14EC502

Hall Ticket Number:

III/IV B.Tech (Regular) DEGREE EXAMINATION

OCTOBER, 2016 **Electronics and Communication Engineering**

Fifth Semester **Linear Control Systems**

Time: Three Hours **Maximum :** 60 Marks

Answer Question No.1 compulsorily. (1X12 = 12 Marks)

Answer ONE question from each unit. (4X12=48 Marks)

1. Answer all questions (1X12=12 Marks)

a. Differentiate open loop and closed loop systems

b. What is dominant pole?

c. What is Characteristic equation of a system? Write its importance.

d. What are transient response and steady state response of a system?

e. Calculate the overshoot of an over-damped system with damping ratio of 1.6

f. State RH criteria for stability of a control system.

g. With reference to frequency response analysis, define resonant peak and resonant frequency.

h. Define Phase Margin and Gain Margin.

i. Write the advantages of Nyquist stability criterion over that of Routh's criterion.

j. Define State and State variables.

k. Define Observability of a system.

l. What is the value of the gain K at any given point on Root locus?

UNIT – I

2.a. Construct equivalent Signal Flow Graph for the block diagram shown in fig.2.a. and obtain the transfer function using Mason's formula. **6M**

2.b Find $Y/_X$ for the block diagram shown in fig.2.b. , using block diagram reduction technique. **6M**

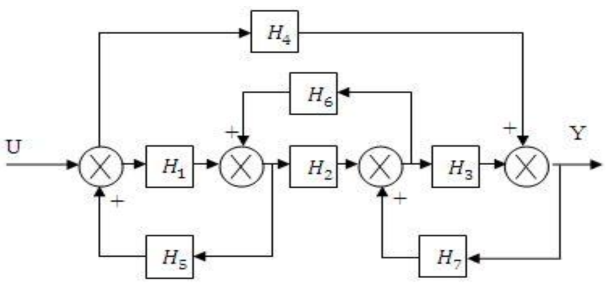

fig.2.a

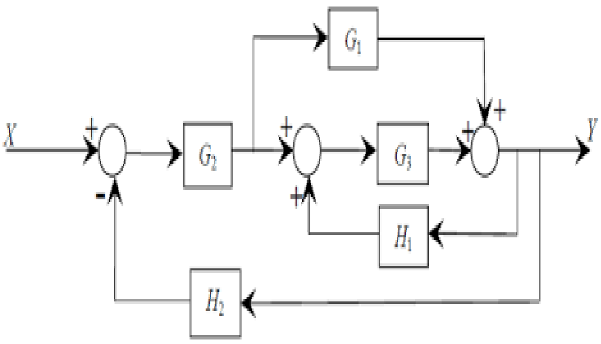

fig.2.b

3.a Determine $\frac{X_1(s)}{X_2(s)}$ for the SFG shown in fig.3.a. **4M**

3.b Write the differential equations governing the mechanical system as shown in fig.3.b. Draw the Force-Voltage and Force- Current electrical analogous circuits and verify by mesh and node equations. **8M**

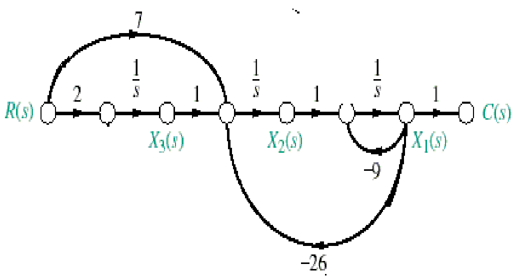

fig.3.a

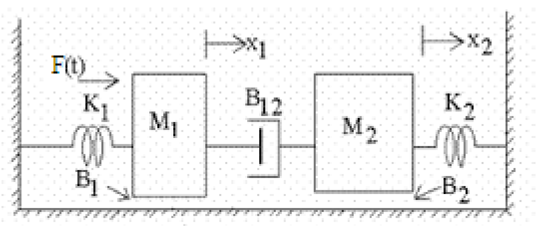

fig.3.b

UNIT – II

4.a. Define and derive the time domain specifications of an under-damped second order system. **6M**

4.b. A unity feedback control system has an open loop transfer function consisting of two poles at $+0.5$ and $+1$, two zeros at -2 and -3 and a variable gain K. Using Routh stability criterion, determine the range of K for which the closed loop system has 0,1 and 2 poles in the right half of S-plane. **6M**

5.a Construct Routh array and determine the stability of the system whose characteristic equation is **8M**

$$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$$

And also determine the number of roots lying on Right half of S- plane, left half of S- plane and on the imaginary axis.

5.b . A unity feedback system has forward transfer function $G(s) = \frac{K(1+2S)}{S(1+5S)(1+S)^2}$. **4M**

The input $r(t) = (1 - 6t)u(t)$ is applied to the system. Determine the minimum value of K, if the steady state error is to be less than 0.1.

UNIT – III

6.a. What is the effect on Polar plot if a pole at origin is added to a transfer function? Explain. Draw the polar plot of a first order system. **6M**

6.b. Sketch the Bode plot for the following transfer function of a system. **6M**

$$G(s)H(s)=\frac{5}{s(s+10)(s+20)}$$

And also determine gain and phase margins.

(OR)

7.a. Explain the frequency domain specifications of a typical system. **6M**

7.b. Sketch the Nyquist plot for a system with open loop transfer function **6M**

$$G(s)H(s) = \frac{K(1 + 0.4s)(1 + s)}{(1 + 8s)(s - 1)}$$

If the system is conditionally stable, find the range of K for which the system is stable.

UNIT – IV

8.a. Write Short notes on Root Locus Construction. 6M

8.b The state space representation of a system is given below: 6M

$$\dot{X} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u; \quad y = [0 \quad 1 \quad 0]\, X$$

Obtain the transfer function of the system.

9.a. A unity feedback control system has an open loop transfer function 6M

$$G(s)=\frac{K}{s(s^2+4s+13)}$$

Sketch the root locus plot of the system.

9.b. Consider a system with state model given below. 6M

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 5 \\ -24 \end{bmatrix} u; \quad y = [1 \quad 0 \quad 0]\, X + [0]u;$$

Verify that the system is Observable and Controllable.