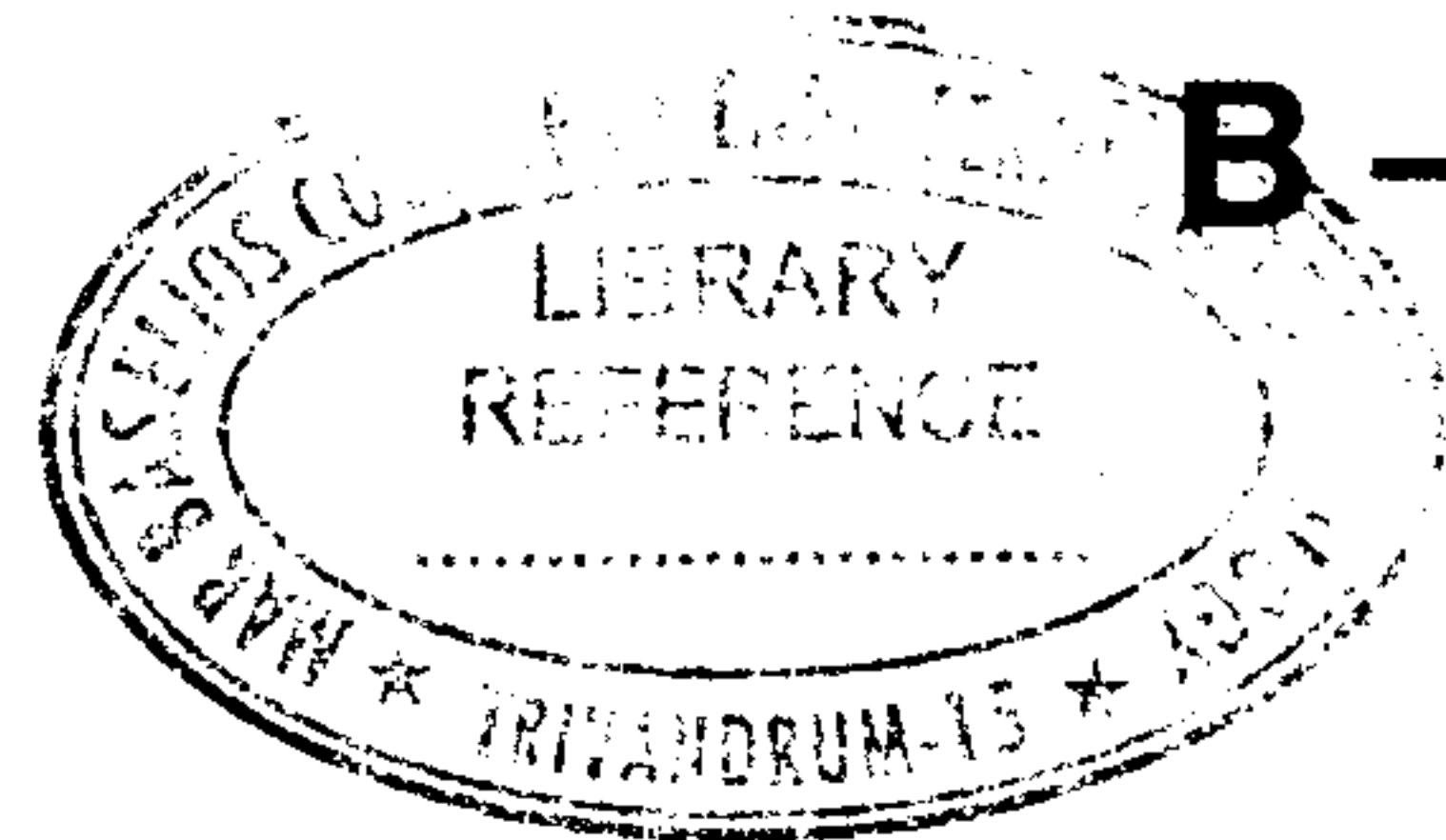




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B – 5991

Reg. No. :

Name :

**Sixth Semester B.Tech. Degree Examination, April 2017
(2013 Scheme)
13.601 : ADVANCED CONTROL THEORY (E)**

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** marks.

1. Test the controllability of the system with state model matrices :

$$A = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & -2 & -3 \end{bmatrix}; \quad B = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} ?$$

2. Determine the Z-Transform for the functions

i) $f(k) = ka^{(k-1)}$ and

ii) $H(s) = \frac{1}{s(s+2)}$?

3. Derive the transfer function and mention the features of the ZOH circuit.

4. Explain any two types of memory type nonlinearities with their transfer characteristics.

5. Test the definiteness of the function :

$$f(x) = x_1^2 + 2x_1x_2 - 3x_2^2 + 2x_1x_3 - 4x_2x_3 - 2x_3^2$$

P.T.O.



PART – B

Answer **any one full** question from **each** Module. **Each** full question carries **20** marks.

Module – I

6. a) Obtain the solution $x(t)$ for a unit step input for the system described by **14**

$$A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}; x(0) = \begin{bmatrix} 0 \\ -1 \end{bmatrix} ?$$

- b) Explain the properties of state transition matrix. **6**

OR

7. a) Develop the canonical diagonal model of the system given by
 $\dot{x} - Ax + Bu; y = Cx$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -3 & -4 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}; C = [1 \ 0 \ 0]$$

12

- b) Write short note on pole placement concept using state feed back ? **8**

Module – II

8. a) Determine the $f(k)$ for $F(z) = \frac{(2z^3 + z)}{(z - 2)^2(z - 1)}$ **6**

- b) Test the stability of the system with characteristics equation

$$Q(z) = z^4 - 1.5z^3 + 0.05z^2 + 0.25z - 0.07; \text{ using Jury's test.} \quad \mathbf{14}$$

OR

9. a) Solve the difference equation $f(k + 2) + 5f(k + 1) + 6f(k) = u(k)$; with
 $f(k) = 0$, for $k < 0$? **12**

- b) Write short note on sampling theorem and aliasing effect ? **8**



Module – III

10. a) Determine the describing function for Relay with Dead zone. **12**
b) How do you use describing function to test the existence and stability of limit cycles ? **8**

OR

11. Write short notes on :
i) Jump resonance.
ii) Conditions for describing function analysis.
iii) Harmonic linearization. **20**

Module – IV

12. a) Draw the phase plane for the system given by $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 2x = 0$ with initial conditions (2, 1) using isocline method to analyse the stability. **14**
b) Explain the features of different Node equilibrium points based on eigen values. **6**

OR

13. a) Determine the stability of the nonlinear system given by **14**
 $\dot{x}_1 = -x_1 - x_2^2$
 $\dot{x}_2 = -x_1 - x_2$
b) Explain the stability of a limit cycle with a suitable nonlinear differential equation and phase plots. **6**

