Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VIII • EXAMINATION – SUMMER • 2015**

**Subject Code: 180503 Date:13/05/2015**

**Subject Name: Process Simulation and Optimization**

**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)** What are the necessity and sufficiency conditions for the optimization problems? And give examples of Optimization applied to Chemical Industries? **07**

**(b)** Discuss degrees of freedom analysis for any one example. **07**

**Q.2** **(a)** Sketch the objective function and constraints of the following nonlinear programming problems: **07**

a) Minimize $f(x) = 10x_1+11x_2$

Subject to $9x_1+11x_2>=29$

x>=0 and integer

**(b)** Discuss the stream tearing of process giving one example. **07**

**OR**

**(b)** Differentiate the ILL-Posed problems to WELL-POSED One. **07**

**Q.3** **(a)** Determine the convexity of the following function **07**

$f(x) = 2x_1^2+2x_1x_2+1.5x_2^2+7x_1+8x_2+24$

$f(x) = 2x_1 + 3x_2 + 6$

**(b)** What is debottlenecking? Also explain partitioning and precedence ordering with one example. **07**

**OR**

**Q.3** **(a)** Differentiate between equation oriented model and modular based model. **07**

**(b)** Explain modern methods of optimization. **07**

**Q.4** **(a)** Compare different methods used for economic analyses. **07**

**(b)** Discuss the formulation of Objective functions. **07**

**OR**

**Q.4** **(a)** The analysis of labor costs involved in the fabrication of heat exchangers can be used to predict the cost of a new exchanger of the same class. Let the cost be expressed as a linear equation. **07**

$$C = \beta_1 + \beta_2 A + \beta_3 N$$

Where β1, β2, and β3 are constants, N=number of tubes, A=shell surface area. Estimate the values of the constants β1, β2 and β3 from the data in following table.

| Labor cost ($) | Area (A) | Number of tubes (N) |
|---|---|---|
| 310 | 120 | 550 |
| 300 | 130 | 600 |
| 275 | 108 | 520 |
| 250 | 110 | 420 |
| 220 | 84 | 400 |
| 200 | 90 | 300 |
| 190 | 80 | 230 |
| 150 | 55 | 120 |
| 140 | 64 | 190 |
| 100 | 50 | 100 |

**(b)** Find the configuration that minimizes the capital costs of a cylindrical pressure vessel. To select the best dimensions (length L and diameter D) of the vessel, formulate a suitable objective function for the capital costs and find the optimal (L/D) that minimizes the cost function. Let the tank volume be V, which is fixed. Compare your result with the design rule-of-thumb used in practice, $(L/D)^{Opt.} = 3.0$. **07**

**Q.5** **(a)** What is feasible region? Explain convexity and concavity of the function. **07**

**(b)** Minimize the quadratic function: $f(x)=x^2-x$ using quasi-newton method. **07**

**OR**

**Q.5** **(a)** Using simplex method **07**

Maximize $Z=5x_1+3x_2$;

subject to $x_1+x_2 <=2; 5x_1+2x_2<=10; 3x_1+8x_2<=12; x_1,x_2=>0$

**(b)** Draw the information flow between modules for sequential modular based flowsheeting package. **07**

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