Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(OLD) – EXAMINATION – SUMMER 2019

Subject Code:141701 **Date:20/05/2019**

Subject Name: Control Theory

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.**

Q.1 **(a)** Explain Open Loop and Closed Loop Control System with suitable Example. Also list their advantages and disadvantages. **07**

(b) Explain Force-Current (F-I) Analogy. **07**

Q.2 **(a)** Obtain differential equations of mechanical system shown in **figure 2 (a)** and draw the electrical network using Force-Voltage (F-V) Analogy. **07**

(b) Using Block Diagram reduction technique, find closed loop transfer function of system shown in **figure 2 (b)** **07**

OR

(b) Define Following: (1) Block Diagram (2)Summing Point (3) Take off Point (4) Feedback Path (5)Touching Path (6) Input node (7) Self loop **07**

Q.3 **(a)** For Signal Flow Graph shown in **figure 3 (a)**, Find the transfer function using Mason's gain formula. **07**

(b) Derive the equation of steady state error for closed loop control system. **07**

OR

Q.3 **(a)** Write short note on effect of input (step, ramp and parabolic) on steady state error. **07**

(b) A unity feedback system has $G(s) = \frac{10(S+6)}{(s+2)(s+4)}$. Determine: (i) Type of system (ii) All error coefficients (iii) Error when step input of magnitude 2 is given to the system. **07**

Q.4 **(a)** Explain following terms of transient response with suitable diagram. (1) Delay Time (2) Rise Time (3) Peak Time (4) Peak Overshoot (5) Settling Time **07**

(b) Using Routh Criterion, determine the stability of the system whose characteristic equation is $S^6 + 3S^5 + 5S^4 + 9S^3 + 8S^2 + 6S + 4 = 0$. Determine the number of roots lying in the right half of S-plane. **07**

OR

Q.4 **(a)** Using Routh Criterion, find range of k for the closed loop control system to be stable for H(S)=1 and $G(S) = \frac{k(S+1)}{S^2(S+2)(S+5)}$ **07**

(b) Sketch the root locus of a unity feedback control system with $G(S) = \frac{k}{S(S+1)(S+3)}$ and determine the value of k for marginal stability. **07**

Q.5 **(a)** Sketch Bode plot of a unity feedback control system having open loop transfer function as given below. Determine gain margin and phase margin. **07**

$$G(S) = \frac{10}{S(1 + 0.1S)(1 + 0.05S)}$$

(b) Draw the polar plot of the given system **07**

$$G(S)H(S) = \frac{10}{S(S + 2)}$$

OR

Q.5 **(a)** Write short note on effect of derivative control action on control system. **07**

(b) Write short note on standard test signals used in control system. **07**

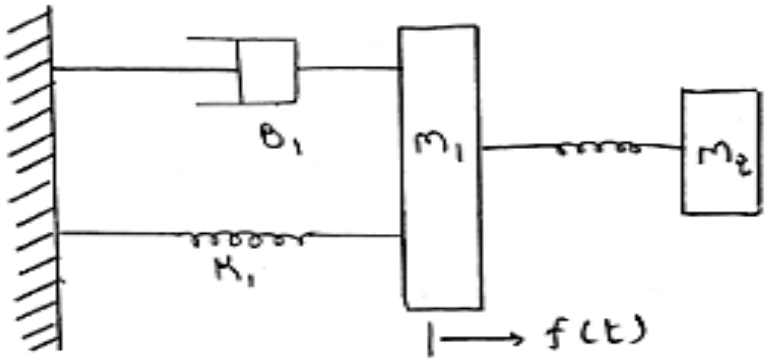

figure 2(a)

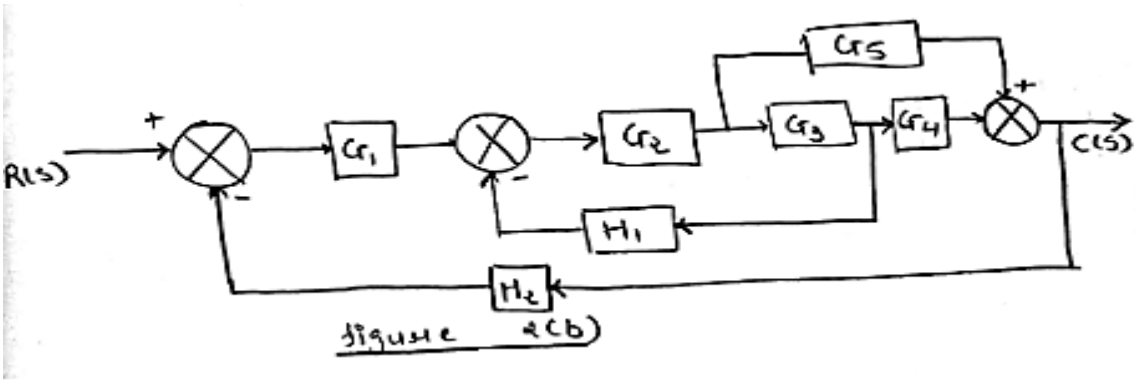

figure 2(b)

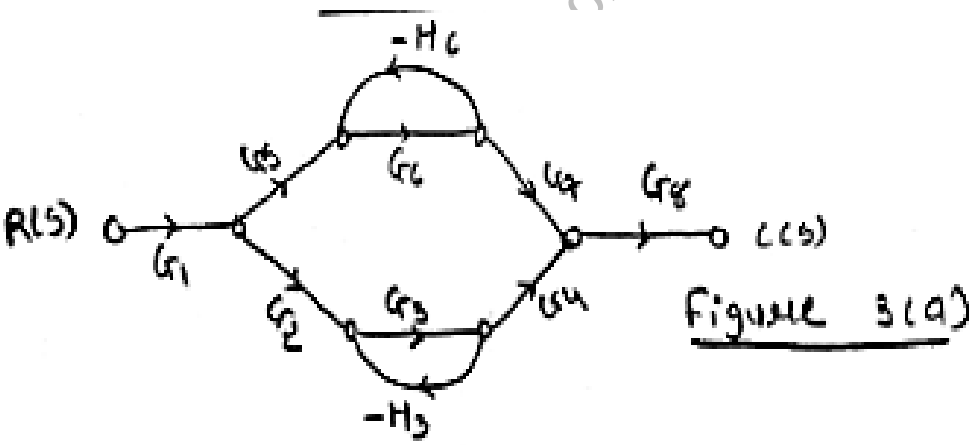

Figure 3(a)

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