

Dr. Babasaheb Ambedkar Technological University, Lonere, Raigad

Department of Chemical and Petrochemical Engineering.

Unit Test: I

Year/Sem: Third/V

Subject: CHPC504 Optimization technique

Marks: 15

Time: 4:30-5:30 PM

Date: 18/08/2017

Note: All questions are compulsory.

Q.1 Minimize the function $F(x) = x^2 - 3x - 20$, with an initial guess $x^{(0)} = 0$ and increment $\Delta = 1$, using Bounding phase method. **(3 M)**

Q.2 Write the algorithm steps for Cubic search method. **(3 M)**

Q.3 Find the minimum value of the function $F(x) = x^2 + \frac{54}{x^2}$. Take an initial guesses, $X_1 = 2$, $X_2 = 5$ and stopping tolerance (ϵ) equals to 0.95, using Bisection method. **(3 M)**

Q.4 Find the volume of the largest right cone that can be inscribed in a sphere of radius 10 unit. (Take volume of right cone, $V = \pi r^2 h/3$. Here r = radius of cone and h = height of cone.) **(6 M)**

$$V = \frac{\pi r^2 h}{3}$$

$(V = 4017.3)$

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Summer Examination – Jun-2018- 2019

Course: B. Tech in Chemical / Petrochemical Engineering.

Sem: V

Subject Name: Optimization Techniques.

Subject Code: CHPC504

Max Marks:70

Date:-11/06/2019

Time:10:00 to 01:00pm

Instructions to the Students:

1. Question One is compulsory.
2. Question Two to Six each carry 12 marks.
3. Draw neat diagrams wherever necessary.

Q.1 Multiple Choice Questions.

10M

1. $f(x) = x^2 + \frac{54}{x}$, the function has
A) Local Minima & inflection optimal point
B) Local Minima & local optimal point
C) Local maximum & inflection optimal point
D) Local maximum & local optimal point
2. Consider the function $f(x) = x^4 + 3x^2 - x - 5$. It has one root at $x = -1$. Use the Newton-Raphson method to find the other real root to 9 decimal places.
A) The other root is $x = 1.185037375$
B) The other root is $x = -1.000003000$
C) The other root is $x = 1.185038651$
D) The iterations do not converge.
3. The $f(x) = 2e^x - x^3 - 10x$, the function has
A) Maxima
B) Minima
C) Both
D) None of these
4. Constraint in an LP model restricts
A) value of the objective function
B) value of the decision variables
C) use of the available resource
D) all the options
5. The role of artificial variables in the simplex method is
A) To aid in finding the initial solution.
B) To find optimal dual prices in the final simplex table.
C) To start phases of simplex method.
D) All the options.

- Q.2 Attempt the following.
- A. Find whether the given direction 's' at the point 'x' is descent for the respective functions:
- For $f(x_1, x_2) = 2x_1^2 + x_2^2 - 2x_1x_2 + 4$, $s = (1, 1)$, $x = (2, 3)$.
 - For $f(x_1, x_2, x_3) = x_1^3x_2 + 0.2 \exp(x_2^2 - x_3)$, $s = (-10, -20, 5)$, $x = (1, 2, 6)$.
- B. Minimize the function $f(x) = x^3 + 5x^2 - 3$ using interval halving method. Do upto 4 iterations.
where $x \in (-1, 5)$.
- Q.3 Attempt the following.
- A. List the search directions for Powell's method to minimize the function $f(x) = 2x_1^2 + x_2^2 - x_1x_2$ starting from $x^0 = (2, 2)$.
- B. Explain the Optimal problem formulation process in detail.
- Q.4 Attempt the following.
- A. Maximize $f(x_1, x_2, x_3) = -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$,
subject to the conditions: $x_1 + x_2 \leq 2$,
 $2x_1 + 3x_2 \leq 12$,
with $x_1, x_2 \geq 0$.
By Kuhn-Tucker conditions.
- B. Solve $2x^3 - 2.5x - 5 = 0$ by Newton - Raphson method, take $x_0 = 2$. Do up to 2 iterations.
- Q.5 Attempt the following.
- A. Minimize the function $f(x_1, x_2) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$ by using evolutionary optimization method. Use $x^0 = (1, 1)$ and $\Delta = (2, 2)$. (use four iterations).
- B. A box with a square box and open top must have a volume of 32,000 cm³. Find the dimensions of the box that minimize the amount of material used.
- Q.6 Write note on.
- Genetic Algorithm
 - Constrained optimization
 - Optimality Criteria For Single variable Optimization

