Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER–VIII • EXAMINATION – SUMMER • 2014

Subject Code: 180405 Date: 27-05-2014

Subject Name: Modeling and Simulations of Bioprocess

Time: 10.30 am - 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Notations used have conventional meaning.**

Q.1 (a) Develop a model for batch bioreactor. Write assumptions clearly. **07**

(b) A courier company is into optimizing exercise for accommodating mails into a box which has the square base and open top. It is to contain 800 cm^3 every day. Find the dimensions that require the least material to construct the box. Assume uniform thickness of material. **07**

Q.2 (a) Find all the basic solutions of the following system of equations identifying in each case the basic and non-basic variables : **07**

$4 X_1 + X_2 + 2 X_3 = 11$, $3 X_1 + X_2 + 5 X_3 = 14$.

(b) Explain the non-traditional optimization processes. **07**

OR

(b) What is the format of optimization problem? Enlist major steps in optimization. **07**

Q.3 (a) Enlist various methods of single variable optimization. Give the importance of Newton-Raphson and Secant Method. **07**

(b) Find an optimal solution using three iterations for the function … $f(x) = x^3 - 5$, in the interval (-10, 5) using bracketing method. **07**

OR

Q.3 (a) Give the definition of convex function. For each of these below mentioned functions, analyze if the given function is convex or concave. **07**

$f(x) = 8x$, $f(x) = 6x^3 - x^2$, $f(x) = -2x$

(b) Discuss the model of anaerobic wastewater treatment process. Mention the dependent and independent variables clearly. **07**

Q.4 (a) A firm manufactures two items. It purchases casting which is then machined, bored and polished. Castings for items A and B cost Rs. 3 and Rs. 4 and are sold at Rs. 6 and rs. 7 each respectively. Running costs of these machines are Rs. 20, Rs. 14 and 17.50 per hour respectively. Formulate the problem so that the product mix maximizes the profit? Capacities of the machines are: **07**

	Part A	Part B
Machining capacity	25 per hr.	40 per hr.
Boring Capacity	28 per hr.	35 per hr.
Polishing capacity	35 per hr.	25 per hr.

(b) Derive structured model for epigenetic system. **07**

OR

Q.4 (a) An animal feed company must produce 200 tons of a mixture containing the ingredients: Proteins (P) and Carbohydrates (C). P costs 30 Rs per ton. C costs 80 Rs per ton. Not more than 800 tons of P can be used and minimum quantity to be used for C is 60 tons. Formulate and then solve graphically, the linear programming problem for finding how much of each ingredient should be used if the company wants to minimize the cost. **07**

(b) Derive and explain segregated model of product formation. **07**

Q.5 (a) Use Euler's method to numerically integrate $f(x,y)= -2x^3 + 12x^2 – 20x + 8.5$ from x=0 to x=4. Take h = 0.5 and given y(0) = 1 **10**

(b) Give the relation for net specification. **04**

Q.5 (a) Use Runge-Kutta method to find out value of y when x=1, given that y=1 where x=0 and given that: **10**

$$\frac{dy}{dx} = \frac{y - x}{y + x}$$

(b) What is significance of Monod Model? **04**

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