Total No. of printed pages = 9

2021

CENTRAL

GIMOLOS"

19/5th Sem/UECE5160

OPRIMIZATION THEORY

Full Marks - 100

Time - Three hours

The figures in the margin indicate full marks for the questions.

Answer question No.1 and any four questions.

1. A. Answer the correct alternatives : 1×10=10

(a) A point x is said to be an _____ point if the function value locally increases as x increases and decreases as x decreases

(i) Local optima

(ii) Global optima

(iii) Inflection point

(iv) None of the above

[Turn over

- (b) Which of the following method is not a gradient based optimization ?
 - (i) Exhaustive search
 - (ii) Golden section search
 - (iii) Region elimination

(iv) None of the above is gradient based

(c) The lower and upper bounds of a variable is a and b respectively. In interval halving method, the error of the function value after n iteration will be CENTRALLIS

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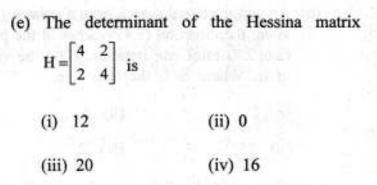
COHNOLOG!

- (i) $(0.5)^{(n/2)}(b-a)$
- (ii) $0.326^{(n/2)}(b-a)$
- (iii) 0.618^(n/2) (b a)
- (iv) 0.326(-n/2) (b a)

(d) An increasing function has

- (i) negative slope
- (ii) positive slope
- (iii) second order derivative can be either positive or negative
- (iv) second order derivative is positive always

103/19/5th Sem/UECE 516C (2)



(f) The H matrix shown in the above question CENTRALLIBR is

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- (i) positive definite
- (ii) negative definite

(iii) positive semi-definite

(iv) can not be stated

(g) In a contour plot smaller the radius is

(i) smaller the function value

(ii) higher the function value

(iii) nearer to the minimum

(iv) None of the above

103/19/5th Sem/UECE 516C (3)

[Turn over

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(h) An unidirectional search from a point A (2,2) along the direction (3,4) reaches at the point (2.6, 2.8) after one iteration. Find the value of α. Where α is the step size.

(i)	1	(ii) .5
(ii)	.25	(iv) .2

(i) Minima of the following function lies in $f(x, y) = (x - 10)^2 + (y-20)^2$

(i) (1,2)	(ii) (10,20)

- (iii) (0,0) (iv) (-10,-20)
- (j) Here is an optimization problems

Maximize $f(x) = 2x_1 + 3x_2$ subject to $x_1 \le 6$

 $x_1 + x_2 \ge 2$

 $x_1, x_2 \ge 0$

No of equality and inequality constraints are and

- (i) 2 and 1 (ii) 3 and 0
- (iii) 3 and 1 (iv) 4 and 0

103/19/5th Sem/UECE 516C (4)

- B. Answer the short questions :
 - (i) Build the Hessian matrix at $x_1 = 2$, $x_2 = 3$ $f(x_1, x_2) = 10(x_1 - 20)^2 + 10(x_2 - 10)^2$
 - (ii) Find out the minima of the following one dimensional functions :

 $f(x) = x^2 + 54/x$

(iii) Find the cross over between the following parents. Assume single point crossover at position 5

 $p1 = 1 \ 0 \ 0 \ 0 \ 1 \ 0 \ 1 \ 0 = 146$

 $p2 = 1 \ 0 \ 1 \ 0 \ 0 \ 0 \ 1 \ 1 = 163$

- (iv) Let an 1 bit schema can contains 0, 1 and *. Find the maximum possible number schemata.
- (v) Linearize the following function at point x=2f(x) = $3x^2 - 2x + 4$
- (a) State the algorithm of Golden section search method. 5
 - (b) Use 3 iterations of golden section search method in order to maximize the function in the interval (-5, 5)

$$f(x) = 10 + x^3 - 2x - 5exp(x)$$
 10

103/19/5th Sem/UECE 516C (5) [Turn over

(c) Perform 2 iterations of Newton-Raphson's method to find the minima of the following function. Assume initial point x⁽¹⁾=1

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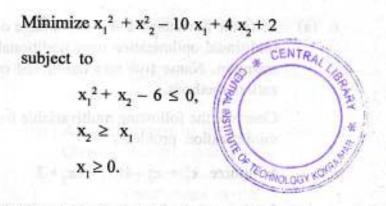
 $f(x) = x^2 - 54/x$

- (a) State and differentiate between parallel subspace property and extended parallel subspace property of Powel's Conjugate direction method for the optimization of quadratic functions. 10
 - (b) What do you understand by "Decent direction"? Find the optimum of the following function using Newton's method for one iteration. Assume initial point $x^{(0)} = (0, 0)$ 2+8=10

$$f(x_1, x_2) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$$

- (a) State what is KKT condition for constrained optimization ?
 - (b) Identify whether the points to the following NLP problem : 3×5=15
 - (i) (0,0)
 - (ii) (0.1,0.1)
 - (iii) (2,1) are feasible optimal points or not?

103/19/5th Sem/UECE 516C (6)



- 5. (b) State what is the linearized search technique for constrained optimization. Write the algorithm of Frank Wolfe's method for optimization. 3+7=10
 - (c) Solve this linear programming problem (2 iterations) 10

(5, 4)

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

subject to

x,≤6

 $x_1 + 2x_2 \le 10$

 $x_1 + x_2 \ge 2$

 $(\mathbf{x}_1, \mathbf{x}_2) \ge 0$

103/19/5th Sem/UECE 516C (7) [Turn over

State the advantage and disadvantage of non-6. (a) traditional optimization over traditional optimization. Name five non traditional optimization methods.

> Consider the following multivariable function minimization problems

Minimize $x_1^2 + x_2^2 - 10x_1 + 4x_2 + 2$

 $7 \ge (x_1, x_2) \ge -8$

Consider a 4 bit solutions for x1, x2 using binary genetic algorithm.

Assume initial random population has been created as

(0, 0)	(3, 2)
(5, 4)	(-3, 4)
(4, 2)	(2,4)

(i) Calculate fitness function of the population. 6

(ii) Apply Roulette wheel selection and select 4 individuals from the population 4 for the matting pool.

100 103/19/5th Sem/UECE 516C (8)

- (iii) Apply a suitable crossover operation.
 Apply crossover location 2 and 6. Find the new childrens and the latest population.
- (iv) Apply mutation to the best 2 solutions. Choose mutation points 3 and 7. Find mutated solutions. Discuss whether there is any improvement in the population.
- (v) Find the optimum solution and best fitness value achieved.
- 7. Write short notes on any two : 10×2=20

(a) Levenberg-Marquardt Algorithm

(b) Particle Swarm Optimization

(c) Simulated Annealing

(d) Lagrangian Duality Theory.



103/19/5th Sem/UECE 516C (9)

100