

**Time - 3 Hour****MM-70**

The question paper contains 4 printed pages.

**Instructions**

1. The question paper contains 9 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 are used in healthcare management. **[14]**

**Q. 2.** Given the following linear programming formulation:

Maximize

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

Subject to:

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

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

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

- a. Solve the problem graphically. **[6]**
- b. What is the total objective function value? **[2]**
- c. Do both variables contribute to the solution? Why? **[2]**
- d. Does any variable have a slack value? If so, what does it mean? **[4]**

**Q. 3.** In a project of launching a new radiation oncology service, list of necessary activities and their duration are shown in the table below:

| Activity Name | Description               | Predecessor | Time |
|---------------|---------------------------|-------------|------|
| A             | Land acquisition          |             | 4    |
| B             | Hire radiation oncologist |             | 16   |
| C             | Select contractor & plan  | A,B         | 8    |
| D             | Build facility            | C           | 24   |
| E             | Acquire equipment         | C           | 28   |
| F             | Hire technical staff      | D,E         | 4    |
| G             | Setup software            | D,E         | 8    |
| H             | Test equipment            | F,G         | 4    |

- a. Construct an activity on arrow network for the project. [4]
- b. Identify the critical path and the project completion time. [2]
- c. Calculate ES, LS, EF, LF, and float for each activity. [8]

**Q. 4.** Referral hospitals (RHs) and primary health centres (PHCs) are the focal points of the public health care system. When critical, emergency or chronic cases are brought to a PHC, they are sent to referral hospitals. While referring a case, the distance between a PHC and a RH is a major criterion for taking a decision. The shortest distance between them is always preferred so that the travel time and cost is minimum, as far as possible.

The following table shows the Distance table between Referral Hospital (RH) and PHC, the bed capacity of referral hospitals (destinations), and the number of cases referred by the primary health centres (sources) per month.

| Referral Hospital (RH) (Destination) | Public Health Center (Source) |                 |                 |                 |                 | RH bed capacity |
|--------------------------------------|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                      | PH <sub>1</sub>               | PH <sub>2</sub> | PH <sub>3</sub> | PH <sub>4</sub> | PH <sub>5</sub> |                 |
| RH <sub>1</sub>                      | 10                            | 20              | 5               | 9               | 10              | 90              |
| RH <sub>2</sub>                      | 5                             | 10              | 8               | 30              | 6               | 40              |
| RH <sub>3</sub>                      | 3                             | 20              | 7               | 10              | 4               | 80              |
| PH Referrals                         | 30                            | 50              | 40              | 60              | 30              |                 |

Determine the optimal transportation plan i.e. how many cases to be referred from each source to each destination so that the total money spent by the community in a month on transportation is minimal. Assume that the travelling cost per kilometre is Rs 10.

Use VAM method for finding initial solution. Carry out the test for optimality for finding the best answer to the problem. [14]

**Q. 5.** The staffing manager of a well-known NGO wishes to improve efficiency of the staffing process by reducing total time taken in 6 key tasks. He has to assign the tasks to five experienced employees for which he had computed the time to complete each task based of their effectiveness matrix.

Employee Time for Different Stages

| Employee | Tasks (Time in Hours) |    |    |    |    |    |
|----------|-----------------------|----|----|----|----|----|
|          | A                     | B  | C  | D  | E  | F  |
| 1        | 12                    | 7  | 20 | 14 | 8  | 10 |
| 2        | 10                    | 14 | 13 | 20 | 9  | 11 |
| 3        | 5                     | 3  | 6  | 9  | 7  | 10 |
| 4        | 9                     | 11 | 7  | 16 | 9  | 10 |
| 5        | 10                    | 6  | 14 | 8  | 10 | 12 |

Determine the optimal assignment of employees to minimize total time taken for the staffing process. Is there an alternative optimal assignment possible? What is the minimum possible time for the assignments? [14]

- Q. 6.** A portion of a hospital pharmacy formulary contains the twenty medications listed in Table below.

| Item No. | Description         | Unit Price (in \$) | Weekly Demand |
|----------|---------------------|--------------------|---------------|
| 1        | Albuterol .083% 3ml | 7.83               | 25            |
| 2        | Alprazolam 1mg      | 3.15               | 35            |
| 3        | Bumetanide 0.5 mg   | 7.42               | 40            |
| 4        | Captopril 50mg      | 29.66              | 10            |
| 5        | Cerumenex           | 9.98               | 15            |
| 6        | Clotrimazole crm 1% | 4.38               | 100           |
| 7        | Deltason 20mg       | 11.89              | 30            |
| 8        | Diflunisal 250mg    | 15.43              | 15            |
| 9        | Fluocinonide 0.05%  | 9.85               | 140           |
| 10       | Intron A 5ml        | 32.23              | 45            |
| 11       | Lanoxin 0.25mg 2ml  | 36.9               | 9             |
| 12       | Morphine 25mg 10ml  | 32.21              | 12            |
| 13       | Mucosil 10% 10ml    | 8.64               | 20            |
| 14       | Mycelex 1%          | 6.78               | 215           |
| 15       | Propulsid 10mg      | 22.9               | 50            |
| 16       | Retin-A 0.1%        | 19.9               | 15            |
| 17       | Succinylcholin 10ml | 10.65              | 25            |
| 18       | Sucralfate 1Gm      | 114                | 65            |
| 19       | Theophylline        | 9.795              | 350           |
| 20       | Triamterene         | 30.81              | 245           |

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

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

Classify the products into A, B, and C categories and draw the ABC classification graph.  
[14]

- Q. 7. (a)** Explain the quality control charts for attributes and variables as applicable to healthcare.

[4]

**(b)** The indicator Family Satisfaction, which is part of the National Hospice and Palliative Care Organization's survey, reflects the percentage of respondents who would not recommend the hospice services to others. The following data are from Holistic Care Corporation's completed

surveys from two hundred families each month during a year, showing the number of respondents each month who expressed dissatisfaction with the organization's services.

| Months    | Dissatisfied<br>Patient<br>Families |
|-----------|-------------------------------------|
|           |                                     |
| January   | 12                                  |
| February  | 14                                  |
| March     | 16                                  |
| April     | 14                                  |
| May       | 25                                  |
| June      | 14                                  |
| July      | 15                                  |
| August    | 16                                  |
| September | 14                                  |
| October   | 14                                  |
| November  | 24                                  |
| December  | 14                                  |

The healthcare manager wishes to construct a control chart for these data within 95.5 percent confidence intervals. Draw the appropriate control chart and state whether the fraction of dissatisfied patient families is under control limits. **[10]**

- Q. 8.** A hospital is exploring the level of staffing needed for a booth in the local mall, where they would test and provide information on diabetes. Previous experience has shown that, on average, every fifteen minutes a new person approaches the booth. A nurse can complete testing and answering questions, on average, in twelve minutes. If there is a single nurse at the booth, hence assume conditions for use of the single channel queuing model, with arrival follow Poisson distribution, Exponential service time distribution, and the queue length can be infinite with FCFS discipline.

Determine system utilization, queue length, line length, wait in queue, wait in the system, and the probability of the system being idle. **[14]**

- Q. 9.** Write short notes on any **two** of the following: **[7 x 2 ]**
- EOQ analysis in healthcare supply chain management.
  - Resource smoothing .
  - 7-QC tools of Quality Management in healthcare.
  - Project Crashing and Cost analysis.

\*\*\*