**JAIPURIA INSTITUTE OF MANAGEMENT, NOIDA**

**PGDM / PGDM (M) / PGDM (SM)**

**Third TRIMESTER (Batch 2023-25)**

**END TERM EXAMINATIONS, APRIL 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| Course Name | **Operations Research** | Course Code | **20521** |
| Max. Time | **2 hours** | Max. Marks | **40 MM** |

INSTRUCTIONS: All questions are compulsory. Use of calculators (simple/ scientific) is permitted.

Q.1. A paper mill produces 2 grades of paper namely x and y. Because of raw material restrictions, it cannot produce more than 400 tonnes of grade x and 300 tonnes of grade y in a week. There are 160 production hours in a week. It requires 0.2 hours and 1.4 hours to produce a tone of product x and y respectively, with corresponding profits of Rs.200 and Rs.500 per ton. Formulate the above LPP to maximize the profit and solve using the graphical method. (10 Marks)

Q.2. Apply the notion of dominance to simplify the rectangular game with the following pay-off matrix, and then solve it graphically. (7 Marks)

$$\left[\begin{matrix}3&-2&4\\-1&4&2\\2&2&6\end{matrix}\right]$$

Q.3. A departmental store purchases Christmas trees, which can be ordered only in lots of 100. Each tree selling price Rs. 40 each. Unsold trees, however, have no salvage value. The purchase price of the trees is Rs. 25 each. The probability distribution obtained from analysis of past data is given below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trees sold  | 100 | 200 | 300 | 400 | 500 |
| Probabilities | 0.20 | 0.35 | 0.25 | 0.15 | 0.05 |

(a) Construct a payoff table  (4 Marks)

(b) Identify the quantity departmental store should buy to maximize its profit? (3 Marks)

Q.4. XYZ Soap company is considering the production of four potential products: Moisturizing Soap, Antibacterial Soap, Natural Soap, and Chemical-Free Soap. It is assumed that the input for all the products can be viewed in terms of just three resources’: oil, water and lye. The composition of these four soaps in terms of these three inputs and maximum supply is shown in the table given below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Moisturizing Soap** | **Antibacterial Soap** | **Natural Soap** | **Chemical-Free Soap** | **Maximum Supply (in lts.)** |
| **Oil**  | 3 | 4 | 4 | 3 | 4700 |
| **Water**  | 2 | 2 | 4 | 3 | 4500 |
| **Lye**  | 1 | 1 | 3 | 2 | 2500 |

The company earns a profit of Rs.29, Rs.32, Rs.72, and Rs.54 by selling each type of soap. Each resource is available in limited quantity. The problem has been formulated and solved, which generated the following report

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Final** | **Reduced** | **Objective** | **Allowable** | **Allowable** |
| **Cell** | **Name** | **Value** | **Cost** | **Coefficient** | **Increase** | **Decrease** |
| $B$2 | Moisturizing Soap | 0 | -1 | 29 | 1 | 1E+30 |
| $C$2 | Antibacterial Soap | 380 | 0 | 32 | 40 | 1.666666667 |
| $D$2 | Natural Soap | 0 | -8 | 72 | 8 | 1E+30 |
| $E$2 | Chemical-Free Soap | 1060 | 0 | 54 | 10 | 5 |
|  |  | **Final** | **Shadow** | **Constraint** | **Allowable** | **Allowable** |
| **Cell** | **Name** | **Value** | **Price** | **R.H. Side** | **Increase** | **Decrease** |
| $F$4 | Oil  | 4700 | 2 | 4700 | 2800 | 950 |
| $F$5 | Water  | 3940 | 0 | 4500 | 1E+30 | 560 |
| $F$6 | Lye | 2500 | 24 | 2500 | 466.6666667 | 1325 |

Based on the report generated, identify

1. Basic variables in the optimal solution
2. Basic variables in the initial solution
3. Values of variables in optimal solution
4. Binding and non-binding constraints
5. Optimal profit (2 x 5 = 10 Marks)

Q.5. Parithi is either sad (S) or happy (H) each day. If he is happy in one day, he is sad on the next day by four times out of five. If he is sad on one day, he is happy on the next day by two times out of three. Over a long run, determine the chances that Parithi is happy on any given day? (6 Marks)