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Mahindra University Hyderabad

École Centrale School of Engineering

Minor II

Program: B.Tech. Branch: Computation & Mathematics Year: Second Semester: Spring

Subject: Optimization Techniques (MA 2210)

Date: 18/04/2024 **Start Time: 10: 00 AM**

Time Duration: 1. 5 Hours **Max. Marks: 20**

Instructions:

1) **All questions are compulsory.**
2) **Please start each answer on a separate page and ensure you clearly number the responses. Also, make sure to address all parts of each question together and in the correct order.**
3) **It is essential to provide an explanation of each step. Correct outcomes without any description will not be evaluated.**
4) **A calculator is allowed.**

Q 01: Select the correct choice for the following questions with proper explanation. Correct choices without valid justification will not be considered. $[01 \times 05]$

A) In a linear programming problem, the optimal value of the objective function is attained at the points

i) Given by intersection of lines representing inequalities with axes only

ii) Given by intersection of lines representing inequalities with the x −axis only

iii) Given by corner points of the feasible region

iv) At the origin

v) None of these

B) The corner points of the feasible region determined by the system of linear constraints are $(0,10)$, $(5,5)$, $(15,15)$, and $(0,20)$. Let $z = px + qy$, where $p > 0$ and $q > 0$. The condition on p and q so that the maximum of z occurs at both points $(15,15)$ and $(0,20)$ is:

i) $p = q$ ii) $p = 2q$ iii) $q = 2p$ iv) $q = 3p$

C) Identify the type of the feasible region given by the set of following inequalities:

$$\left.\begin{matrix} x - y \le 1 \\ x - y \ge 2 \end{matrix}\right\}; \text{ and } x \ge 0 \text{ and } y \ge 0.$$

i) A triangle

ii) A rectangle

iii) An unbounded region

iv) An empty region

D) In a maximization linear programming problem, if at least one artificial variable is in the basis but not at zero level and the net evaluation $\Delta_j = (z_j - c_j)$ for each variable is non-negative, then we have

i) A feasible solution ii) No feasible solution

iii) An unbounded solution iv) An optimum solution

E) If an iso-profit line yielding the optimum solution coincides with a constraint line, then

i) The solution is unbounded ii) The solution is infeasible

iii) The constraint that coincides is redundant iv) None of the above

Q 02: Obtain the dual of the following primal problem: [03]

$\min z_x = 3x_1 - 2x_2 + x_3$; subject to the constraints

$$\left.\begin{array}{r} 2x_1 - 3x_2 + x_3 \leq 5 \\ 4x_1 - 2x_2 \geq 9 \\ -8x_1 + 4x_2 + 3x_3 = 8 \end{array}\right\}; \text{ and}$$

$x_1 \geq 0, x_2 \geq 0$, and x_3 is unrestricted.

Q 03: A milk plant manufactures two types of products, A and B, and sells them at a profit of ₹ 5 on type A and ₹ 3 on type B. Each product is processed on two machines, G and H. Type A requires one minute of processing time on G and two minutes on H. Type B requires one minute on G and one minute on H. Machine G is available for not more than one hour 40 minutes, while machine H is available for two hours 20 minutes during any working day. Formulate and solve the linear programming problem to maximize the profit. [05]

Q 04: Use the Simplex method to solve the following linear programming problem: [07]

$\min z = -6x_1 - 10x_2 - 4x_3$; subject to the constraints

$$\left.\begin{array}{r} x_1 + x_2 + x_3 \leq 1000 \\ x_1 + x_2 \leq 500 \\ x_1 + 2x_2 \leq 700 \end{array}\right\}; \text{ and}$$

$x_1 \geq 0, x_2 \geq 0$, and $x_3 \geq 0$.