Seat No.: _____ Enrolment No._____

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 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 **08**

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

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

E_1 = 10,000 cal/gmol E_2 = 20,000 cal/gmol

The objective is to find the temperature-time profile that maximizes the yield of B for operating temperatures below 282^0F. The optimal control problem is therefore

Maximize B(1.0) **subject to** $[dA/dt] = -(k_1 + k_2)A$, $[dB/dt] = k_1 A$

$A(0)=A_0$, $B(0)=B_0$, $T \leq 282\ ^0F$.

[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**

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

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

	(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**

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

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 Runga-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**

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