUNE 2012**

EE 04 603—CONTROL SYSTEM—I

Time : Three Hours Maximum : 100 Marks

*Answer* **all** *questions.*

I. (a) Compare the representation of a system in state space and transfer function.

(b) What is state transition matrix ? List the properties of state transition matrix.

(c) Determine the transfer function of a zero order hold circuit.

(d) Determine the stability of the system with characteristic equation :

$$z^4 + 2z^3 + 1.75z^2 - 0.5z - 0.5 = 0$$

using Jury's stability test.

(e) What is gain margin of a system ? How it can be determined from the Nyquist plot ?

(f) What are M and N circles ?

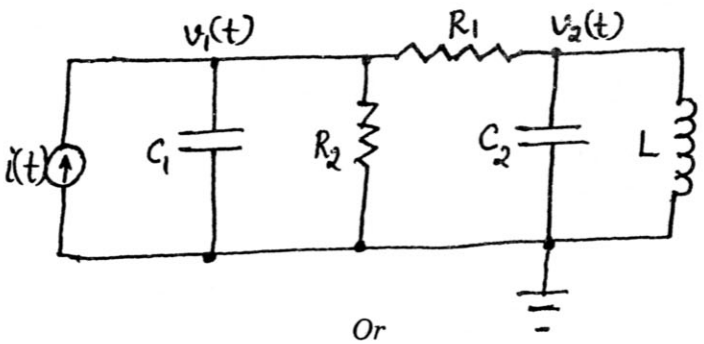
(g) What are the different frequency domain specifications ?

(h) Sketch the circuit of a phase lag compensator and determine its transfer function. Also determine the relations for maximum phase lag and frequency at maximum phase lag.

(8 × 5 = 40 marks)

II. (a) Define state of a system. (5 marks)

(b) Derive the state space representation of the following system.




(10 marks)

*Or*

(c) Derive the relation for the state of the system represented by $\dot{x} = Ax + Bu$. (5 marks)

(d) Determine the transfer function of the following system :

$$\dot{x} = \begin{bmatrix} 0 & -2 \\ 1 & -3 \end{bmatrix} x + \begin{bmatrix} 2 \\ 0 \end{bmatrix} u, \; y = [1 \quad 0]\, x$$

(6 marks)

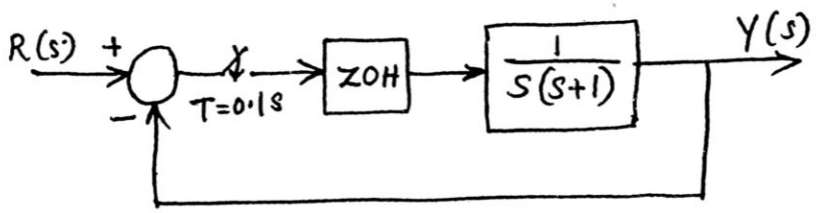
**Turn over**

(e) Sketch the state diagram for the following system and obtain the state space representation :

$$\frac{Y(s)}{R(s)} = \frac{4(s+3)}{(s+2)(s+4)}.$$

(4 marks)

III. Determine the unit step response of the system shown in figure :




(15 marks)

*Or*

(a) Determine the $z$-transform of $e^{at} \cos \omega t$. (5 marks)

(b) Determine the stability of the system with characteristic equation :

$$z^4 + 1.3z^3 - 1.68z^2 - 0.45z + 0.32 = 0$$

Using Routh's stability criterion. (10 marks)

IV. A unity feedback system has a plant $G(s) = \frac{k}{s(s+2)(s+50)}$. Determine the phase margin, when $k = 1330$.

*Or*

Sketch the root locus of the system with open loop transfer function,

$G(s)H(s) = \frac{k}{s(s+1)(s+2)}$ and determine the value of $k$ at which the system has a damping ratio of 0.5.

(15 marks)

V. Consider a unity feedback system with forward transfer function $G(z) = \frac{z+0.5}{z(z-1)}$. Design a suitable compensator to place the poles at $0.8 \pm j\,0.8$.

*Or*

A unity feedback system has a plant transfer function $G(s) = \frac{40}{s(s+2)}$. Design a suitable compensation to meet the following specifications :

Steady state error for a ramp input $\leq 0.05$, phase margin $\leq 30°$, crossover frequency approximately equal to 2 rad/s.

(15 marks)

[4 × 15 = 60 marks]