Printed Page:- 05 **Subject Code:- AAS0404**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: IV - THEORY EXAMINATION (2023 - 2024)
Subject: Optimization and Numerical Techniques

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. Surplus variable (CO1) 1

(a) Is the difference between the left and right sides of a constraint?

(b) Is the amount by which the left side of a is ≤ constraint is smaller than the right side.

(c) Is the amount by which the left side of a is ≤ constraint is larger than the right side.

(d) Exists for each variable in a linear programming problem.

1-b. The coefficient of artificial variable in the objective function in Big-M method is (CO1) 1

(a) -M

(b) +M

(c) -1

(d) 0

1-c. The part of feasible solution space eliminating by plotting a cut contains (CO2) 1

(a) Only integer solutions

(b) Only non-integer solutions

(c) Both A) and B)

(d) None of the above

1-d. In a branch and bound problem , if X= 5, and Y= 3.7, which of the following 1

would be a possible branching option. (CO2)

(a) $y \geq 4$

(b) $x \leq 5$

(c) $y \geq 3$

(d) $y \leqslant 4$

1-i. Which digits should come in place of * and $ if the number 62684*$ is divisible by both 8 and 5? (CO5) 1

(a) 1 & 0

(b) 0 & 5

(c) 1 & 4

(d) 4 & 0

1-e. The extreme points of the set $\{(x,y): |x| \leq 5, |y| \leq 5\}$ are (CO3) 1

(a) (-5 , 5), (5 , 5), (5 ,- 5), (-5 , -5)

(b) (-5 , 5), (0 , 0), (0 , -5), (-5 , 0)

(c) (5 , 5), (0 , 0), (0 , 5), (5 , 0)

(d) None of these

1-j. Which one of the following function $f: R \rightarrow R$ is an injective function. (CO5) 1

(a) $f(x) = |x|, x \varepsilon R$

(b) $f(x) = -x, x \varepsilon R$

(c) $f(x) = c, x \varepsilon R$

(d) None of these

1-f. A maximization or minimization problem with no restriction on the decision variables is known as (CO3) 1

(a) Constrained optimization problem

(b) Integer programming problem

(c) Unconstrained optimization problem

(d) None of these

1-g. Gauss Seidel method is also termed as a method of (CO4) 1

(a) Elimination method

(b) Successive Displacement

(c) False positions

(d) Iterations

1-h. Newton- Gregory Forward interpolation formula can be used _____(CO4) 1

(a) Only for unequally spaced interval

(b) Only for equally spaced interval

(c) Both A and B

(d) None of these

2. Attempt all parts:-

2.a. Consider a chocolate manufacturing company that produces only two types of chocolate A and B. Both the chocolates require Milk and Choco only. To manufacture each unit of A and B, the following quantities are required: 2

i. Each unit of A requires 1 unit of Milk and 3 units of Choco
ii. Each unit of B requires 1 unit of Milk and 2 units of Choco.

The company kitchen has a total of 5 units of Milk and 12 units of Choco. On each sale, the company makes a profit of Rs 6 per unit A sold and Rs 5 per unit B sold. Formulate the above as an LPP to maximize the profit. (CO1)

2.b. How do we classify the IPP based on the type of integer variables. (CO2) 2

2.c. Write a short note on convex function (CO3) 2

2.d. Write down the Newton Forward interpolation formula.(CO4) 2

2.e. Which type of the function is if function $f:R \to R$ is defined by $f(x) = x^2$.(CO5) 2

SECTION-B 30

3. Answer any five of the following:-

3.f. Using Lagrange interpolation, find $f(4)$ from the following data: (CO4) 6

x	0	2	3	6
$f(x)$	-4	2	14	158

3-a. Solve the following LPP by graphical Method (CO1) 6

Maximize $Z = 8x_1 + 5x_2$

Subject to $2x_1 + x_2 \leq 500$

$x_1 \leq 150$

$x_2 \leq 250$

and $x_1, x_2 \geq 0$

3.g. How many words can be formed by using all letters of the word "MATHEMATICS" and also find how many words can be formed when the vowels always come together, never come together? (CO5) 6

