

**E 9119**

B.Sc. (Applied Science) DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Fifth Semester

Apparel and Fashion Technology

FT 5.5 — OPERATIONS RESEARCH

Time : Three hours

Maximum : 100 marks

Use of statistical tables permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the difference between slack variable and surplus variable?
2. Obtain the dual of the following linear programming problem :

$$\text{Maximize } z = 5x_1 + 12x_2 + 4x_3$$

Subject to the constraints :

$$x_1 + 2x_2 + x_3 \leq 5$$

$$2x_1 - x_2 + 3x_3 = 2$$

$$x_i \geq 0, \text{ where } i = 1, 2, 3.$$

3. Distinguish between sequencing and scheduling.
4. What are the rules for constructing a project network?
5. Given maximum lead time as 20 days and normal lead time as 15 days with annual consumption 12,000 units, find buffer stock.
6. What are the two main decisions to be made in inventory control?
7. What is meant by utilization factor?
8. What are the limitations of simulation?
9. What are two types of replacements? Illustrate with example.
10. What is meant by payoff matrix?

PART B — (5 × 16 = 80 marks)

11. (i) A firm manufactures refrigerators and air coolers. Production takes place in two separate departments. Refrigerators are produced in department – I and air coolers are produced in department–II. The firm's two products are produced and sold on a weekly basis. The weekly production cannot exceed 25 refrigerators in department–I and 35 air coolers in department–II, because of the limited available facilities in these departments. The firm regularly employs a total of 60 workers in two departments. A refrigerator requires 2 man–weeks of labour, while an air cooler requires 1 man–week of labour. The firm receives a profit margin of Rs. 300 and Rs. 200 per refrigerator and cooler respectively. Determine the product mix in order to maximize profit. Solve it by using graphical method. (9)
- (ii) An automobile dealer is faced with the problem of determining the minimum cost policy for supplying dealers with the desired number of automobiles. The relevant data are given below. Obtain the minimum total cost of transportation.

|             |   | Dealers |     |     |     |     |        |
|-------------|---|---------|-----|-----|-----|-----|--------|
|             |   | 1       | 2   | 3   | 4   | 5   | Supply |
|             | A | 1.2     | 1.7 | 1.6 | 1.8 | 2.4 | 300    |
| Plant       | B | 1.8     | 1.5 | 2.2 | 1.2 | 1.6 | 400    |
|             | C | 1.5     | 1.4 | 1.2 | 1.5 | 1.0 | 100    |
| Requirement |   | 100     | 50  | 300 | 150 | 200 |        |

The cost unit is in 100 rupees.

(7)

12. (a) Find the optimum sequence for the following sequencing problem :

| Jobs :                             | J <sub>1</sub> | J <sub>2</sub> | J <sub>3</sub> | J <sub>4</sub> | J <sub>5</sub> | J <sub>6</sub> | J <sub>7</sub> | J <sub>8</sub> |
|------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| M <sub>1</sub> (Time in minutes) : | 14             | 26             | 17             | 11             | 9              | 26             | 18             | 15             |
| M <sub>2</sub> (Time in minutes) : | 21             | 15             | 16             | 21             | 22             | 12             | 13             | 25             |

Find also the minimum total elapsed time and idle times on the machines M<sub>1</sub> and M<sub>2</sub>. (16)

Or

(b) A project consists of the following activities and time estimates :

|                         |     |     |     |     |     |     |     |     |     |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Activity :              | 1-2 | 2-3 | 1-4 | 2-5 | 2-6 | 3-6 | 4-7 | 5-7 | 6-7 |
| Least Time (days) :     | 3   | 2   | 6   | 2   | 5   | 3   | 3   | 1   | 2   |
| Greatest Time (days) :  | 15  | 14  | 30  | 8   | 17  | 15  | 27  | 7   | 8   |
| Most likely time (days) | 6   | 5   | 12  | 5   | 11  | 6   | 9   | 4   | 5   |

- (i) Draw the network, find critical path and the project time duration :
- (ii) What is the probability that the project will be completed in 27 days?
- (iii) What due date has about 95% chance of being met? (16)

13. (a) A manufacturing company purchases 9,000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs. 15 and the carrying charges are 15% of the average inventory per year. You have been asked to suggest a more economical purchasing policy for the company. What advice would you offer, how much would it save the company per year? (16)

Or

(b) An ice cream company sells one of its types of ice-creams by weight. If the product is not sold on the day it is prepared, it can be sold for a loss of Re. 0.50 per pound but there is an unlimited market for one day old ice-creams. On the other hand, the company makes a profit of Rs. 3.20 on every pound of ice-cream sold on the day it is prepared.

If daily orders form a distribution with  $f(x) = 0.02 - 0.0002x$ ,  $0 \leq x \leq 100$ , how many pounds of ice-cream should the company prepare every day? (16)

14. (a) A supermarket has two girls ringing up sales at the counters. If the service time for each customer is exponential with mean 4 minutes, and if the people arrive in a Poisson fashion at the rate of 10 per hour :

- (i) What is the probability to having to wait for service?
- (ii) What is the expected percentage of idle time for each girl?
- (iii) If a customer has to wait, what is the expected length of his waiting time? (16)

Or

(b) An automobile production line turns out about 100 cars a day, but deviations occur owing to many causes. The production is more accurately described by the probability distribution given below :

|             |      |      |      |      |      |      |      |      |      |      |      |
|-------------|------|------|------|------|------|------|------|------|------|------|------|
| Production  | 95   | 96   | 97   | 98   | 99   | 100  | 101  | 102  | 103  | 104  | 105  |
| Per day     |      |      |      |      |      |      |      |      |      |      |      |
| Probability | 0.03 | 0.05 | 0.07 | 0.10 | 0.15 | 0.20 | 0.15 | 0.10 | 0.07 | 0.05 | 0.03 |

Finished cars are transported across the bay at the end of each day by ferry. If the ferry has space for only 101 cars, what will be the average number of cars waiting to be shipped and what will be the average number of empty spaces on the ship? (16)

15. (a) A fleet owner finds from his past records that the costs per year of running a vehicle whose purchase price is Rs. 50,000 are as follows :

| Year :              | 1      | 2      | 3     | 4     | 5      | 6      | 7      |
|---------------------|--------|--------|-------|-------|--------|--------|--------|
| Running Cost (Rs.): | 5,000  | 6,000  | 7,000 | 9,000 | 11,500 | 16,000 | 18,000 |
| Resale value (Rs.): | 30,000 | 15,500 | 7,500 | 3,750 | 2,000  | 2,000  | 2,000  |

Thereafter, running cost increases by Rs. 2,000, but resale value remains constant at Rs. 2,000. What is the optimum period for replacement? (16)

Or

- (b) (i) In a game of matching coins with two players, suppose A wins one unit value when there are two heads, wins nothing when there are two tails, and loses  $\frac{1}{2}$  unit value when there are one head one tail. Determine the pay-off matrix, the optimum strategy for each player, and the value of the game. (8)

- (ii) Using dominance property solve : (8)

|                | B <sub>1</sub> | B <sub>2</sub> | B <sub>3</sub> | B <sub>4</sub> |
|----------------|----------------|----------------|----------------|----------------|
| A <sub>1</sub> | -5             | 3              | 1              | 20             |
| A <sub>2</sub> | 5              | 5              | 4              | 6              |
| A <sub>3</sub> | -4             | -2             | 0              | -5             |

---