

(3 Hours)

[Total Marks: 80]

- N.B: (1) Question No.1 is compulsory.  
 (2) Attempt any three questions out of remaining five questions.  
 (3) Draw diagrams/ figure wherever necessary.  
 (4) Assume suitable data if necessary and indicate it clearly

Q.1. a) Write a note on Modelling and Simulation. (20M)

b) State and explain various methods of sterilization. What is its importance in Bioprocess Operations?

c) Write a note on Batch Distillation

d) Write a formula to solve equation by Runge Kutta Method.

Q.2. a) Derive mathematical model for Fed Batch Reactor. (10M)

b) Derive the model equation for Ethanol Fermentation Process. (10M)

Q3. a) Derive mathematical model for Continuous Stirred Tank Reactor (CSTR). (10M)

b) Derive the model equation for Antibiotic Production Process. (10M)

Q.4. a) Using Newton Raphson method for the equation  $x^3 - 5x + 3 = 0$ , find the root starting with  $x_0 = 1$  (10M)

b) Solve the following equations by Gauss-Seidel Method. (10M)

$$27x + 6y - z = 85$$

$$6x + 15y + 2z = 72$$

$$x + y + 54z = 110$$

Q.5. a) In an experiment a quantity G was measured as follows (10M)

G(20)= 95.90
G(21)= 96.85
G(22)= 97.77
G(23)= 98.68
G(24)= 99.56
G(25)= 100.41
G(26)= 101.24

Compute  $\int_{20}^{26} G(x)dx$  by both Simpsons (1/3)<sup>rd</sup> Rule and Trapezoidal Rule.

b) Fit a straight line  $y = a + bx$  to the following data.

(10M)

x	1	2	3	4	5	6
y	49	54	60	73	80	86

Q.6. Write Short notes on

(20M)

- Continuity Equation
- Component Continuity Equation
- Energy Equation
- Equation of Motion