C 22584 (Pages : 4) Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE (2014 SCHEME) EXAMINATION, APRIL 2017

Electronics and Communication Engineering

EC 14 605—CONTROL SYSTEMS

Time : Three Hours Maximum : 100 Marks

1. (a) The transfer function of the system is given by :

$$T(s)=\frac{K(s+6)}{s(s+2)(s+5)\left(s^2+7s+12\right)}.$$

Find (a) Poles ; (b) Zeros ; (c) Pole-zero plot in s-plane.

(b) Find the closed loop transfer function using Mason's Gain formula for the block diagram in Fig. 1 :

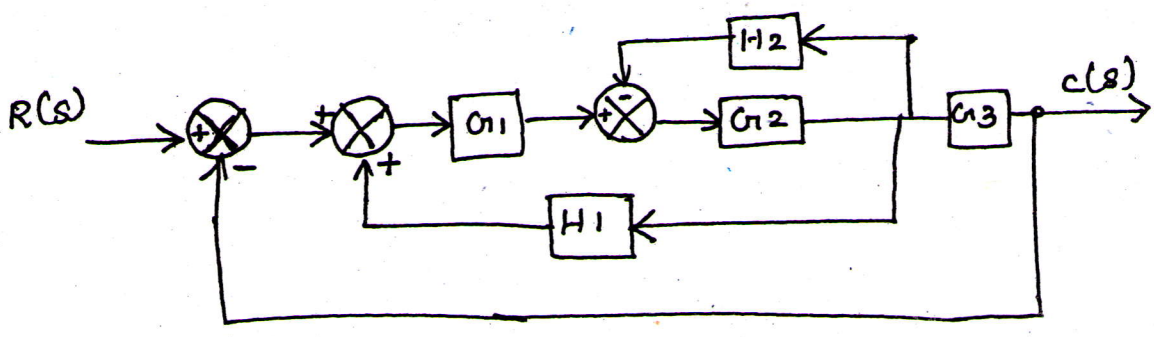


Fig. 1

(c) Obtain the transfer function of simple RLC series network.

(d) A second order system is given by : $\frac{C(s)}{R(s)}=\frac{25}{s^2+6s+25}$. Find its rise time, peak time, peak overshoot, settling time with respect to unit step input.

(e) Obtain the step response of the second order system.

(f) Derive the transfer function of derivative control and explain its effect on the transient response.

Turn over

(g) Derive the pulse transfer function of open and closed loop data sampled system.

(h) Analyze the stability of the system using bilinear transformation.

(i) Derive transfer function from the state model of the system.

(j) Obtain state transition matrix using Laplace transform for A matrix given below :

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

(8 × 5 = 40 marks)

2. (a) (i) Obtain the transfer function of DC servomotor for speed control.

(ii) Compare open loop and closed loop systems.

(10 + 5 = 15 marks)

Or

(b) (i) Using block diagram reduction technique, find the transfer function from each input to the output for the following system in Fig. 2.

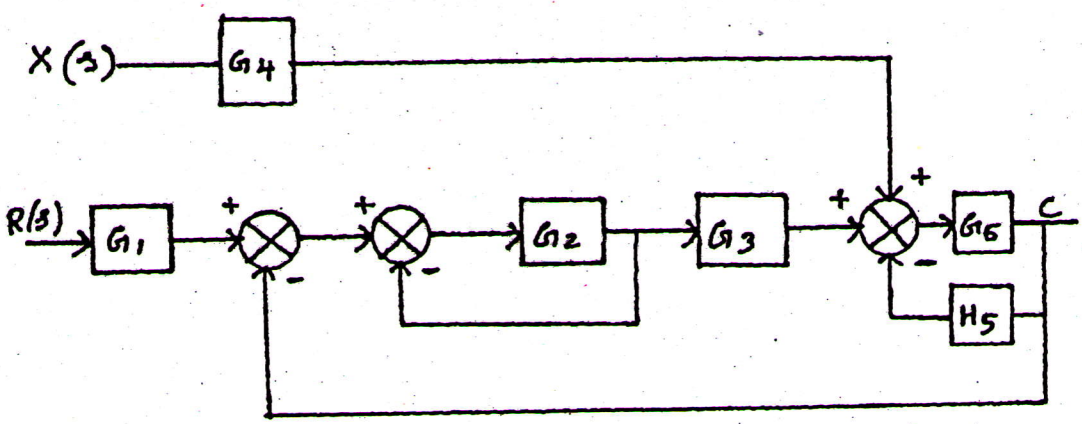


Fig. 2

(ii) Write the differential equations for the following mechanical system shown in Fig. 3 :

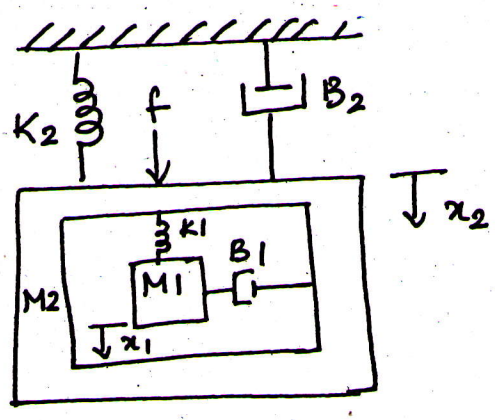


Fig. 3

3. (a) (i) For a closed loop system with $G(s)=\frac{1}{(s+5)}$ and $H(s)=5$, calculate generalized error coefficients and find the error series.

(ii) Sketch Bode plot for the following transfer function and determine gain and phase margin :

$$G(s)=\frac{0.75(1+0.2s)}{s(1+0.5s)(1+0.1s)}.$$

(5 + 10 = 15 marks)

Or

(b) (i) Using Routh Hurwitz criterion, find the stability of $s^4+s^3-3s^2+2=0$.

(ii) A unity feedback system has an open loop transfer function $G(s)=\frac{k}{s(s+1)(s+3)}$. Draw the root locus and determine the value of K.

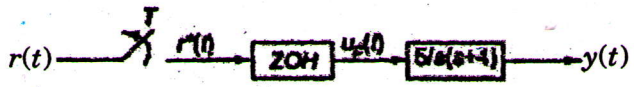
(5 + 10 = 15 marks)

4. (a) Test the stability of the system :

$F(z)=2z^4+5z^3+10z^2+2z+1$ using Jury's criterion and Routh's criterion.

Or

(b) (i) For the system shown below, find the output at the sampling instants $y(nT)$. The input is a unit impulse and the sampling period is 0.1 seconds. Also find $y(nT)$ when $T \to \infty$.



(ii) Consider a discrete time LTI system described by :

$$y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n)+\frac{1}{3}x(n-1).$$

Obtain the unit sample response of the system using Z-transform.

5. (a) (i) Explain in detail the state space representation of linear time invariant system with phase variable as forcing function .

(ii) Obtain the homogeneous solution of the equation $x(t)=Ax(t)$

where $A=\begin{bmatrix}-9 & 1\\ -14 & 0\end{bmatrix}$ and $x(0)=\begin{bmatrix}1\\ 1\end{bmatrix}$.

(8 + 7 = 15 marks)

Or

(b) (i) Diagonalize the following system matrix :

$$A=\begin{bmatrix}0 & 6 & -5\\ 1 & 0 & 2\\ 3 & 2 & 4\end{bmatrix}.$$

(ii) What is state transition matrix ? Explain their properties.

(8 + 7 = 15 marks)

[4 × 15 = 60 marks]