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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2150909 **Date:11/05/2016**

Subject Name:Control System 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.**

Q.1 **(a)** Draw a neat block diagram of a general closed loop control system. Explain the role of each of these block in detail. 07

(b) Obtain the overall transfer function of the system whose block diagram is given in Fig.1 using block diagram reduction technique. 07

Q.2 **(a)** Draw a schematic diagram of armature controlled DC motor and its block diagram with closed loop. Derive the transfer function for armature controlled DC motor. 07

(b) Obtain the overall transfer function of the system whose block diagram is given in Fig.1 using Mason's gain formula. 07

OR

(b) Write the governing differential equations of the mechanical system shown in Fig 2. Write analogous electrical equations based on force –voltage analogy. Draw the corresponding circuit diagram. 07

Q.3 **(a)** Explain in brief the open loop and closed loop control systems with one example of each. Compare their merits and demerits. 07

(b) Write a note on state variable approach verses the classical approach of transfer function for the analysis of control systems. 07

OR

Q.3 **(a)** (i) Draw a series RLC circuit. Obtain its state space model considering the current and capacitor voltage as state variables. 04

(ii) Discuss in brief the concept of linearity of any control system in general. 03

(b) Explain what is type of a system and derive steady state error constants of type-0, type-1 and type-2 systems for following inputs: unit step, unit ramp and unit parabolic. 07

Q.4 **(a)** Using R-H criterion determine the stability of the systems represented by the following characteristic equations: 04

(i) $S^5 + S^4 + 24S^3 + 48S^2 - 25S - 5 = 0$. State how many roots of characteristic equations are on the right half of the s-plane.

(ii) $S^4 + 2S^3 + 10S^2 + 8S + 3 = 0$ 03

(b) Explain Nyquist contour in brief and Nyquist stability criterion. 07

OR

Q.4 **(a)** Sketch the root locus of a system whose open loop transfer function is as given below: 10

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

Write all important steps used to construct the root loci.

(b) Write a brief note on frequency response. 04

Q.5 **(a)** Derive the expression of response of first order system for a unit step input and unit impulse. Is it possible to get expression of response for impulse input if the expression is available for unit step input? If yes why? 07

(b) Write a note on how location of roots of characteristic equation plays an important role on the stability and behavior of the system. Use the sketches of impulse responses for different locations of roots. 07

OR

Q.5 **(a)** Sketch the Bode plots for the transfer function given below: 10

$$G(S)H(S) = \frac{2000}{S(S+2)(S+100)}$$

Find the gain margin and the phase margin of the system.

(b) Write a brief note on polar plots with a sketch of a simple example. 04

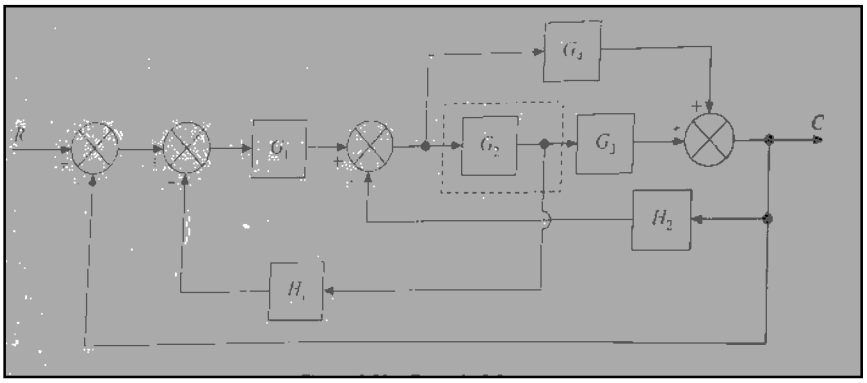

Figure 1

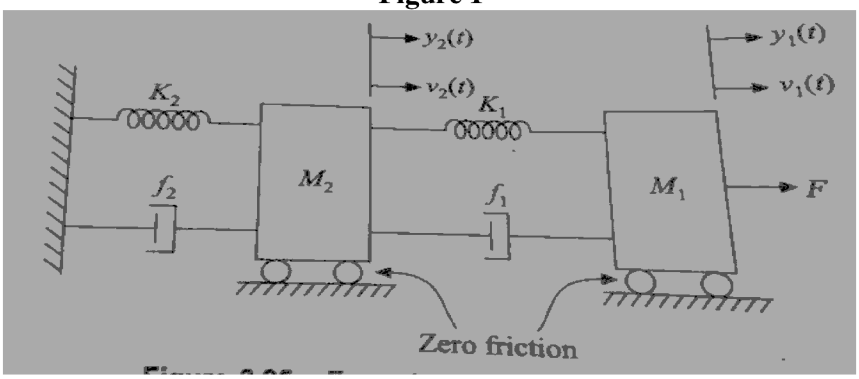

Figure 2

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