D 34355 (Pages : 3)

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

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

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, MARCH 2013

EC 04 603—CONTROL SYSTEMS

(2004 Scheme)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

I. 1 State and prove final value theorem.

2 Explain about closed loop and open loop system.

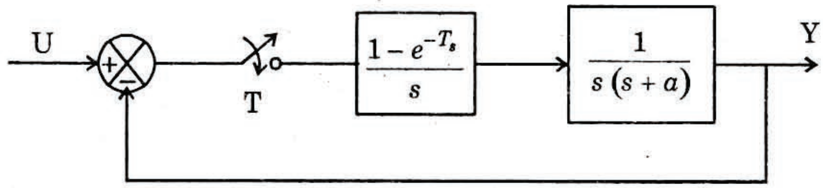
3 Explain the Routh's stability criterion.

4 Consider the unity-feedback control system whose open loop transfer function is $G(s) = \frac{1}{s(s+1)}$. Obtain rise time and maximum overshoot.

5 Obtain the *z*-transform of sin *wt*.

6 Explain about Routh Hurwitz polynomial.

7 Obtain the discrete-time state-space representation of the system shown below :



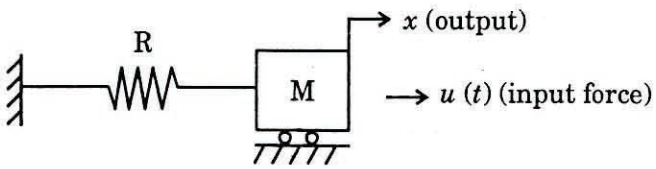
8 Explain about linear time invariant system.

(8 × 5 = 40 marks)

II. (a) (i) Solve the following differential equation $2\ddot{x} + 7\dot{x} + 3x = 0$; $x(0) = x_0$, $\dot{x}(0) = 0$.

(9 marks)

(ii) Obtain the transfer function of the mechanical system shown below :

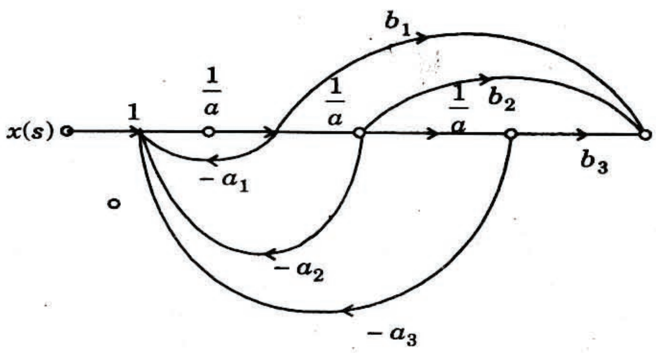


(6 marks)

Or

Turn over

(b) (i) Obtain the transfer function of the system shown below :

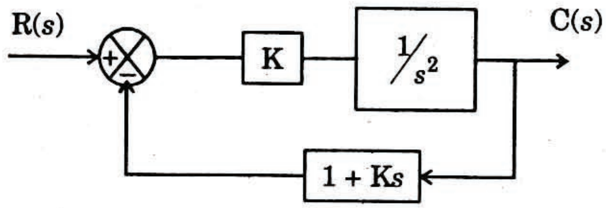


(ii) Explain the properties of Laplace transform.

III. (a) Discuss the effects of integral and derivative control action on system performance.

Or

(b) (i) Consider the servomechanism shown in figure. Determine the values of K and K so that maximum overshoot in unit step response is 25 % and the peak time in 2 sec.



(9 marks)

(ii) Obtain the unit step response of a unity feedback system whose open loop transfer function is :

$$G(s) = \frac{5(s+20)}{s(s+4.59)(s^2+3.4)s+16.35}.$$

(6 marks)

IV. (a) Solve the difference equation by using :

(i) the z-transform method $x(k+2)+3x(k+1)+2xk)=0, x(0)=0, x(1)=1.$

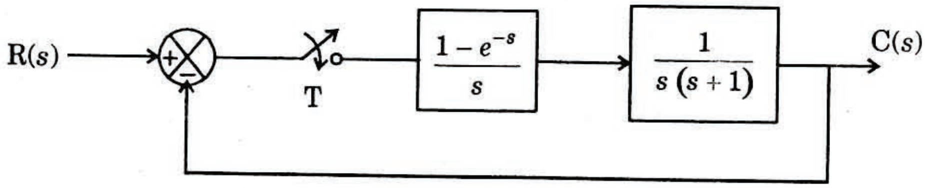
(5 marks)

(ii) Find the response of the following system $x(k+2)-3x(k+1)+2x(k)=u(k).$

(10 marks)

Or

(b) (i) Obtain the unit step response of the system shown :



(9 marks)

(ii) Comment on the stability analysis in z-plane. (6 marks)

V. (a) (i) Obtain the state-transition matrix $\phi(t)$ of the following system :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

Obtain also the inverse of the state-transition matrix.

(10 marks)

(ii) Obtain the discrete state space representation of the following continuous time system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} (u).$$

(5 marks)

Or

(b) (i) Derive the state-space representation of time variant scalar difference equations where the forcing function involves $u(k), u(k+1), \ldots u(k+n).$

(8 marks)

(ii) Consider the system described by $\ddot{y} + 3\ddot{y} + 2\dot{y} = u.$ Derive the state space representation of the system.

(7 marks)

[4 × 15 = 60 marks]