Seat No.: _____  Enrolment No. 

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER– V (New) EXAMINATION – WINTER 2019**

**Subject Code: 2150909** **Date: 25/11/2019**

**Subject Name: Control System Engineering**

**Time: 10:30 AM TO 01:00 PM** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**MARKS**

**Q.1** **(a)** With a suitable example explain automatic control system **03**

**(b)** What is laplace transform ? Explain the advantages of laplace transform. **04**

**(c)** Find out the transfer function for the block diagram shown in the Fig. 1 **07**

**Q.2** **(a)** With suitable example, Explain self loop, sink node and forward path **03**

**(b)** Derive steady state error for a type 1 system with parabolic input. **04**

**(c)** For the mechanical system shown in Fig 2 write down F-I analogy and draw equivalent electric network **07**

**OR**

**(c)** For the mechanical system shown in Fig 3 write down F-V analogy and draw equivalent electric network **07**

**Q.3** **(a)** Define: State variable, state vector and state space **03**

**(b)** Assuming zero initial conditions derive the transfer function for the system described by the standard state variable model. **04**

**(c)** Obtain the state model of series RLC circuit, considering voltage across capacitor as the output. **07**

**OR**

**Q.3** **(a)** Write down the standard form of state variable model and mention the size of each matrix in the model for a system having n number of states, m number of inputs and p number of outputs **03**

**(b)** Write down state model of the system described by following differential equation **04**

$$\frac{2d^3y}{dt^3}+\frac{4d^2y}{dt^2}+\frac{6dy}{dt}+8y=10u(t)$$

**(c)** Find transfer function of the system described by following state model **07**

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-5 & -1\\ 3 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}2\\ 5\end{bmatrix}r(t);\ y=\begin{bmatrix}1 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

**Q.4** **(a)** Draw only the magnitude plot of the bode plot for **03**

$$G(s)H(s)=(1+\frac{s}{z_1})$$

**(b)** Using routh's criterion check stability of a unity gain feedback system with $G(s)=\frac{3}{S(S+1)(S+2)}$ **04**

**(c)** Draw the root locus plot for **07**

$$G(s)H(s) = \frac{k}{S(S+2)}$$

**OR**

**Q.4** **(a)** Draw only the magnitude plot of the bode plot for **03**

$$G(s)H(s) = \frac{1}{(1+\frac{s}{p_1})}$$

**(b)** Using routh's criterion check stability of a unity gain feedback system with **04**

$$G(s) = \frac{1}{(S+2)(S+4)}$$

**(c)** Draw the root locus plot for **07**

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

**Q.5** **(a)** List at least three advantages and three disadvantages of a lead compensator **03**

**(b)** Draw and explain the pole zero plot and bode plot of a lead compensator. **04**

**(c)** Explain in detail the steps to design a lead compensator **07**

**OR**

**Q.5** **(a)** List at least three advantages and three disadvantages of a lag compensator **03**

**(b)** Draw and explain the pole zero plot and bode plot of a lag compensator. **04**

**(c)** Explain in detain the steps to design a lag compensator **07**

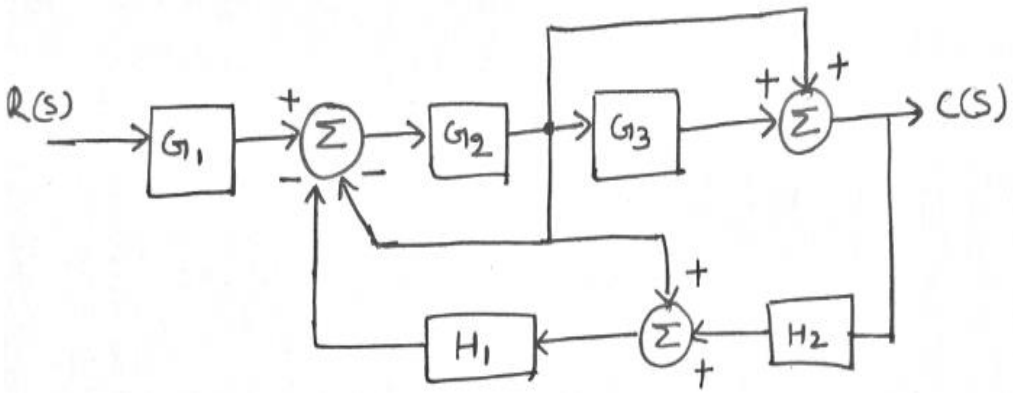


Fig. 1

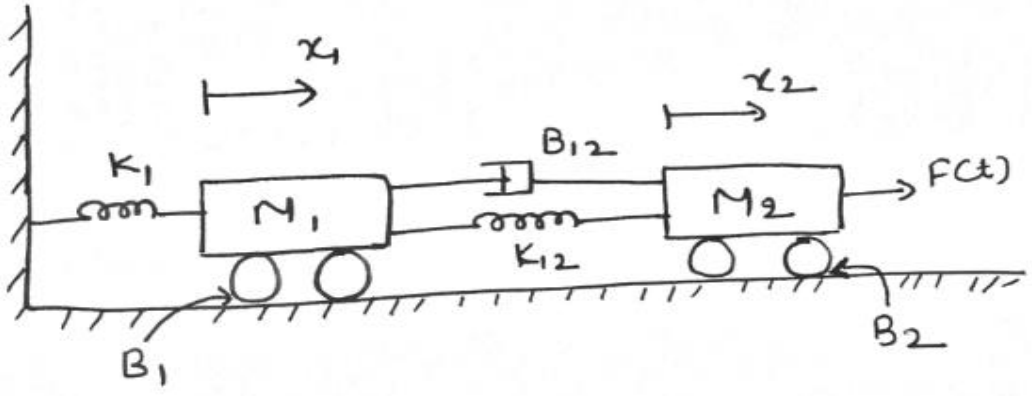


Fig. 2

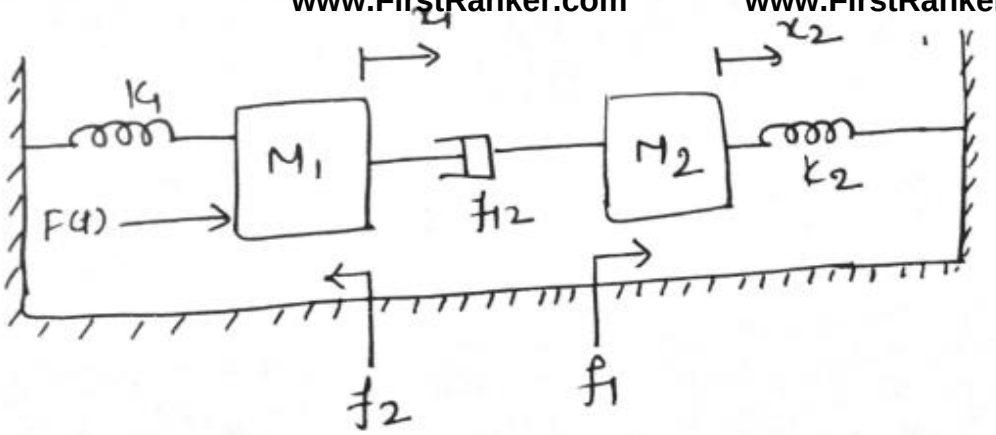


Fig. 3