



Reg. No. : .....

Name : .....

**Sixth Semester B.Tech. Degree Examination, May 2018**  
**(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. Write short note on pole placement by state feed back method ?
2. Determine the transfer function from the state model  
 $\dot{X} = AX + BU$   $A = \begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}$ ;  $B = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ ;  $C = [1 \quad -1]$ .
3. Derive the solution for  $x(k)$  for a sampled data system :  $x(k + 2) - 3x(k + 1) + 2x(k) = 0$ ; with  $x(0) = 0$ ;  $x(1) = 1$ ?
4. Explain any three peculiar behavior of nonlinear elements ?
5. Explain the features of focus equilibrium points based on eigen values ?

PART – B

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

**Module – I**

6. a) Obtain the solution for the system described by

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

**14**

- b) Test the observability of the system ?  $A = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & -3 \end{bmatrix}$ ;  $C = [-1 \quad 1 \quad 2]$ . **6**

OR

P.T.O.



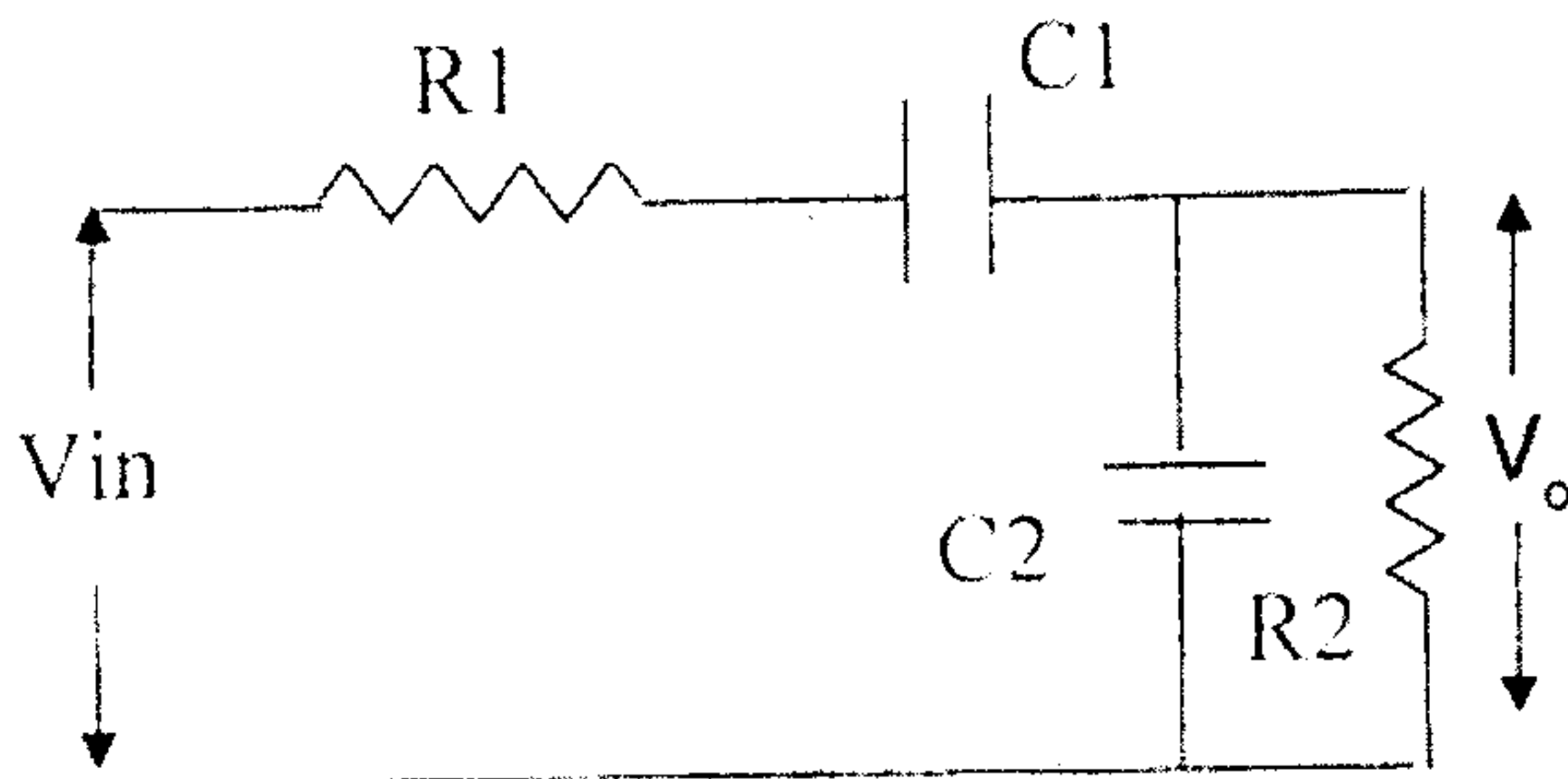
7. a) Develop the phase variable state model of the system given by

$$T(s) = \frac{(2s^2 - 3s + 1)}{(s^3 + 5s^2 + 2s + 6)}. \text{ Show all steps involved.}$$

12

- b) Develop the state model for the electrical circuit shown in Fig. 1 ?

8



### Module - II

8. a) Determine the Z- transform  $F(z)$  in terms of  $X(z)$  from fundamentals for

i)  $f(k) = kx(k)$

ii)  $f(k) = x(n + k)$ .

8

- b) Write short note on :

i) Pulse Transfer function.

ii) Properties of state transition matrix for sampled data system.

(5+7)

OR

9. a) Test the stability of the system with characteristic equation  $Q(z) = z^3 - 1.1z^2 - 0.1z + 0.2$  using Bilinear transformation and Routh criterion ?

12

- b) Write short note on :

i) ZOH circuit.

ii) ZIT using power series method.

8

### Module - III

10. a) Determine the describing function for saturation with dead zone.

b) How do you use harmonic linearization for system analysis ?

(10+10)

OR

11. In a closed loop system a linear system with  $G(s) = \frac{10}{s(s+2)(s+4)}$  is in cascade with a relay nonlinearity in the forward path. Test the stability of the limit cycle using describing function method.

20



**Module – IV**



12. a) Analyse the equilibrium point stability for the following system using delta method for phase plane plot  $\frac{d^2x}{dt^2} + 2x \frac{dx}{dt} + 2x = 0$  . **14**

b) Test the definiteness of the function :  $f(x) = x_1^4 + 2x_1x_2 + 2x_2^2 + x_1^2$  ? **6**

OR

13. a) Use Lyapunov method to determine the value of K such that the following LTI system is stable  $\dot{X} = \begin{bmatrix} -1 & 1 \\ -2 & K \end{bmatrix} X$ . **14**

b) Explain the physical significance of Lyapunov function. **6**

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