Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (New) EXAMINATION – WINTER 2015

Subject Code:2142003 **Date:28/12/2015**

Subject Name: Control Theory

Time: 2:30pm to 5:00pm **Total Marks: 70**

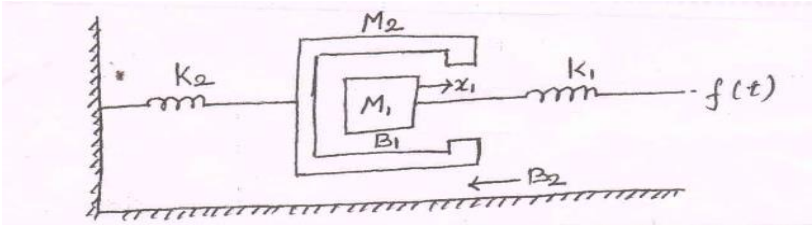
Instructions:

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

Q.1 **(a)** Explain in detail all the point of difference between open loop and closed loop system. **07**

(b) Explain force voltage and force current analogy with proper example. **07**

Q.2 **(a)** For the given mechanical system Write down differential equations, mechanical circuit diagram and find out $X_1(s)/F(s)$. **07**



(b) For the given electrical system transfer function Vo/Vi **07**

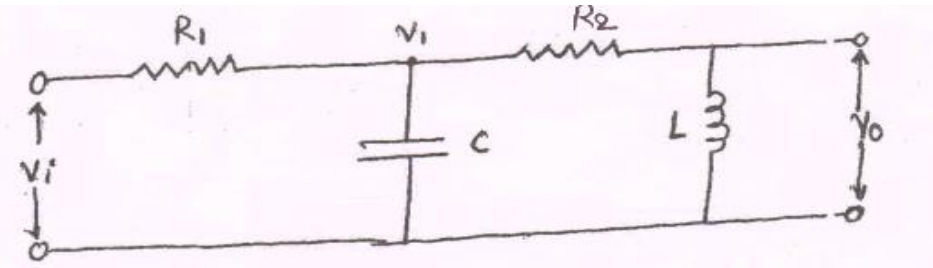
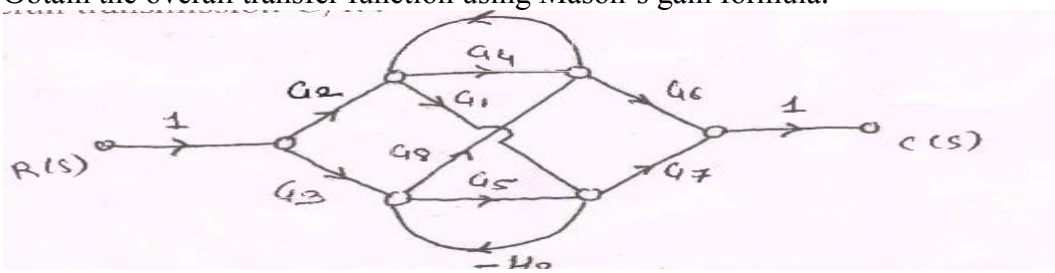


Fig.1

OR

(b) Obtain the overall transfer function using Mason's gain formula. **07**



Q.3 **(a)** Mention all the rules for block diagram reduction with proper example. **07**

(b) Obtain a state space and out-put equation for the system defined by **07**

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

OR

Q.3 **(a)** Explain following terms with necessary diagrams. **07**

- Delay Time
- Rise Time
- Peak Time
- Steady state error
- Settling Time

(b) A system has the following transfer function **07**

$$\frac{C(s)}{R(s)} = \frac{20}{s+10}$$

Determine its unit impulse and unit step response with zero initial conditions.

Q.4 **(a)** Derive the expression for static error coefficients. How these coefficients are useful in determining the steady state error? **07**

(b) A second order system is represented by the transfer function given below **07**

$$\frac{C(S)}{R(S)} = \frac{25}{S^2 + 6S + 25}$$

Find its rise time, peak time, peak overshoot and settling time

OR

Q.4 **(a)** Derive the expression for unit step response for second order control system for $0<\xi<1$. **07**

(b) Check the stability of the given characteristic equations using R-H criterion. **07**

$$s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$$

Q.5 **(a)** Explain Root Locus Technique rules in detail **07**

(b) Explain constant-M circles and constant-N circles by deriving related expressions. Explain how resonant peak can be obtained **07**

OR

Q.5 **(a)** Define and explain following terms with respect to frequency response **07**
(i) Gain Margin (ii) Phase Margin (iii) Gain cross-over frequency (iv)Phase cross-over Frequency

(b) State and explicate Nyquist Stability criteria. Make clear about phase margin and gain margin using Nyquist plot. **07**

****