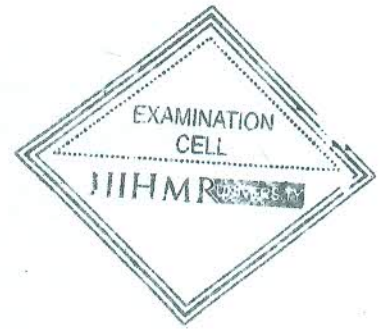


**LIHMR UNIVERSITY**  
**School of Pharmaceutical Management**

**MBA Pharmaceutical Management**  
**Batch-09 (2017-2019) – 2 Year**

**Operations Research**  
**Term Examination**



**Time - 3 Hour**

**MM-70**

The question paper contains 3 printed pages.

**Instructions**

1. The question paper contains 8 Questions. Candidates are required to answer any five (5) questions.
2. All questions carry equal marks.

- Q. 1. What is Operations Research (OR)? Trace the history of OR and explain the important models that could be used in pharmaceutical organizations. [14]
- Q. 2. A pharmaceutical project manager is faced with a project with the following activities:

| Activity | Predecessor | Duration (days) |
|----------|-------------|-----------------|
| A        | -           | 18              |
| B        | A           | 19              |
| C        | A           | 17              |
| D        | B           | 15              |
| E        | C           | 18              |
| F        | D           | 13              |
| G        | E           | 17              |
| H        | F, G        | 12              |

Construct an activity on arrow network for the project. Identify the paths and path project durations. Determine the critical path and the project completion time. Calculate ES, LS, EF, LF, and float for each activity. [14]

- Q. 3. (a) Explain the mathematical structure of linear programming problem which could be used in resource allocation. [4]

(b) Given the following linear programming formulation:  
Maximize

$$1,600 x_1 + 3,000 x_2$$

Subject to:

$$40 x_1 + 25 x_2 \leq 80,000 \text{ (constraint1)}$$

$$20 x_1 + 30 x_2 \leq 60,000 \text{ (constraint2)}$$

$$x_1, x_2 \geq 0 \text{ (non-negativity constraints).}$$

Solve the problem graphically. What is the total objective function value? Does any variable have a slack value? [10]

- Q. 4. A pharmaceutical company produces a pill as per the nutritional requirements considered important by the dietician. The drug company mixes two foods, say X and Y in such a way that a pill contains at least 6 units of vitamin A, 7 units of vitamin B,

12 units of vitamin C and 9 units of vitamin D. The vitamin contents of 1 unit of food X and 1 unit of food Y are given below.

|        | Vitamin A | Vitamin B | Vitamin C | Vitamin D |
|--------|-----------|-----------|-----------|-----------|
| Food X | 1         | 1         | 1         | 2         |
| Food Y | 2         | 1         | 3         | 1         |

One unit of food X costs Rs. 50, whereas one unit of food Y costs Rs. 80. The problem faced by the drug company is that of determining the least cost of the mixture which will produce the desired pill. [14]

**Q. 5.** (a) Explain the structure of transportation problem as a special class of the linear programming problem. [4]

(b) A pharmaceutical company has three plants located in a state. The monthly production of a particular drug at each plant is as follows:

Plant 1: 6 lakh units

Plant 2: 1 lakh units

Plant 3: 10 lakh units

Each month the firm must fulfill the needs of four distribution centers. Minimum requirement at each center is as follows:

Distribution center 1: 7 lakh units

Distribution center 2: 5 lakh units

Distribution center 3: 3 lakh units

Distribution center 4: 2 lakh units

Cost in thousand of rupees of shipping one lakh units from each plant to each distribution center is given in the following table:

| To-><br>From   | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> |
|----------------|----------------|----------------|----------------|----------------|
| P <sub>1</sub> | 2              | 3              | 11             | 7              |
| P <sub>2</sub> | 1              | 0              | 6              | 1              |
| P <sub>3</sub> | 5              | 8              | 15             | 9              |

Find the solution for the given problem by using Vogel's Approximation Method, if the objective is to minimize the total transportation cost. [10]

**Q. 6.** A pharmaceutical company has five persons working in a department - Satish, Lalita, Bindu, Chitra and Raj. Each of these individuals is uniquely qualified with experience in specific components. The Coordinator of this department has just received five jobs that be assigned to these individuals, and only one job may be assigned to each individual. The estimated number of days required to complete each of these jobs by the five individuals is given in the table below.

|                        |        | Jobs |    |     |    |    |
|------------------------|--------|------|----|-----|----|----|
|                        |        | I    | II | III | IV | V  |
| Employees<br>(Persons) | Satish | 10   | 5  | 13  | 15 | 16 |
|                        | Lalita | 3    | 9  | 18  | 13 | 6  |
|                        | Bindu  | 10   | 7  | 2   | 2  | 2  |
|                        | Chitra | 7    | 11 | 9   | 7  | 12 |
|                        | Raj    | 7    | 9  | 10  | 4  | 12 |

The Coordinator would like to minimize the number of days required for the completion of these jobs. Solve this using Hungarian method. How many work days will be required to complete these jobs? Who will be assigned to each job? [14]

Q. 7. (a) Explain the EOQ model in hospital supply chain management. [4]

(b) The following data corresponds to the annual consumption of 8 pharmaceutical products which was obtained from inventory records:

| Item No. | Annual Consumption<br>(no. of units) | Price per unit<br>(Rs.) |
|----------|--------------------------------------|-------------------------|
| 1        | 3000                                 | 200                     |
| 2        | 60,000                               | 2                       |
| 3        | 20                                   | 5000                    |
| 4        | 200                                  | 12.5                    |
| 5        | 350                                  | 9                       |
| 6        | 6000                                 | 25                      |
| 7        | 40                                   | 1000                    |
| 8        | 300                                  | 70                      |

For inventory control reasons the hospital want to classify the products into three categories A, B, and C according to the following basis.

| Category | Percentage of total<br>ACV |
|----------|----------------------------|
| A        | 70                         |
| B        | 20                         |
| C        | 10                         |

Classify the products into A, B, and C categories and draw the ABC classification graph. [10]

Q. 8. Write short notes on any two of the following: [7 x 2]

- EOQ model in pharmaceutical supply chain management.
- Queuing and capacity planning in hospitals.
- PERT probabilistic approach in project management.

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