Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2160104 **Date: 05/05/2017**

Subject Name: Basic Control Theory

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

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

MARKS

Q.1 **Short Questions** **14**

1 Define transfer function

2 For ramp input, what is the error constant formula?

3 What is the damping factor of Critically damped system?

4 For the second order system with unity feedback has open-loop transfer function G(s) =16/[s(s+4)]. Find damping ratio and natural frequency of closed-loop system.

5 In F-I analogy, the resistance and inductor analogous to _____and _____, respectively.

6 What is meant by db/dec?

7 What is an open loop system?

8 Define order of the system.

9 What is the standard test signals employed for time domain studies?

10 What is the effect of PD controller on the system performance?

11 Define settling time.

12 For the undamped (marginal stable) system, the value of damping ratio is_____

13 Find the time constant of the system given by G(s) = 10/s+5

14 Is state variable model representation of any system unique?

Q.2 **(a)** Briefly explain the first order system and its time response to a unit step input. **03**

(b) What is analogous system? Explain it With suitable Example, in brief. **04**

(c) Find out the overall transfer function using block diagram reduction rules for the figuregiven below **07**

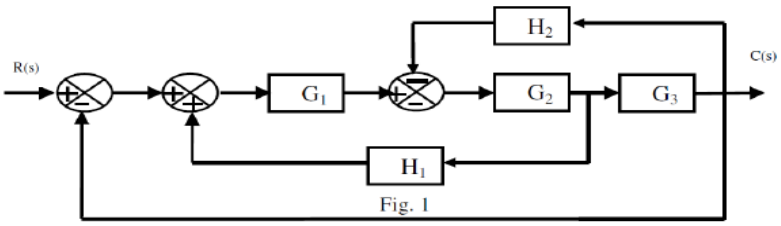
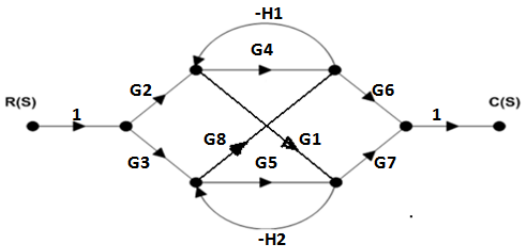


Fig. 1

OR

(c) Obtain the transfer function for the system shown below. **07**



Q.3 **(a)** Find polar plot of $G(s) = \frac{1}{s^2(Ts+1)}$ **03**

(b) For unity feedback control system shown below obtain steady state error for unit step input, $G(s) = \frac{10}{s^2+4s+50}$ **04**

(c) Draw the Bode plot for the open-loop transfer function G(s)=K/[s(s+3)(s+100)] for the velocity error constant=10. Also find gain cross over frequency, phase cross over frequency, GM and PM. **07**

OR

Q.3 (a) Sketch the polar plot of G(S)= K s / (Ts+1). **03**

(b) Obtain second order step response for the under damped case. **04**

(c) Consider an open loop transfer function $G(s)H(s) = 50/(s+1)(s+2)$ Determine whether the system is stable when the feedback path is closed. Use nyquist stability criterion. **07**

Q.4 (a) Using RH criterion find stability of the characteristic equation given as $s^4 + 2\,s^3 + 2s^2 + 3s + 5 = 0.$ **03**

(b) For the second order system, with transfer function as given below, obtain maximum percentage overshoot M_p and peak time t_p. **04**

25/(s^2 + 6s + 25)

(c) The open-loop transfer function of the unity feedback system is G(s)=K/[s(s+4)(s^2+4s+8)]. Construct root locus of it and find range of K for which system is stable. **07**

OR

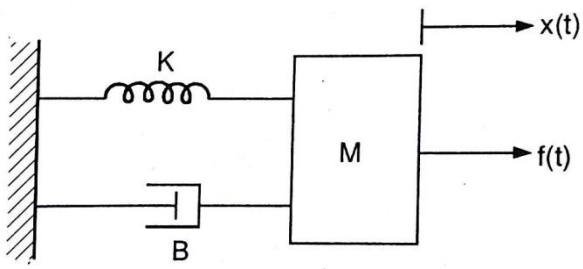
Q.4 (a) Explain ON-OFF controller with neutral zone. **03**

(b) Write note on steady state error and error constants. **04**

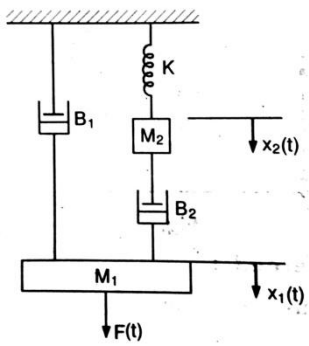
(c) Draw the root locus diagram for a closed loop system whose loop transfer function is given by G(S)H(s)=K/s(s+5)(s+10). Comment on stability. **07**

Q.5 (a) Stat advantages and disadvantages of frequency response. **03**

(b) For the system given below, find the transfer function X(s)/F(s) and damping ratio ξ, natural frequency ω_n, settling time t_s and peak time t_p. **04**



(c) Draw the equivalent mechanical system of the given system. Hence write the equilibrium equations for it and obtain electrical analogus circuits using (i) F-V analogy (ii) F-I analogy **07**



OR

Q.5 (a) For a RLC circuit, derive the state model of the system. **03**

(b) Discuss the limitations of transfer functions and advantages of analysis of control systems using state space. **04**

(c) A system whose characteristic equation is given by $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$, find out whether system is stable or not. **07**