Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2141004 **Date:17/05/2019**

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)** Define the following test signals. **03**

1. Unit Impulse
2. Unit Step
3. Unit Ramp

(b) Discuss the effect of adding a pole to a closed loop transfer function. **04**

(c) Derive the expression of a second order control system subjected to unit step signal. **07**

Q.2 **(a)** Discuss the effect of feedback on system gain and stability. **03**

(b) Define the following terms with respect to a second order system subjected to unit step signal. **04**

1. Delay time
2. Rise time
3. Peak time
4. Settling time

(c) Derive the expressions for error constants K_p , K_v and K_a corresponding to step, ramp and parabolic input respectively **07**

OR

(c) Discuss open loop control systems and closed loop control systems with suitable examples. **07**

Q.3 **(a)** 1. A system having repeated roots on imaginary axis is _____. **03**
(A) Stable (B) Unstable (C) Marginally stable (D) Conditionally stable
2. A system has its two poles on the negative real axis and one pair of poles lies on jω axis. The system is _____.
(A) Stable (B) Unstable (C) Marginally stable (D) Either A or C
3. Define order of a control system.

(b) Discuss force voltage (F-V) analogous system with analogous quantity. **04**

(c) Find the transfer function for the system shown in figure 1. **07**

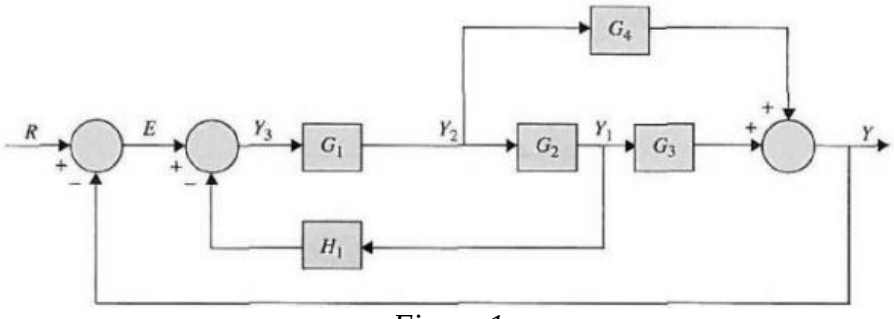

Figure 1

OR

Q.3 **(a)** 1. State the necessary and sufficient condition for system stability. **03**
2. Define type of a control system.
3. Define steady state error.

(b) Discuss force current (F-I) analogous system with analogous quantity. **04**

(c) Obtain the transfer function for the signal flow graph shown in figure 2. **07**

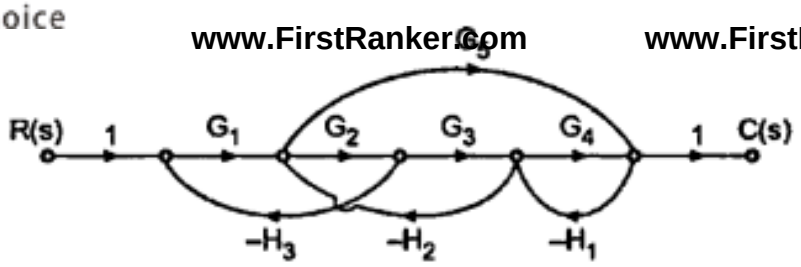

Figure 2

Q.4 **(a)** Discuss Hurwitz's stability criteria. **03**

(b) Examine the stability of the system using Routh's method. **04**

$s^5+2s^4+3s^3+6s^2+2s+1=0$

(c) Sketch the root locus for the system having **07**

$$G(s)H(s)=\frac{k(s+5)}{(s^2+4s+20)}$$

OR

Q.4 **(a)** State advantages and limitations of Routh's stability criterion. **03**

(b) For the unity feedback system **04**

$$G(s)=\frac{k}{s(1+0.4s)(1+0.25s)}$$

find the marginal value of k.

(c) For the system shown in figure 3, show that the system is always overdamped , independent of the selection of R and C. **07**

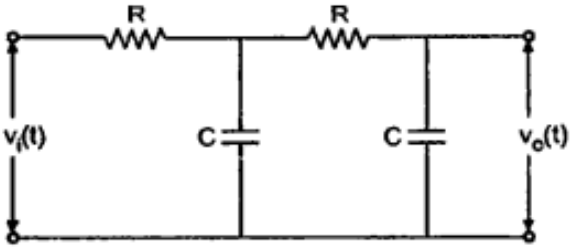

Figure 3

Q.5 **(a)** Discuss Nyquist criteria for stability. **03**

(b) Define the following terms **04**

1. Gain cross over frequency
2. Phase cross over frequency
3. Gain Margin
4. Phase Margin

(c) Explain the nature of Bode plot for **07**

1. Poles at the origin
2. Zeros at the origin

OR

Q.5 **(a)** Discuss briefly PID controller. **03**

(b) Compare time response and frequency response of system. **04**

(c) Derive correlation between transfer function and state-space equations. **07**

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