

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VIII • EXAMINATION – SUMMER • 2015

Subject code: 180405**Date:05/05/2015****Subject Name: Modelling and Simulation of Bioprocess****Time: 10.30AM-01.00PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) Briefly give the classifications of models. 06**(b) The following is formulated as an optimization problem. A 08**

batch reactor operating over 1-h period produces two products according to the parallel mechanisms A to B and A to C. Both reactions are irreversible and first order in A and have rate constants given by

$$K_i = k_{i0} \exp [E_i/RT], \quad i = 1, 2$$

$$\text{Where } k_{10} = 10^6/\text{s}, \quad k_{20} = 5.10^{11}/\text{s},$$

$$E_1 = 10,000 \text{ cal/gmol} \quad E_2 = 20,000 \text{ cal/gmol}$$

The objective is to find the temperature-time profile that maximizes the yield of B for operating temperatures below 282°F. The optimal control problem is therefore

$$\text{Maximize } B(1.0) \quad \text{subject to} \quad [dA/dt] = -(k_1 + k_2)$$

$$A, \quad [dB/dt] = k_1 A$$

$$A(0) = A_0, \quad B(0) = B_0, \quad T \leq 282 \text{ } ^\circ\text{F}.$$

[1] What are the independent variables in the problem?

[2] What are the dependent variables in the problem?

[3] What are the equality constraints?

[4] What are the inequality constraints?

Q.2 (a) Explain the unstructured kinetic model of cell growth. 07**(b) Use three iterations for the function $f(x) = x^2 - 10 \exp(0.1x)$ in the interval (-10,5) 07****OR****(b) Find all the basic feasible solution of the equations: 07**

$$2x_1 + 6x_2 + 2x_3 + x_4 = 3, \quad 6x_1 + 4x_2 + 4x_3 + 6x_4 = 2$$

Q.3 (a) Mention separately the dependent and independent variables 10 for activated sludge process and Derive suitable model equations.

- (b) Explain genetic algorithm with its main feature and compare it with artificial neural network. **04**

OR

- Q.3** (a) Develop model with all design equations for CSTR in Chemostate. **10**

- (b) An animal feed company must produce 200 tons of a mixture containing the ingredients P and Q. P costs 30 Rs per ton. Q costs 80 Rs per ton. Not more than 800 tons of P can be used and minimum quantity to be used for Q is 60 tons. Formulate the linear programming problem for finding how much of each ingredient should be used if the company wants to minimize the cost. **04**

- Q.4** (a) What is linear programming? Give its uses in the real world. **08**

- (b) Find the maxima and minima of the function **06**

$$f(x) = 12X_5 - 45X_4 + 40X_3 + 5$$

OR

- Q.4** (a) Classify the optimization problem. **08**

- Q.4** (b) Define: basic solution, feasible solution, basic feasible solution, optimal solution **06**

- Q.5** (a) Explain the model for dynamics of the epigenetic system. **09**

- (b) Apply Runge-kutta method of fourth order to find an approximate value of y when x=0.2 given that $dy/dx=x+y$ and $y(0)=1$. **05**

OR

- Q.5** (a) Find the approximate value of y corresponding to x=1 when $dy/dx=x+y$ and y=1 when x=0. Take h=0.1. **09**

- (b) Find the positive root of $x^4-x-10=0$ correct to three decimal places, using Newton-Raphson method. **05**
