Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – WINTER • 2014

Subject Code: 141701 **Date: 31-12-2014**

Subject Name: Control Theory

Time: 02:30 pm - 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.**

Q.1 (a) Differentiate Open loop & Closed loop control system. Explain its merits & demerits with example. **07**

(b) Derive transfer function for an armature controlled DC Motor. **07**

Q.2 (a) Explain significance of 'Time Constant' for first order and second order system with example. **07**

(b) Find the transfer function of the figure: - 1 using the Mason's gain formula. **07**

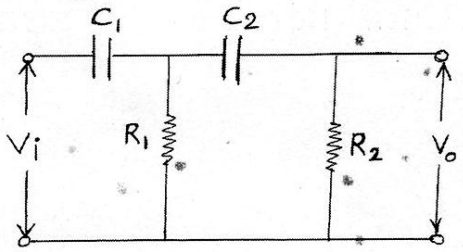

Fig : 1

OR

(b) Determine close loop transfer function of the system shown in figure:- 2 using the block diagram reduction technique. **07**

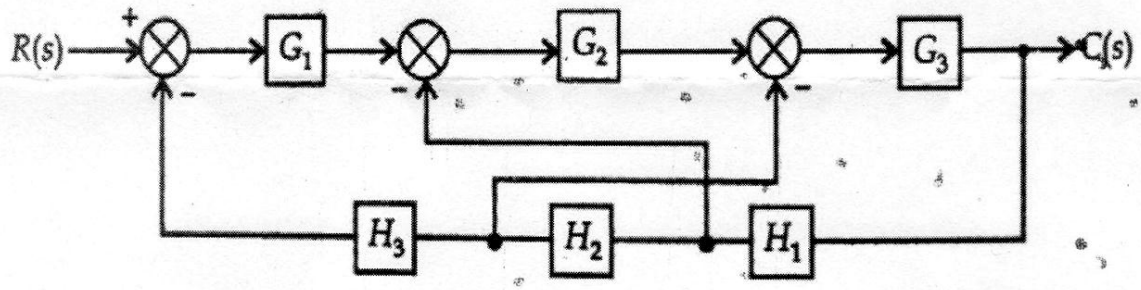

Figure:- 2

Q.3 (a) Define following terms. **07**

1. State space
2. State variable
3. Transfer function
4. Settling time
5. Peak time
6. Non touching loops
7. Sink Node

(b) Determine the stability of the following characteristics equation using the Routh criterion. **07**

1. $D(s) = s^4 + s^3 + s^2 + s + 3$
2. $D(s) = s^7 + 3s^6 + 3s^5 + s^4 + s^3 + 3s^2 + 3s + 1$

OR

Q.3 (a) Explain Standard Test signals & derive equation for steady state error & it's coefficients. **07**

(b) Explain Nyquist's stability criterion. **07**

Q.4 (a) Derive the transfer function of any one thermal system with neat sketch. **07**

(b) Derive the transfer function of the second order control system subject to unit step input. Draw response curves for under damped, over damped and critically damped system. **07**

OR

Q.4 (a) Draw the Root Locus diagram for system transfer function given by **07**

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

(b) Draw the Bode plot of the **07**

$$G(s) = \frac{200(s+2)}{s(s^2+10s+100)}$$

Q.5 (a) Draw and explain the Polar plots of Type – 0, 1, 2 systems. **07**

(b) Explain force-voltage & force to current analogy using any one example. **07**

OR

Q.5 (a) Explain the advantages of state space approach over classical methods and also obtain the state variable equation with necessary block diagrams and derivations. **07**

(b) Define and explain following terms with respect to frequency response **07**

1. Gain Margin
2. Phase Margin
3. Gain cross over frequency
4. Phase cross over frequency

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