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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2140307 **Date: 14/06/2017**

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.**

MARKS

Q.1 Short Questions **14**

1 In an open loop control system

A Output is independent of control input **B** Output is dependent on control input

C Only system parameters have effect on the control output **D** None of the above

2 A car is going at a constant speed of 50 km/h, which of the following is the feedback element for the driver ?

A Clutch **B** Legs

C Needle of the speedometer **D** Steering wheel

3 The initial response when the output is not equal to input is called

A Transient response **B** Error response

C Dynamic response **D** None of these

4 The capacitance, in force-current analogy, is analogous to

A momentum **B** velocity

C displacement **D** mass

5 The type 0 system has _____ at the origin.

A no pole **B** net pole

C single pole **D** two poles

6 The time required for the response to rise from 10% to 90% of the final value for over damped systems and 0 to 100% of the final value for under damped systems is called the

A Rise time **B** Pickup time

C Settling time **D** Transient time

7 If poles of system are left side of s plane then system is _____ .

A stable B Unstable

C Marginally stable D None

8 What is the output of Y(s)/X(s) = _____

9 Write down forward paths of below system:

10 Give different examples of open loop system.

11 Give different examples of close loop system.

12 Find out poles and zeros of below given transfer function:

$$G(s)H(s) = \frac{K(s+1)(s+2)}{s(s+3)(s+4)}$$

13 Find out order and type of below given transfer function:

$$G(s)H(s) = \frac{K(s+1)(s+2)}{s(s+3)(s+4)}$$

14 An impulse function is a derivative of _____ function

A	Parabolic	B	Step
C	Ramp	D	Linear

Q.2 **(a)** Find transfer function of following system. Also find order and type of the system. **03**

(b) Explain mason gain formula. **04**

(c) Derive transfer functions for the following mechanical system. **07**

OR

(c) Find out transfer function of below given Signal Flow Graph. **07**

Q.3 **(a)** What is the output of Y(s)/X(s) = _____ **03**

(b) Explain Electrical-Mechanical Analogy. **04**

(c) Consider the block diagram shown in the following figure. Simplify this block diagram using the block diagram reduction rules and find out C2(s)/R1(s). **07**

OR

Q.3 **(a)** Find the stability of the control system having characteristic equation, $s^4+2s^3+s^2+2s+1=0$ using RH method. **03**

(b) The close loop transfer function of a position control system is given by **04**

$$G(s) = \frac{K}{s^4 + 6s^3 + 30s^2 + 60s + K}$$

By applying the Routh criterion discuss the stability of the closed loop system as a function of K.

(c) Consider the block diagram shown in the following figure. Simplify this block diagram using the block diagram reduction rules. **07**

Q.4 **(a)** Define state variable using example. **03**

(b) Define: Maximum overshoot and delay time of system. **04**

(c) Draw the Bode Plot for following transfer function and find (a) Gain Margin, (b) Phase Margin (c) Gain Crossover frequency (d) Phase Crossover frequency. Also comment on stability. **07**

$$G(s)H(s) = \frac{25(s+4)}{s(s+1)(s+10)}$$

OR

Q.4 **(a)** Define Gain margin and Phase margin. **03**

(b) Define steady state error of system and derive it for different standard inputs and TYPE 0 system. **04**

(c) Obtain the phase and gain margins of the system shown in figure for the two cases, where K = 10 and K = 100 with the help of bode plot. Also discuss about the stability of same system with both gain. **07**

Q.5 **(a)** Define damping factor ξ of system and explain system's behavior for different values of zeta(ξ). **03**

(b) Draw the Nyquist plot of below given open-loop transfer function: Determine the stability of the system using Nyquist criteria. **04**

$$G(s)H(s) = \frac{10}{s(s+1)(s+2)}$$

(c) Draw the root locus for following transfer function: **07**

$$G(s)H(s) = \frac{K}{s(s+1)(s+3)}$$

OR

Q.5 **(a)** Explain stable system, unstable system and marginally stable system with reference to pole location in s plane. **03**

(b) Draw Polar plots of following open loop transfer functions and also comment on stability **04**

$$G(s)H(s) = \frac{1}{(T_1 s+1)(T_2 s+1)}$$

(c) Draw the root locus for following transfer function: **07**

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

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