BE (INSTRU) Sem VII CBSGS 03/12/18 (1/2)

Duration: 3 Hours **Total Marks :80**

Note:

1. **Question one is compulsory.**
2. **Solve any three from remaining and suitable data**

Q1. **Solve any four** **20**

a. Explain in detail Physical nonlinearity which has memory?

b. Draw sinusoidal response of saturation with dead zone nonlinearity and write the response equation.

c. Differentiate linear and nonlinear system in detail

d. Explain Lyapnov theorem in details

e. Derive classical control "c" from the IMC controller 'q'

Q2. a **10**

Explain in detail Jump response with example

Q2. b Formulate the describing function for relay with dead zone. **10**

Q3.a For the system described by, investigate variant gradient method to find Lyapnov's function For non linear system, **10**

$$\dot{x}_1 = -2x_2$$

$$\dot{x}_2 = -2x_2 + 2x_1x_2^2$$

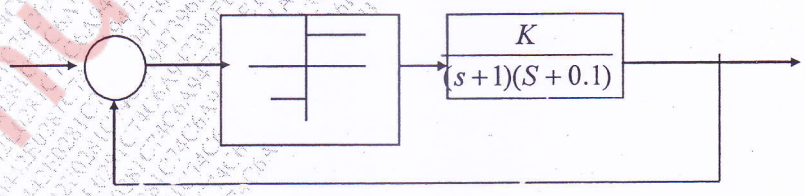
Q3.b. Design the optimal controller via Riccati equation for the system **10**

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 2 & -1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

to minimize the performance index

$$J = \int_0^\infty (x_1^2 + x_2^2 + u^2)dt$$

Q4.a. Investigate Stability using Describing function of following system which has unity relay signal as a nonlinearity. **10**



54929

BE (INSTRU) SEM VII CBSGS 03/12/18

Q4.b. Determine stability using Krasovskii method **10**

$$\dot{X}_1 = -X_1;$$

$$\dot{X}_2 = X_1 - 2X_2 - X_2^3$$

Q5.a. Explain in details IMC based PID controller Design/tuning. **10**

Q5.b. Using different equilibrium point comment of singular point and draw trajectories **10**

$$\dot{x}_1 = -x_1^3 + x_2$$

$$\dot{x}_2 = x_1 - x_2^3$$

Q6a. Give definition of 1,2, and ∞ norm **04**

Q6b Compute 2-norm of following, **06**

$$A=\begin{bmatrix} 0.8 & 0 \\ 0 & 1.7 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 0 \\ 0 & 5 \end{bmatrix}$$

Q6c **10**

Draw Phase trajectory using delta method for given systemand comment of stability, intinal condition is (0,0)

$$\ddot{x} + 5\dot{x} + 4x = 0$$
