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

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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**

**(An Autonomous Institute Affiliated to AKTU, Lucknow)**

**B.Tech**

**SEM: IV - THEORY EXAMINATION (2022-2023.)**

**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. In a LPP Dual of a dual is (CO1) 1

(a) Dual

(b) Primal

(c) Not a LPP

(d) None of these

1-b. 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-c. In the Branch and Bound approach to a Max IL Problem, a node is terminated if (CO2) 1

(a) A node has an infeasible solution

(b) A node yields a solution that is feasible but an integer

(c) A node yields a solution that is feasible but not an integer

(d) Both a) and b)

1-d. Consider the following problem: (CO2) 1

Max. Z = 8x + 3y,
subject to
5x + y ≤ 3, x + 7y ≤ 3,
x≥ 0, y ≥ 0 and are integers
This problem is:

(a) A pure IPP.

(b) A 0-1 IPP.

(c) A mixed IPP.

(d) Not an IPP.

1-e. A twice differentiable function :$\mathbb{R}^2 \rightarrow \mathbb{R}$ *is convex. Then the Hessian matrix is: (CO3)* 1

(a) Negative-definite for all x $\in\mathbb{R}$

(b) Negative semi-definite for all x $\in\mathbb{R}$

(c) Positive definite for all x $\in\mathbb{R}$

(d) Positive semi-definite for all x $\in\mathbb{R}$

1-f. In non linear programming problem, the objective function is convex and subject to constraint is convex then the problem is (CO3) 1

(a) Minimization problem

(b) Maximization problem

(c) Both maximization and minimization problem

(d) None of these

1-g. In Crout's method elements of upper triangular matrix is taken as (CO4) 1

(a) 1, 1, 1

(b) 0, 0, 0

(c) 1, 0, 1

(d) None of these

1-h. Trapezoidal rule for evaluating of $\int_a^b f(x)dx$ requires the interval (a , b) to be divided into (CO4) 1

(a) 2 n subintervals of equal width

(b) 2n+1 subintervals of equal width

(c) Any number of subintervals of equal width

(d) None of these

1-i. A dice is thrown twice. What is the probability of getting two numbers whose product is even? (CO5) 1

(a) 1/4

(b) 3/5

(c) 3/4

(d) None of these

1-j. Find the unit digit of $(4137)^{754}$. (CO5) 1

(a) 7

(b) 9

(c) 3

(d) None of these

**2. Attempt all parts:-**

2.a. What are the basic assumptions of a LPP? (CO1) 2

2.b. What is fractional part of (-2/3) in Gomory's method? (CO2) 2

2.c. Find minimum point of the function $Z = x^2 + y^2$ (CO3) 2

2.d. Evaluate $\Delta(x + \cos x)$ the interval of differencing is h=1. (CO4) 2

2.e. Find the largest number of 4-digits divisible by 12, 15, 18 and 27. (CO5) 2

**SECTION B** **30**

**3. Answer any <u>five</u> of the following:-**

3-a. A company manufactures two types of boxes, corrugated and ordinary cartons. The boxes undergo two major processes: cutting and pinning operations. The profits per unit are Rs. 8 and Rs. 4 respectively. Each corrugated box requires 3 minutes for cutting and 6 minutes for pinning operation, whereas each carton box requires 4 minutes for cutting and 1 minute for pinning. The available operating time is 60 minutes and 120 minutes for cutting and pinning machines. Formulate to maximize the profits and also find out the max profit. (CO1) 6

3-b. Find the dual of the following LPP: (CO1) 6
Max. $Z = x + 3y$
Subject to constraints
$3x + 2y \le 6$
$3x + y = 4$

.

$x, y \geq 0$

3-c. Define Integer Programming problem. Explain with an example , how in some case non-integers solution to a LPP is meaningless. (CO2) 6

3-d. Write short note on zero-one programming and Knapsack problem. and also Write down some of the practical applications of IPP. (CO2) 6

3.e. Show that the set $S=\{X: X=(x_1,x_2, x_3), x_1^2+x_2^2+x_3^2 \leq 1\}$ is a convex set. (CO3) 6

3.f. Use Lagrange's method of interpolation to find the value of f(4) for the data: (CO4) 6

f(0) = -4, f (2) = 2, f (3) = 14, f(6) = 158.

3.g. Check that for the following statement which of the conclusion follows logically and also explain why? (CO5) 6

Statements:

1. All dogs are asses.
2. All asses are bulls.

Conclusions:

1. Some dogs are not bulls.
2. Some bulls are dogs.
3. All bulls are dogs.
4. All dogs are bull

**SECTION C** **50**

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

4-a. Solve the following LP problem by Big M Method (CO1) 10

Maximize $Z = 7x + 5y$

s.t.

$6x + y \leq 2$

$4x + y \geq 3$

Both x and y all $\geq 0$

4-b. Solve the following LP problem by Two phase method: (CO1) 10

Maximize $Z = 10x + 13y$

s.t.

$2x + y \leq 8$

$x + 4y \geq 7$

Both x and y all $\geq 0$

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

5-a. Solve the following integer programming problem by using Branch and bound method: (CO2) 10

Max. $Z = 2X + 2Y$

s.t.

$5X + 3Y \le 8$

$X + Y \le 2$

$X, Y \ge 0$ and are integers.

5-b. Solve the following integer programming problem by using Gomory's method: (CO2) 10

Max. $Z = 3X + 2Y$

s.t.

$X - Y \le 3$

$X + 2Y \le 2$

$X, Y \ge 0$ and $Y$ is integer.

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

6-a. Use the Lagrange's multipliers to solve the following non-linear programming problem. Does the solution maximize or minimize the objective function? (CO3) 10

Max $Z = 2x^2 + y^2 + 3z^2 + 10x + 8y + 6z - 100$

subject to

$x + y + z = 20$

$x, y, z \ge 0$

6-b. Use Kuhn Tucker conditions to solve the following problems:(CO3) 10

Max $Z = -x^2 - 2y^2 + 2x + 3y$

subject to

$x + 3y \le 6$

$5x + 3y \le 10$

$x, y \ge 0$

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

7-a. Solve the following system of linear equations using Gauss Seidel method: (CO4) 10

$10x + 2y + z = 9$

$2x + 20y - 2z = -44$

$-2x + 3y + 10z = 22.$

7-b. Evaluate $\int_0^1 \sqrt{\text{Sinx} + \text{Cosx}}\, dx$ using Simpson's one third rule and also with Simpson's third eighth rule. (CO4) 10

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

8-a. Solve the following- (CO5) 10

A. The sum of squares of three numbers is 138 and the sum of their products taken two at a time is 131. Find their sum.

B. A certain number when divided by 899 leaves the remainder 63. Find the remainder when the same number is divided by 29.

C. How many words can be formed by using all letters of the word "DAUGHTER" so that the vowels are never come together?

8-b. i) Check whether the function given by $f:R \rightarrow R$ is defined by $f(x) = 2x^3 + 3$ is bijective function or not. (CO5) 10

ii) A candidate is called for an interview by three companies. For the first company there are 12 candidates and for the second there are 15 candidates and for the third there are 10 candidates. What are the chances of his getting at least one of the companies?