

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2022**

**Subject Code:3140313**

**Date:04-07-2022**

**Subject Name:Control System and Analysis**

**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.
4. Simple and non-programmable scientific calculators are allowed.

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|---|--------------|
|   | <b>MARKS</b> |
| <b>Q.1 (a)</b> Define transfer function. Write properties of Transfer function. | <b>03</b>    |
| <b>(b)</b> Find out transfer function of electrical network given in figure 1.  | <b>04</b>    |

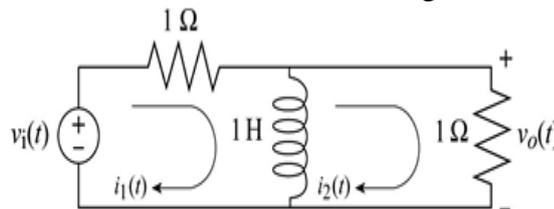


Figure 1

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|--|---|-----------|
|  | <b>(c)</b> Explain Open loop and Close loop system with examples. | <b>07</b> |
|--|---|-----------|
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| <b>Q.2 (a)</b> | Find out transfer function for the given impulse response $e^{-8t}$ .  | <b>03</b> |
| <b>(b)</b>     | Obtain differential equation of mechanical system shown in figure 2 and Draw the electric network using force-voltage analogy. | <b>04</b> |

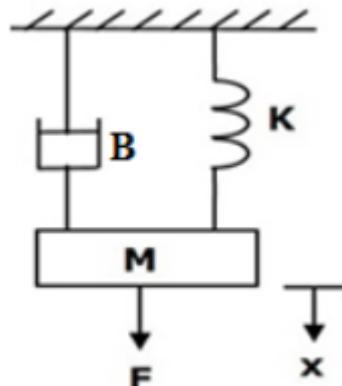


Figure 2.

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|------------|--|-----------|
| <b>(c)</b> | Explain Block diagram reduction Rules. | <b>07</b> |
|------------|--|-----------|
- OR**
- |            |   |           |
|------------|---|-----------|
| <b>(c)</b> | Find the single block equivalent by block diagram reduction for the system given in figure 3. | <b>07</b> |
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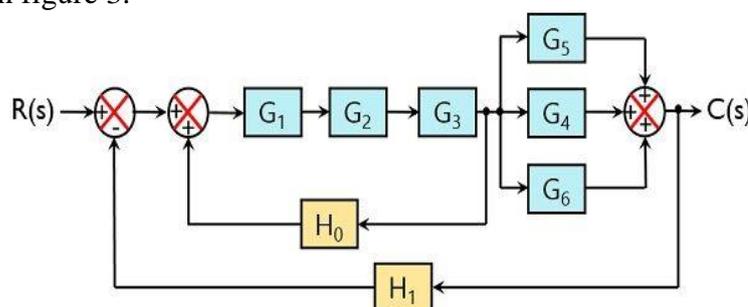


Figure 3.

- Q.3** (a) For a system with input  $x$ , output  $y$  given by,  $\frac{dy}{dt} + 2y = \frac{dx}{dt} + x$ . Find the transfer function. **03**
- (b) Find out impulse response of First order control system. **04**
- (c) Using Mason's gain formula, find the gain of the following signal flow graph shown in figure 4. **07**

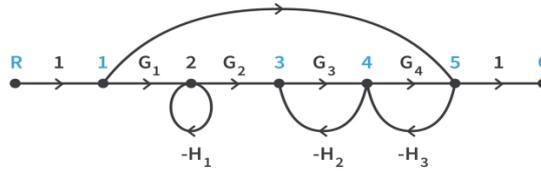


Figure 4.

**OR**

- Q.3** (a) Find out inverse Laplace transform of  $G(s) = \frac{(s+2)}{(s+4)(s+6)}$ . **03**
- (b) Check the stability of the system using routh's array for the characteristic equation,  $S^5 + 6S^4 + 15S^3 + 30S^2 + 44S + 24$ . **04**
- (c) Find out time domain specification of given system  $G(s) = \frac{36}{s^2 + 5s + 18}$ . **07**

- Q.4** (a) Explain Force to Current Analogy. **03**
- (b) Find the range of  $k$  for stable operation  $G(s) = \frac{k}{s(s+1)(s+2)}$ ,  $H(s) = 1$ , by using Routh's array. **04**
- (c) Explain Steady state error of Type 0, 1, 2 systems for Unit impulse, Unit Step and Unit Ramp function. **07**

**OR**

- Q.4** (a) Explain Torque to Voltage Analogy. **03**
- (b) A system having transfer function  $G(s) = \frac{1}{2(s+0.5)}$  is subjected to a unit step input. Find the steady value of output. **04**
- (c) For the system having the open loop transfer function  $G(s)H(s) = \frac{10}{s(s+1)(s+10)}$ . Determine the stability of the system by plotting the bode plot of the system. **07**

- Q.5** (a) Define Resonance Frequency, Gain Margin, and Phase Margin. **03**
- (b) Find the polar plot of  $G(s) = \frac{1}{(1+2s)(1+3s)}$  **04**
- (c) Sketch the root locus plot of a unity feedback system with an open loop transfer function of  $G(s) = \frac{k}{s(s+2)(s+4)}$ . Find the range of  $k$  for which system has damped Oscillatory response. **07**

**OR**

- Q.5** (a) Write advantages and disadvantages of Frequency domain analysis. **03**
- (b)  $G(s) = \frac{1}{s+1}$ . Decide the stability using Nyquist Plot. **04**
- (c) The transfer function of the system is given as,  $T(s) = \frac{s+3}{s^3 + 5s^2 + 8s + 4}$ . Obtain the state variable model of the system. **07**

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