C) Minimize the Himmelblau function $F(x) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$ by simplex search method. Take initial simplex of three points $x_1 = (0, 0)$, $x_2 = (2, 0)$, $x_3 = (1, 1)$ also take $\gamma = 1.5$, $\beta = 0.5$. Do up to second iteration. (6M)

Q.5) Solve any three.

A) What are the advantages and limitations of GA? (4M)

B) Write the similarity between GA and traditional method. (4M)

C) Write the algorithm for Exhaustive search method. (4M)

D) What is GA? And motivation of GA. (4M)

Q.6) Solve any two.

A) Find the minimum value of the function $F(x) = 4x^3 + x^2 - 7x + 14$ with an initial guess $(0, 1)$ using Golden section method. Take stopping tolerance $\epsilon = 0.15$. (6M)

B) An open topped serving box will be made by cutting squares out of each corner by 12 cm and 18 cm sheet of cardboard and folding the tabs up to form a box. What size squares should be cut to maximize the volume of box. (6M)

C) Write the algorithm for Secant method. (6M)

*** END OF QUESTION PAPER***

a) $\gamma > 1$

b) $\gamma < 1$

c) $\gamma = 1$

d) $0 < \gamma < 1$

Q.2) Solve any two

A) Bracket the minimum point for the function $F(x) = x^2 + (54/x)$ using Bounding phase method. Take an initial guess $x^0 = 0.6$ and an increment $\Delta = 0.5$. (6M)

B) Minimize the Himmelblau function $F(x) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$ using Box evolutionary method. Take an initial point $x^0(1, 1)$, size reduction parameter $\Delta = (2, 2)$ and initialize $\bar{x} = x^0 = (1, 1)$. Do up to second iteration. (6M)

C) A rectangular sheet of paper with perimeter 39 cm is rolled in to a cylinder. What dimensions of the sheet would maximize the volume of the cylinder. (6M)

Q.3) Solve any three.

A) Write the algorithm for Cubic search method (4M)

B) Write a short note on the following terms. (4M)

I) Kuhn- Tucker condition II) Equality constraints and inequality constraints.

C) Define the following terms. (4M)

I) Reflection point II) Expansion coefficient III) Contraction coefficient IV) Feasible point.

D) Write the algorithm for Bisection method. (4M)

Q.4) Solve any two.

A) The combined perimeter of circle and rectangle is 100 cm. The length of rectangle is twice its width. Find the dimensions of each to minimize the total area? (6M)

B) Find the minimum value of the function $F(x) = x^2 + (54/x)$ using Newton-Raphson method with an initial guess $x_1 = 1$. Take stopping tolerance $\epsilon = 5$. (6M)

Group II

- Q.4 (A) What is the significance of Newton's methods?
(B) Minimize $f(x_1, x_2) = (x_1^2 - x_2)^2 + x_2^2$, perform five iterations of a unidirectional search method along the following search direction $S = (2, 1)$ from $(-5, 5)$ up to $(5, 0)$
- Q.5 (A) Minimize Himmelblau function by Cauchy's method. $X^{(0)} = (0, 0)$, $\epsilon_1 = \epsilon_2 = 0.001$ up to one iteration. Use 4 to 5 iterations of golden section search method in the range of $(0, 1)$ to find $\alpha^{(0)}$.
(B) Min $f(x_1, x_2) = (x_1^2 - x_2)^2 + x_2^2$, perform five iterations of a unidirectional search method along the following search directions $S = (2, 1)$ from point $(-5, 5)$ to $(5, 0)$

