Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – WINTER 2013

Subject Code: 161905 Date: 04-12-2013

Subject Name: Control Engineering

Time: 02:30 pm to 05:00 pm Total Marks: 70

Instructions:

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

Q.1 **(a)** Write Requirements of a good control system. Critically compare Open loop and Closed loop systems. Is an automatic electric iron an open loop or closed loop control system? **07**

(b) What is Transfer function? Obtain the transfer function of mechanical network shown in Fig. **1**. **07**

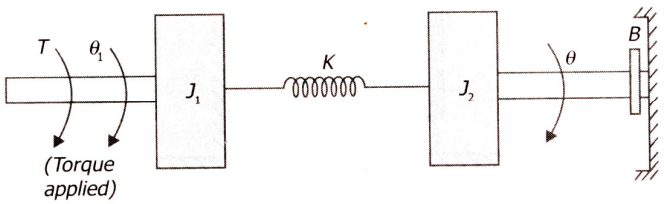

Figure:1

Q.2 **(a)** Write the differential equations governing the system shown in Figure **2** and draw the Force-voltage analogous electrical network. **07**

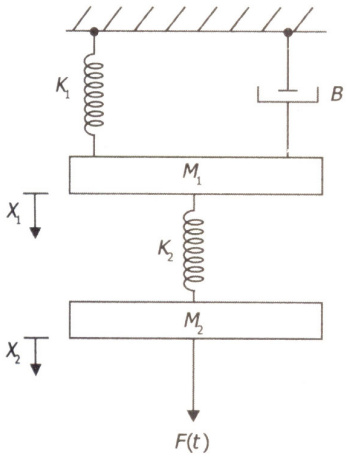

Figure:2

(b) Briefly explain Signal flow graphs with their properties. Also explain Mason's gain equation for signal flow graph. **07**

OR

(b) Reduce block diagram as shown in Figure **3** and obtain overall transfer function. **07**

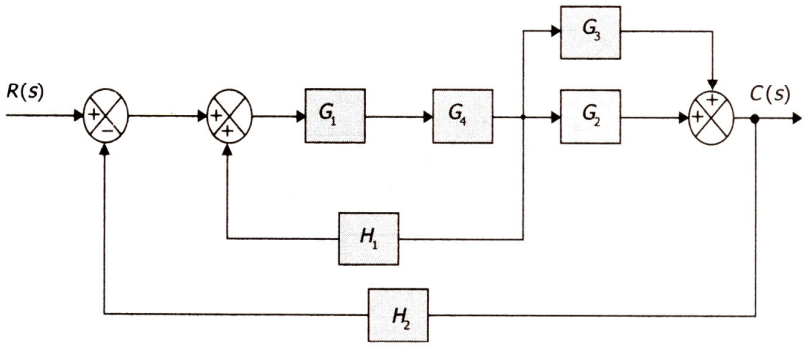

Figure:3

Q.3 **(a)** What is Fuzzy logic? Explain the concept of Fuzzy logic with a suitable example. **06**

(b) Explain the following : **08**

(**1**)Translational mechanical and Rotational mechanical systems.

(**2**) An Automatic control system

(**3**) Proportional lag and Controlled lag

(**4**) Linear time invariant and Linear time varying systems

OR

Q.3 **(a)** State whether the following statements are **True** or **False**. **06**

(1) Feedback control systems are also referred to as closed–loop systems.

(2) Fixed-time traffic light control system is an example of closed-loop control system.

(3) In a multivariable control system there is one input variable but variable outputs.

(4) Addition of a zero to the open-loop transfer function has the effect of shifting the root-locus to the left, thereby increasing stability and decreasing settling time.

(5) In a signal-flow graph forward path is a path from the input node to the output node.

(6) A system is unstable if all the poles of the characteristic equation are towards the left-hand side of the S-plane.

(b) The open loop transfer function of a control system is given as: **08**

$$G(s)H(s) = \frac{K}{(s+1)(s+10)(s+30)}$$

Draw the root locus. Determine the value of K for which the system is critically damped and also the value of K for which the system becomes unstable.

Q.4 **(a)** The forward path transfer function of unity feedback control system is given by, **07**

$$G(s) = \frac{k(s+10)(s+20)}{s^2(s+2)}$$

Apply Routh's criterion to determine the stability of a closed loop control system as a function of k. Determine the value of k that will cause sustained constant amplitude oscillations in the system. Determine the frequency of oscillations.

(b) Write note on "Programmable Logic controller (PLC) with its advantages. Also write its applications **07**

OR

Q.4 **(a)** Classify DC motors. Discuss their characteristics. Explain the construction and components of a DC motor. **07**

(b) A unity feedback system has an open-loop transfer function **07**

$$G(s) = \frac{25}{s\,(s+8)}$$

Determine its damping ratio, peak overshoot and time required to reach the peak output. Now a derivative component having transfer function of **s/5** is introduced in the system. Discuss the values obtained above.

Q.5 **(a)** Explain Proportional-Derivative (PD) hydraulic controller with a sketch. **06**

(b) Explain the following : **08**

(**1**) What is Relay? Explain the working principle of a pneumatic relay.

(**2**) Explain theory of four way and Pilot valves.

OR

Q.5 **(a)** Name various components used in any hydraulic circuits. Explain Vane pump with a neat sketch briefly. **06**

(b) Explain the following : **08**

1) Write comparison between Pneumatic systems and Hydraulic systems.

2) Explain pneumatic nozzle-flapper amplifier with a neat sketch.

****