MID-SEMESTER EXAMINATION

INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH (ME324)

ME, IIT Guwahati **01-03-2023, 2 – 4 PM** **Total Marks: 50**

Note: Answer all **four** questions. Show your calculations in support of your answer.

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1. The postmaster of a local post office wishes to hire extra helpers during the festival season because of a significant increase in the volume of mail handling and delivering. Due to limited office space and budgetary conditions, the number of temporary helpers must not exceed 10. According to past experience, one man can handle an average of 300 letters and 80 packages per day, and a woman can handle 400 letters and 50 packages per day. The postmaster estimates that the volume of extra mail and packages will be no less than 3,400 and 680, respectively. A man receives Rs. 125 daily, and a woman gets Rs. 110 daily.
   (a) Write down the objective function, constraint equations, variable bound for the given problem. **(5)**
   (b) How many man and woman helpers should be hired to keep the payroll at a minimum? Use a graphical method to solve the problem. **(10)**

2. An industrial recycling center uses two scrap aluminum metals, A and B, daily to produce a special alloy. Scrap A contains 6% aluminum, 3% silicon, and 4% carbon. Scrap B has 3% aluminum, 6% silicon, and 3% carbon. The costs per ton for scarps A and B are Rs. 100 and Rs. 80, respectively. The specifications of the special alloy require that (1) the aluminum content must be at least 3% and at most 6%, (2) the silicon content must lie between 3% and 5%, and (3) the carbon content must be between 3% and 7%. The center can handle 1000 tonnes of scraps per day. Write down the objective function and constraint equations to minimize special alloy costs. **(10)**

3. Consider the following LP problem:

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

   subject to

   $$x_1 \leq 6,$$
   $$x_1 + 2x_2 \leq 10,$$
   $$x_1, x_2 \geq 0$$

   Find the optimal solution and optimal function value using simplex method. **(15)**

4. (a) Consider the following linear programming (LP) problem: **(5)**

   Maximize $z = 3x_1 + 2x_2$

   subject to
   $$x_1 \leq 4$$
   $$x_2 \leq 6$$
   $$3x_1 + 2x_2 \leq 18$$
   $$x_1 \geq 0,\ x_2 \geq 0$$

Please comment about the LP problem and whether it has a unique optimal/infeasible/unbounded/multiple optimal solutions. The answer should be supported with graphical solutions.

4. (b) A linear programming problem is shown below: **(5)**

$$\text{Maximize} \quad z = 3x + 7y$$

$$\begin{aligned} \text{subjected to} \quad & 3x + 7y \leq 10 \\ & 4x + 6y \leq 8 \\ & x, y \geq 0 \end{aligned}$$

Please comment about the LP problem and whether it has a unique optimal/infeasible/unbounded/multiple optimal solutions. The answer should be supported with graphical solutions.