Group III

- Q.6 (A) Explain Random search algorithm for minimization of Himmelblau function with constraints. Assume $x(0) = (3, 3)$, $Z(0) = (6, 6)$, $P=3, Q=10$, $\epsilon = 0.25$, r_1, r_2 in the range of $(-5, 5)$. Up to second interval reduction.
(B) Explain Frank Wolfe algorithm in detail.
- Q.7 (A) Maximize $3x_1^2 - 2x_2$ subjected to $2x_1 + x_2 = 4$, $x_1^2 + x_2^2 \leq 19.4$, $x_1 \geq 0$. Check $(0, 4)$ & $(3.4, -2.8)$ are K-T points. If equality constraint is $2x_1 + x_2 = 6$, how the max function value changes.
(B) Write a short note on Variable removal method for constrained minimization.

Group IV

- Q.8 (A) Formulate the integer nonlinear programming problem. Explain in short the penalty function method with algorithm.
(B) Give the outline of basic genetic programming algorithm with flowchart.
- Q.9 (A) What is posynomial form? Write general geometric programming expression in posynomial form. Determine degree of difficulty in following problem
 $\min f = 0.188 yd$
subjected to $1.75yh^{-1}d^{-1} \leq 1$, $900y^{-2} + y^{-2}h^2 \leq 1$
(B) What are the operators of genetic algorithm? Write a brief note on reproduction or selection with example.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE-Raigad

End Semester Examination - ~~December 2010~~ May 2015

Class B.Tech (Chemical / Petrochemical Engineering) Semester V

Subject Code : CHPC 504

Subject: Optimization Techniques

Time: 03 Hours 27/05/15

Max. Marks: 70

- Question No. 1 is compulsory
- Attempt any one question from groups, I, II, III, IV .
- Assume suitable data where ever necessary and mention it clearly

Q.1 Multiple Choice Questions

- a) At any point x^* the first derivative is non zero and the first nonzero higher order derivative is n , then If n is odd, x^* is ----- and If n is even, x^* is----- 2
i) Local minimum ii) local maximum iii) local optimum
iv) inflection point v) global minimum
- b) Calculate $|| (x_1, x_2) ||$ if $x_1=(3,2)$, $x_2=(1,2)$ 2
i) 2 ii) 4 iii) 5 iv) $\sqrt{8}$
- c) True or False 2
i) Genetic Algorithms belong to the family of multidimensional direct search methods.
ii) Multidimensional direct search methods are not guaranteed to find the global-optimum
- d) following is not the gradient based method 2
i) bisection method ii) Newton Raphson's method iii) point estimation method
iv) secant method
- e) For ----- Δ , the bracketing accuracy of bounding phase method is less but bracketing of minimum is faster. 2
i) Smaller ii) larger iii) zero iv) negative

Group I

- Q.2 (A) What is the difference between region elimination method and point estimation method? Write the algorithm for successive quadratic estimation method. 5
- (B) Minimize $f(\lambda) = x^2 + (54/x)$ by using 8
a) Exhaustive search method interval (0,5)
b) bounding phase method in interval (0,5)
- (C) Write the formulae for central difference techniques for first order, second order derivatives of single variable problem. 2
- Q.3 (A) Write the Fibonacci series. Minimize $f(x) = x^5 - 5x^3 - 20x + 5$ by Fibonacci method with algorithm in the range (0,5). Assume $n = 10$ and $k = 2$. 7
- (b) Minimize $f(\lambda) = x^2 + (54/x)$ by golden section search method in the range (0,5) use $k = 1$ till it will be 8.