Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B.Tech.

Branch	**: EEE**	**Semester**	**: 4th**
Title of the Course	**: Control Systems**	**Course Code**	**: EEB 252**

Time: 2 Hours **Maximum Marks: 25**

Note : 1. All the 6 questions are compulsory.

2. All the symbols have their usual meaning. Make suitable assumptions wherever required.

Q1. For a 2nd-order system with the following transfer function:

$$G(s) = \frac{3}{s^2+2s-3}$$

Determine the following: **(1+2 = 3 Marks)**

a) The DC gain

b) The final value to a unit-step input.

Q2. For the unity feedback system shown in Fig. 1, specify the gain K of the proportional controller so that the output $y(t)$ has an overshoot of no more than 10% in response to a unit step. **4 Marks**

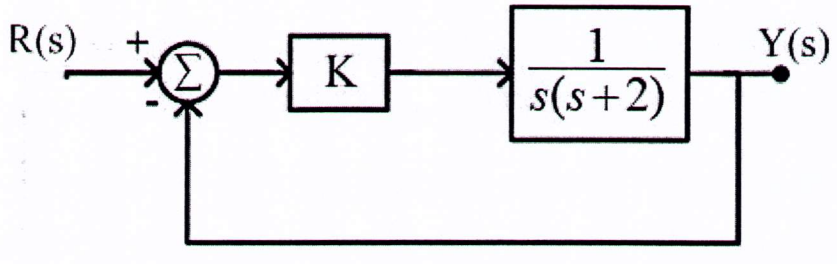

Fig. 1

Q3. Using Routh's stability criterion, determine the number of roots with positive real part for the following equation: **5 Marks**

$$s^5 + 10s^4 + 30s^3 + 80s^2 + 344s + 480 = 0$$

Q4. Write the equations of motion for a body of mass M suspended from a fixed point by a spring with the constant k. Also, specify where the body's displacement is zero. **3 Marks**

Q5. Find the transfer function $\frac{Y(s)}{R(s)}$ for the system shown in Fig. 2 by using the block diagram algebra.

4 Marks

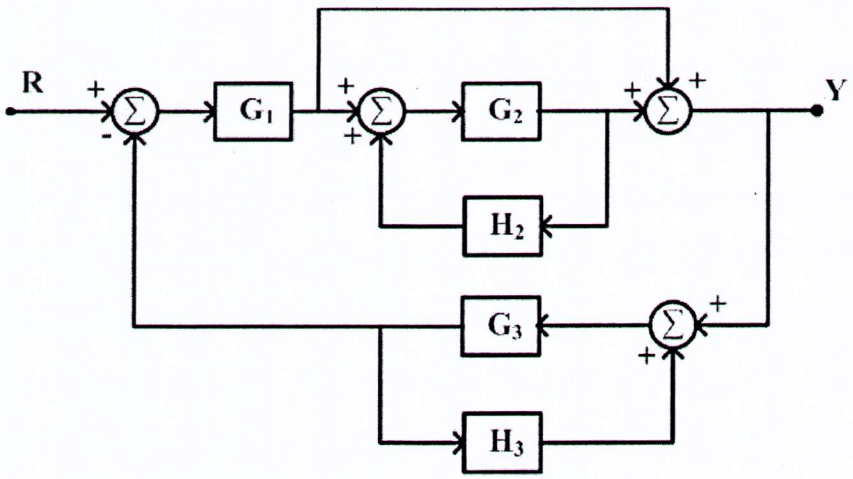

Fig. 2

Q6. Suppose $\tilde{S}$ denotes the sensitivity of the filtered feedback system (Fig. 3) to changes in the plant transfer function $G(s)$ and let T denotes the transfer function from reference to output. The filter dynamics and the sensor dynamics are denoted by $F(s)$ and $H(s)$, respectively. Answer the following:

a) Compute the sum $\tilde{S} + T$ and determine the relationship between $F(s)$ and $H(s)$ for the sum $\tilde{S} + T$ to be equal to unity. **4 Marks**

b) Compute the sensitivity of the filtered feedback system with respect to changes in the filter transfer function $F(s)$. **2 Marks**

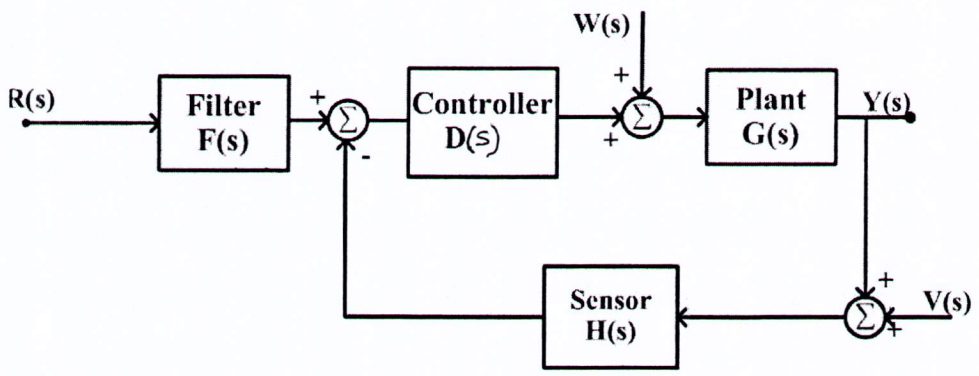

Fig 3.