Name of the Course : **B.Sc. (Hons.) Mathematics CBCS**

Semester : **VI**

Unique Paper Code : **32357611**

Name of the Paper : **DSE-4: Linear Programming and Theory of Games**

Duration: **2 Hours** Maximum Marks: **75**

*Attempt any four questions. All questions carry equal marks. All symbols have usual meaning.*

**1.** Find all the existing basic feasible solutions for the following system of equations

$$5x_1 + 4x_2 + x_3 + x_4 + 2x_5 = 8$$
$$x_1 + x_2 + 3x_3 + 2x_4 + 6x_5 = 12.$$

Are the basic feasible solutions non-degenerate? Justify your answer.

**2.** Solve the following linear programming problem using Two Phase method

Maximize $z = 4x_1 + 5x_2 - 3x_3$

subject to $x_1 + x_2 + x_3 = 10$

$-x_1 + x_2 \leq -1$

$x_1 + 3x_2 + x_3 \leq 14$

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

**3.** Write the dual of the following problem and solve the dual graphically.

Minimize $z = 6x_1 + 2x_2$

subject to $2x_1 - x_2 \geq -1$

$-3x_1 - 2x_2 \leq -3$

$x_1, x_2 \geq 0$.

Utilize the theorems of duality to obtain the values of all the primal variables from the optimal dual solution. State the theorems used.

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**4.** Write the equivalent primal and dual linear programming problems of the following game theory problem

**Player B**

**Player A** $\begin{bmatrix} 2 & 0 & 3 \\ 3 & 5 & -3 \\ 5 & 1 & -3 \end{bmatrix}$

Solve any one of the linear programming problems to obtain optimum payoffs and optimal strategies for both the players.

**5.** The following table gives cost of transporting goods from factories A, B, C and D to destinations E, F, G, H and I

**Destinations**

| **Factories** | **E** | **F** | **G** | **H** | **I** | **Supply** |
|---|---|---|---|---|---|---|
| **A** | 8 | 10 | 12 | 17 | 15 | **100** |
| **B** | 15 | 13 | 18 | 11 | 9 | **150** |
| **C** | 14 | 20 | 6 | 10 | 13 | **160** |
| **D** | 13 | 19 | 7 | 6 | 12 | **280** |
| **Demand** | **70** | **170** | **50** | **210** | **190** | |

Find the optimal transportation cost and optimal allocation of goods from factories to destinations. Determine alternate optimal allocation of goods with the same transportation cost.

**6.** A certain equipment needs five repair jobs which have to be assigned to five mechanics. The estimated time (in hrs.) that each mechanic requires to complete the repair job is given in the following table

| Mechanic | Job | | | | |
|---|---|---|---|---|---|
| | $J_1$ | $J_2$ | $J_3$ | $J_4$ | $J_5$ |
| $M_1$ | **3** | **10** | **3** | **8** | **2** |
| $M_2$ | **6** | **8** | **7** | **6** | **1** |
| $M_3$ | **6** | **8** | **7** | **5** | **3** |
| $M_4$ | **4** | **2** | **7** | **3** | **1** |
| $M_5$ | **8** | **6** | **12** | **8** | **4** |

Assuming that each mechanic can be assigned to only one job, determine how each job is assigned to a mechanic to minimize the time allotment. Explain each iteration.

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