Code No: 742AD **R17**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**MBA II Semester Examinations, December - 2019**
**QUANTITATIVE ANALYSIS FOR BUSINESS DECISIONS**

**Time: 3hours** **Max.Marks:75**

**Note:** This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A** **5 × 5 Marks = 25**

1.a) What is a model? What purpose does it serve? [5]
b) What is duality in Linear Programming problem? [5]
c) What is an unbalanced assignment problem? Illustrate your answer with example. [5]
d) i) What is cost slope?
ii) Distinguish between PERT&CPM. [5]
e) For the GI/G/1, FCFS model, using the basic definitions and relationships, verify the following relationships:
i) $L = L_q + (1 - P_0)$ ii) $L = L_q + \rho$ iii) $P_0 = 1 - \rho$ [5]

**PART - B** **5 × 10 Marks = 50**

2.a) Explain briefly the steps (perhaps overlapping) involved in an Operations Research Study.
b) A company having a mechanical workshop has recently discontinued production of an unprofitable product. It has resulted in a considerable spare capacity. The company has decided to use this capacity to the maximum extent to produce three products which are profitable. The productivity coefficient in machine hours per unit and available machine time is given below:

| Machine type | Product 1 | Product 2 | Product 3 | Time Available Machine Hours per week |
|---|---|---|---|---|
| Milling Machine | 9 | 3 | 5 | 500 |
| Lathe | 5 | 4 | 0 | 350 |
| Grinder | 3 | 0 | 2 | 150 |

The sales department has indicated that the demand for Products 1 and 2 exceeds the maximum production rate whereas sales potential for Product 3 is 20 units per week. The profits for the three products have been estimated respectively as Rs. 3500, Rs.1400, and Rs. 1750 for the three products. The company wants to decide the optimum level of production to maximize its profit.
Formulate this problem as a mathematical model. [5+5]

**OR**

3.a) Write a short note on Sensitivity analysis and its importance.
b) Consider the following problem:
Minimize $Z = 5x_1 + 7x_2$,
Subject to,
$2x_1 + 3x_2 \geq 42$,
$3x_1 + 4x_2 \geq 60$,
$x_1 + x_2 \geq 18$,
and $x_1 \geq 0, x_2 \geq 0$.
Solve this problem graphically and explain briefly the steps involved in reaching the optimum solution. [4+6]

4. David, LaDeana and Lydia are the sole partners and workers in a company which produces fine clocks. David and LaDeana each are available for 40 hours per week at the company, while Lydia is available to work for a maximum of 20 hours per week. The company makes two different types of clocks: a grand-father clock and a wall clock. To make a clock, David (a mechanical engineer) assembles the inside mechanical parts of the clock while LaDeana (Woodworker) produces the hand carved wood casings. Lydia is responsible for taking orders and shipping the clocks. The amount of time required for each of these tasks is shown below:

| | Time Required | |
|---|---|---|
| | Grandfather Clock | Wall Clock |
| Assemble clock mechanism | 6 hours | 4 hours |
| Carve wood casing | 8 hours | 4 hours |
| Shipping | 3 hours | 3 hours |

Each grandfather clock built and shipped yields a profit of $300, while each wall clock yields a profit of $200.
Three partners now want to determine how many clocks of each type should be produced per week to maximize the total profit.
a) Formulate a linear programming model in algebraic form for the problem.
b) Solve this problem. [10]

**OR**

5. There are 3 sources and four destinations with the costs of transportation are as shown in the following table.

| | Destination | | | | | |
|---|---|---|---|---|---|---|
| Source | 1 | 2 | 3 | 4 | 5 | Supply |
| 1 | 8 | 6 | 3 | 7 | 5 | 20 |
| 2 | 5 | ∞ | 8 | 4 | 7 | 30 |
| 3 | 6 | 3 | 9 | 6 | 8 | 30 |
| | 25 | 25 | 20 | 10 | 20 | |

Balance this transportation matrix and solve for optimal solution. [10]

6. For the following problem begin with Hungarian Method and using iterations solve for optimal solution. [10]

| | Task | | | |
|---|---|---|---|---|
| Assignee | 1 | 2 | 3 | 4 |
| A | 4 | 6 | 5 | 5 |
| B | 7 | 4 | 5 | 6 |
| C | 4 | 7 | 6 | 4 |
| D | 5 | 3 | 4 | 7 |

**OR**

7. Consider the assignment problem with following cost matrix:

| | Job | | |
|---|---|---|---|
| Person | 1 | 2 | 3 |
| A | 5 | 7 | 4 |
| B | 3 | 6 | 5 |
| C | 2 | 3 | 4 |

Formulate this problem as a linear programming problem and solve. [10]

8. An investment of $10,000 in a high risk venture has a 50-50 chance over next year of increasing to $14,000 or decreasing to 8,000. Thus the net return can be either $4,000 or -$2,000.

a) Assuming a risk-neutral investor and a utility scale from 0 to 100, determine the utility of $0 net return on investment and associated indifference probability.

b) Suppose the two investors A and B have exhibited the following indifference probabilities:

| | **Indifference Probability** | |
|---|---|---|
| **Net Returns ($)** | Investor A | Investor B |
| **-2000** | 1.00 | 1.00 |
| **-1000** | 0.30 | 0.90 |
| **0** | 0.20 | 0.80 |
| **1000** | 0.15 | 0.70 |
| **2000** | 0.10 | 0.50 |
| **3000** | 0.05 | 0.40 |
| **4000** | 0.00 | 0.00 |

Graph the utility functions for investors A and B, and categorize each investor as either a risk averse person or a risk seeker. [10]

**OR**

9. A company is in the process of preparing a budget for launching a new product. The following table provides the associated activities and their durations. Construct the project network. [10]

| | **Activity** | **Predecessors** | **Duration (days)** |
|---|---|---|---|
| **A:** | Forecast Sales volume | - | 10 |
| **B:** | Study competitive market | - | 7 |
| **C:** | Design item and facilities | A | 5 |
| **D:** | Prepare production schedule | C | 3 |
| **E:** | Estimate cost of production | D | 2 |
| **F:** | Set sales price | B, E | 1 |
| **G:** | Prepare Budget | E, F | 14 |

10. On an average 96 patients per 24-hours day require the service of an emergency clinic. Also on an average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs. 100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost Rs. 10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue from $1\frac{1}{3}$ patients to $\frac{1}{2}$ patient. [10]

**OR**

11.a) Explain two-person zero-sum game by giving suitable example

b) Explain Minimax and Maxmin principles used in solving games.

c) What is the saddle point?

d) Define the value of a game.

e) Solve the following game by giving optimum strategies for each player and value of the game: [10]

| | | Player B | | | |
|---|---|---|---|---|---|
| | | B1 | B2 | B3 | B4 |
| Player A | A1 | 3 | 3 | 1 | 10 |
| | A2 | 5 | 5 | 4 | 6 |
| | A3 | 4 | -2 | 0 | -5 |

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