

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/ Backlog), November-December 2017

B. Tech in Chemical Engineering, Semester VII

Roll No.....

CHE701: Optimization of chemical processes

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. Which of the following is NOT required for using Newton's method for optimization?
 - a) The lower bound for search region
 - b) Twice differentiable optimization function
 - c) The function to be optimized.
 - d) A good initial estimate that is reasonably close to the optimal.
- ii. For what value of x , is the function $x^2 - 2x - 6$ minimized?
 - a) 0
 - b) 1
 - c) 5
 - d) 3
- iii. Which of the following statements is INCORRECT?
 - (A) If the second derivative at x_i is negative, then x_i is a maximum.
 - (B) If the first derivative at x_i is zero, then x_i is an optimum.
 - (C) If x_i is a maximum, then the second derivative at x_i is positive.
 - (D) The value of the function can be positive or negative as any optima.
- iv. Graphical method can be applied to solve a LPP when there are only ----- variable.
 - a) One
 - b) More than One
 - c) Two
 - d) Three
- v. In maximization cases , ----- are assigned to the artificial variables as their coefficients in the objective function
 - a) +m
 - b) -m
 - c) 0
 - d) None of the above
- vi. Dual of the dual is -----
 - a) Primal
 - b) Dual

- c) Alternative
d) None of the above
- vii LP model is based on the assumptions of -----
a) Proportionality
b) Additivity
c) Certainty
d) All of the above
- viii A set of values $X_1, X_2, \dots, X_n$ which satisfies the constraints of the LPP is called -----
a) Solution
b) Variable
c) Linearity
d) None of the above
- xi A minimization problem can be converted into a maximization problem by changing the sign of coefficients in the -----
a) Constraints
b) Objective Functions
c) Both A and B
d) None of the above
- x All the parameters in the linear programming model are assumed to be -----
a) Variables
b) Constraints
c) Functions
d) None of the above

- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- I Write the limitation and objective of classical techniques?
- II Write the advantage and disadvantage of Newton's method in unconstrained multivariable optimization?
- III What is the difference between a slack and a surplus variable?
- IV Define each term:
1. Conjugate directions
2. Hessian matrix of a function

Q.3A Determine the stationary points of the following function? 05
 $f(x) = 2x^6 - 6x^4 + 6x^2 + 10$

Q.3B Consider the following problem 05
 $\max 3x_1 + 2x_2$
s.t.
 $3x_1 + x_2 \leq 12$
 $x_1 + x_2 \leq 6$
 $5x_1 + 3x_2 \leq 27$
 $x_1, x_2 \geq 0$
1. Write the dual objective function.
2. How many variables are there in its dual.

	3. How many constraints are there in its dual. 4. How many dual variables are unrestricted sign in its dual? 5. How many dual constraints are "=" type.	
Q.4	Use the Simplex Algorithm to solve the model. Max. $z = x_1 + x_2 + 3x_3$ subject to $3x_1 + 2x_2 + x_3 \leq 3$ $2x_1 + x_2 + 2x_3 \leq 2$ $x \geq 0$	05
Q.5A	Use the graphical solution technique to find the optimal solution to the model. max. $3x_1 + 2x_2$ st 2 $x_1 + 2x_2 \leq 5$ $2x_1 + x_2 \leq 4$ $x_1 + 2x_2 \leq 4$ $x_1, x_2 \geq 0$	05
Q.5B	Minimize the following function using the lagrangian multiplier method $f(x_1, x_2) = \frac{5}{x_1 x_2^2}$ subject to $g(x_1, x_2) = x_1^1 + x_2^2 - 1 = 0$	05
Q.6A	Find the where $f(x) = x^7 - 1000$ intersects the axis, find solution correct to three decimal place (up to three iteration only).	10
Q.6B	Minimize $f = (x - 1)^4$ via the quasi-Newton Method, starting at (1) $x = -1$ and select step size small (up to three iteration only).	10
	OR	
Q.6B	Find the maximum of following function $f(x) = 1 - 8x + 2x^2 - \frac{10}{3}x^3 + \frac{1}{4}x^4 + \frac{4}{5}x^5 - \frac{1}{6}x^6$ Hint $f'(x) = (1+x)^2(2-x)^3$ by using the Newton's method start at $x = -2$	10
Q.7A	Minimize $f(x) = 2x_1^2 + x_2^2 - 3$ starting point $X_0 = (1, 1)$ with the direction initial condition being $S_0 = [-4, -2]$ find the conjugate direction to the initial direction S_0 and optimality condition of given function.	10
Q.7B	Minimize the $f(x) = e^{x^2} + 2x^2e^{-x}$ at starting point $X = [-1, 1]$ by using the quadratic interpolation method.	10
	OR	
Q.7B	Minimize the $f(x) = x^5 - 5x^3 - 20x + 5$ at $X = [0, 4]$ by using the cubic interpolation method.	10
Q.8A	Solve the Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1x_2 + 2x_1^2 + x_2^2$ from the starting point $X_1 = (0, 0)$ using Steepest descent method, Conjugate gradient method and Newton's method and write comparative study of the methods?	15