3-b. Write the dual of the given LPP: (CO1) 6

Min $Z = x_1 + 5x_2 + x_3$

Subject to $x_1 + x_2 + x_3 = 20$

$-3x_1 - 5x_2 + 2x_3 \geq 55$

$x_1 + 7x_2 + 4x_3 \geq 120$

$x_1, x_2, x_3 \geq 0$

3-c. Explain the importance of Integer Programming Problem with examples. (CO2) 6

3-d. Discuss zero one problem and give its applications. (CO2) 6

3.e. Define the convex set. Prove that intersection of two convex set is convex. (CO3) 6

SECTION-C 50

4. Answer any one of the following:-

4-a. Solve the following LPP by using Big − M method: 10

Minimize $z = 12x_1 + 20x_2$

Subject to $6x_1 + 8x_2 \geq 100$,

$7x_1 + 12x_2 \geq 120$,

$x_1, x_2 \geq 0$ (CO1)

4-b. Solve the LPP by using Two phase method: 10

Max. $Z = 5x_1 + 3x_2$

Subject to

$2x_1 + x_2 \leq 1$

$x_1 + 4x_2 \geq 6$

and $x_1, x_2 \geq 0$ (CO1)

5. Answer any one of the following:-

5-a. Find the optimum integer solution of the following IPP by using Branch and Bound method: (CO2) 10

Max $z = 2x_1 + 3x_2$

Subject to

$x_1 + x_2 \leq 35$

$4x_1 + 9x_2 \leq 36$

$x_1, x_2 \geq 0$ and are integers

5-b. Use Gomory's cutting plane method to solve: (CO2) 10

Max $z = 8x_1 + 5x_2$

s.t. $x_1 + x_2 \leq 6$

$9x_1 + 5x_2 \leq 45$

$x_1, x_2 \geq 0$ and are integers

6. Answer any one of the following:-

6-a. Solve the following non-linear programming problem: (CO3) 10

Optimize $Z = 4x_1^2 - 4x_1x_2 + x_3^2 + 2x_2^2$,

Subject to, $x_1 + x_2 + x_3 = 15$,

$2x_1 - x_2 + 2x_3 = 20$,

$x_1, x_2, x_3 \geq 0$

6-b. Solve the following problem by using Kuhn-Tucker method: (CO3) 10

Max. $f(x,y) = 7x^2 + 5y^2 - 6x$

Subject to,

$x + 2y \leq 10$

$x - 3y \leq 9$

$x, y \geq 0$.

7. Answer any one of the following:-

7-a. Solve the following system of equations by using Gauss-seidel method (perform three iterations) (CO4) 10

$$3x + 20y - z = -18$$

$$20x + y - 2z = 17$$

$$2x - 3y + 20z = 25$$

7-b. 10

Calculate an approximate value of $\int_0^6 \frac{e^x}{1+x} dx$ using (CO4)

(i)Trapezoidal rule

ii) Simpsons 1/3rd rule

(iii)Simpsons 3/8th rule

8. Answer any <u>one</u> of the following:-

8-a. The probability that machine 'A' will be performing a usual function in 5 years time is 1/4, while the probability that machine 'B' will be operating usually at the end of the same period is 1/3 . Find the probability in the following cases that in 5 years time: (CO5) 10

i. Both machines will be performing as usual function.

ii. Neither will be operating.

iii. At least one of the machines will be operating.

8-b. Directions (A-E): E**xpenditures of a Company (in Lakhs Rupees) per Annum over the Given Years (CO5)** 10

	Item of Expenditure			
Year Salary	**Fuel and Transport**	**Bonus**	**Interest of lons**	**Taxes**
1998 288	**98**	**3.25**	**23.4**	**38**
1999 342	**112**	**2.52**	**32.5**	**108**
2000 324	**101**	**3.84**	**41.6**	**74**
2001 336	**133**	**3.68**	**34.4**	**88**
2002 420	**142**	**3.96**	**49.4**	**98**

A. What is the average amount of interest per year which the company had to pay during this period?

B. The total amount of bonus paid by the company during the given period is approximately what percent of the total amount of salary paid during this period?

C. Total expenditure on all these items in 1998 was approximately what percent of the total expenditure in 2002?

D. Find the total expenditure of the company over these items during the year 2000?

E. The ratio between the total expenditure on Taxes for all the years and the total expenditure on Fuel and Transport for all the years respectively is approximately?