

**PARUL UNIVERSITY**  
**FACULTY OF ENGINEERING & TECHNOLOGY**  
**B.Tech. Summer 2022 - 23 Examination**

**Semester: 4****Subject Code: 203107257****Subject Name: Control Systems****Date: 27/03/2023****Time: 02:00 pm to 04:30 pm****Total Marks: 60****Instructions:**

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

**Q.1 Objective Type Questions - ( Fill in the blanks, one word answer, MCQ-not more than Five in case (15) of MCQ) (All are compulsory) (Each of one mark)**

1. Poles of transfer function are the Laplace transform variable values which causes the transfer function to become \_\_\_\_\_
2. \_\_\_\_\_ is the value of parabolic input in Laplace domain.
3. If a pole is located at  $s = -5$  in left-hand plane (LHP), Transfer function (TF) of system is represented in Laplace domain by \_\_\_\_\_
4. \_\_\_\_\_ unit is adopted for magnitude measurement in Bode plots.
5. \_\_\_\_\_ point on root locus specifies the meeting or collision of two poles.
6. Which among the following is not an advantage of an open loop system?
  - a) Simplicity in construction & design
  - b) Easy maintenance
  - c) Rare problems of stability
  - d) Requirement of system recalibration from time to time
7. Which among the following represents an illustration of closed loop system?
  - a) Automatic washing machine
  - b) Automatic electric iron
  - c) Bread toaster
  - d) Electric hand drier
8. If a step function is applied to the input of a system and the output remains below a certain level for all the time, the system is
  - a) not necessarily stable
  - b) stable
  - c) unstable
  - d) always unstable
9. Addition of zeros in transfer function causes which of the following?
  - a) Lead-compensation
  - b) Lag-compensation
  - c) Lead-lag compensation
  - d) None of the above
10. What should be the nature of root locus about the real axis?
  - a) Assymmetric
  - b) Symmetric
  - c) Exponential
  - d) Decaying
11. What is transmittance in SFG?
12. What is a signal flow graph?
13. Write the force balance equation of an ideal mass, dashpot and spring element.
14. Define closed loop control system.
15. Define Rise time ( $t_p$ ).

**Q.2 Answer the following questions. (Attempt any three)****(15)**

- A) What are the basic elements used for modeling mechanical translational system?
- B) Write five rules of block diagram reduction.
- C) Compare open loop transfer function closed loop transfer function.
- D) Draw the equivalent mechanical system and analogous system based on Force Voltage ( F-V) analogy for the given system shown in **Figure.1**

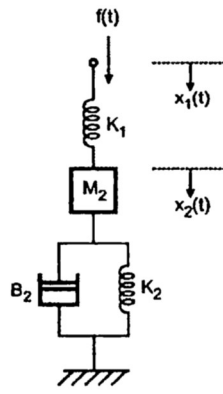


Figure.1

Q.3 A) Find Transfer function  $C(s)/R(s)$  for a Signal flow graph shown in **Figure.2** (07)

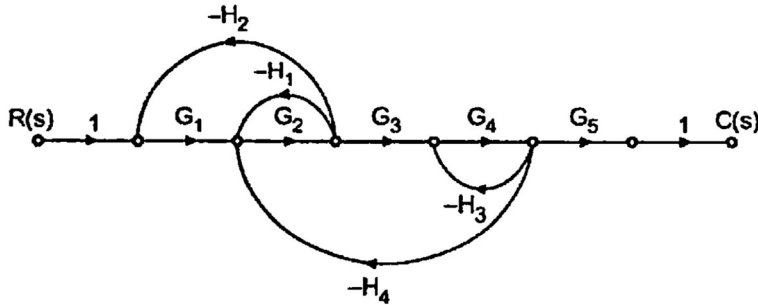


Figure.2

B) Obtain State Space Model of series RLC circuit shown in **Figure.3** (08)

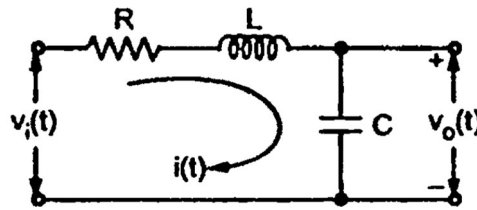


Figure.3

OR

B) Write the advantages and disadvantages of Routh's criterion (08)

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

check the stability of given characteristic equations of system using Routh's Criteria

Q.4 A) Sketch the root locus for the open-loop transfer function of a unity feedback control system given by (07)

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

Find the value of K for marginal stability

OR

A) For the unity feedback control system (07)

$$G(s) = \frac{k \cdot s^2}{(0.2s + 1)(0.02s + 1)}$$

Sketch the Bode plot. Determine gain and phase margin. Comment on the stability of the system.

B) A second order system is given by  $G(s) = \frac{25}{(s^2 + 6s + 25)}$  find its rise time peak time, peak overshoot and settling time if subjected to unit step input, also calculate expression for its output response (08)