

**GUJARAT TECHNOLOGICAL UNIVERSITY****M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013****Subject code: 714603****Date: 06-06-2013****Subject Name: Advanced Operation Research****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

**Q.1 (a)** Define Operation Research. Explain the scope and limitations of OR. **07**

- (b)** A company manufactures two products P1 and P2. The profit per unit of the two products is Rs. 50 and Rs. 60 respectively. Both the products require processing in three machines. The following table indicates the available machine hours per week and the time required on each machine for one unit of P1 and P2. Formulate the LP problem. (Do not solve). **07**

| Machine | Product |        | Available time<br>(Hr/week) |
|---------|---------|--------|-----------------------------|
|         | P1      | P2     |                             |
| 1       | 2       | 1      | 300                         |
| 2       | 3       | 4      | 509                         |
| 3       | 4       | 7      | 812                         |
| Profit  | Rs. 50  | Rs. 60 |                             |

**Q.2 (a)** A company has three plants with capacities of 50, 60 and 70 units respectively to meet the demands of the three warehouses with respective requirements of 40, 70 and 80 units. The transportation cost is shown in table (in Rs.). Determine the initial basic feasible solution to the following transportation problem by using **07**

- 1) North-West Corner Method and
- 2) Least Cost Method

| Sources↓ | Destination |    |    | Supply |
|----------|-------------|----|----|--------|
|          | D           | E  | F  |        |
| A        | 4           | 5  | 1  | 40     |
| B        | 3           | 4  | 3  | 60     |
| C        | 6           | 2  | 8  | 70     |
| Demand   | 70          | 40 | 60 | 170    |

- (b)** What are the characteristics, applications and limitations of a Linear programming problem? **07**

**OR**

- (b)** What do you mean by unbalanced transportation problem? Explain with suitable example. Also explain how we solve degeneracy in transportation case with illustration. **07**

**Q.3 (a)** Describe the following terminologies: **07**

1. Pure strategy
2. Mixed strategy
3. Saddle point
4. Pay-off

- (b) Four men perform four different jobs. The time taken by each while performing a particular job is as given in the matrix. Find the assignment which minimizes the total time. 07

| Persons\Jobs | 1 | 2 | 3 | 4 |
|--------------|---|---|---|---|
| A            | 0 | 5 | 2 | 8 |
| B            | 0 | 3 | 8 | 2 |
| C            | 2 | 0 | 4 | 7 |
| D            | 2 | 0 | 1 | 1 |

**OR**

- Q.3** (a) For the following pure strategy game, what is the optimal plan for both the players? Determine the value of the game. 07

|          |     | Player B |    |     |    |    |
|----------|-----|----------|----|-----|----|----|
| Player A |     | I        | II | III | IV | V  |
|          | I   | -2       | 0  | 0   | 5  | 3  |
|          | II  | 4        | 2  | 1   | 3  | 2  |
|          | III | -4       | -3 | 0   | -2 | 6  |
|          | IV  | 5        | 3  | -4  | 2  | -6 |

- (b) Define the following terms: 07
1. Slack variable
  2. Surplus variable
  3. Artificial variable
  4. Optimal solution

- Q.4** (a) Discuss integer linear programming. Give an example each of a pure and a mixed integer linear programming problem. 07

- (b) Listed in the table are the activities and sequencing necessary for a Maintenance job on the EDM machine in a machine shop. Draw a network diagram for the project. 07

| Activities | Predecessor |
|------------|-------------|
| A          | ---         |
| B          | A           |
| C          | B           |
| D          | B           |
| E          | B           |
| F          | C           |
| G          | C           |
| H          | F, G        |
| I          | D, E, H     |
| J          | I           |

**OR**

- Q.4** (a) What is integer linear programming? Explain the merits and demerits of rounding off a continuous optimal solution to an LP problem to obtain an integer solution. 07

- (b) Differentiate between CPM and PERT. 07

- Q.5** (a) A self service store employs one cashier at its counter; Ten customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, find 07

1. Average number of customers in the system
2. Average number of customers in queue
3. Average time a customer spends in the system
4. Average time a customer waits before being served.

- (b) A project consists of 7 activities, whose time estimates are listed in the table below. 07

| Activity<br>(i-j) | Estimated duration |             |             |
|-------------------|--------------------|-------------|-------------|
|                   | Optimistic         | Most likely | Pessimistic |
| 1-2               | 1                  | 1           | 7           |
| 1-3               | 1                  | 4           | 7           |
| 1-4               | 2                  | 2           | 8           |
| 2-5               | 1                  | 1           | 1           |
| 3-5               | 2                  | 5           | 14          |
| 4-6               | 2                  | 5           | 8           |
| 5-6               | 3                  | 6           | 15          |

1. Draw the network diagram of the project.
2. Find expected duration, variance and standard deviation for each activity.
3. Find out the project length.

**OR**

- Q.5 (a)** Define the following terms: 07
1. Maximal Flow Problem
  2. Minimum Spanning Tree Algorithm
  3. Shortest Path Problem

- (b) TCS has recruited 500 software engineers in Mexico. It has 3 projects on which it can allocate these resources. They can be allocated only in batches of 100. Following are the issues that are expected to be resolved per day when a particular resource is allocated to a particular project. The objective is to maximize the issues resolved per day. Solve this dynamic programming problem. 07

|     | Project 1 | Project 2 | Project 3 |
|-----|-----------|-----------|-----------|
| 0   | 0         | 0         | 0         |
| 100 | 2         | 1         | 2         |
| 200 | 3         | 4         | 4         |
| 300 | 6         | 5         | 6         |
| 400 | 7         | 6         | 9         |
| 500 | 9         | 8         | 9         |

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