Total No. of Questions : 12]

SEAT No. :

**P2985**

[Total No. of Pages : 7

# [5154]-540
# B.E. (Mechanical)
# OPERATIONS RESEARCH
## (2012 Course) (402045 C) (Semester - I) (Elective - II) (End Sem.)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) ***Draw neat diagrams wherever necessary.***
2) ***Use of electronic pocket calculator is allowed.***
3) ***Assume suitable data, if necessary.***

***Q1)*** A firm manufactures pain relieving pills in two sizes A and B. Size A contains 4 grains of element X, 7 grains of element Y and 2 grains of element Z. Size B contains 2 grains of element X, 10 grains of element Y and 8 grains of element Z. It is found by users that it requires at least 12 grains of element X, 74 grains of element Y and 24 grains of element Z to provide immediate relief. It is required to determine the least number of pills a patient should take to get immediate relief. formulate the problem as standard L.P.P. **[7]**

OR

***Q2)*** a) What is Decision Making? Explain and differentiate this under the condition of certainty and uncertainty. **[4]**

b) State advantages and limitations of decision tree approach. **[3]**

***Q3)*** Solve the following transportation problem using Stepping Stone Method. **[7]**

| Plants | Destination | | | | Supply |
|---|---|---|---|---|---|
| | D1 | D2 | D3 | D4 | |
| P1 | 20 | 30 | 50 | 17 | 7 |
| P2 | 70 | 35 | 40 | 60 | 10 |
| P3 | 40 | 12 | 60 | 25 | 18 |
| Requirement | 5 | 8 | 7 | 15 | |

OR

***P.T.O.***

***Q4)*** A team of 5 horses and 5 riders has entered a jumping show contest. The number of penalty points to be expected when each rider rides any horse is shown below. **[7]**

| | | Rider | | | | |
|---|---|---|---|---|---|---|
| | | $R_1$ | $R_2$ | $R_3$ | $R_4$ | $R_5$ |
| Horse | $H_1$ | 5 | 3 | 4 | 7 | 1 |
| | $H_2$ | 2 | 3 | 7 | 6 | 5 |
| | $H_3$ | 4 | 1 | 5 | 2 | 4 |
| | $H_4$ | 6 | 8 | 1 | 2 | 3 |
| | $H_5$ | 4 | 2 | 5 | 7 | 1 |

How should the horses be allotted to the riders so as to minimize the expected loss of the team?

***Q5)*** Two firms are competing for business under the conditions such that one firm's gain is another firm's loss. Firm A's payoff matrix is given below: **[6]**

| | | Firm B | | |
|---|---|---|---|---|
| | | No Advertising | Medium Advertising | Heavy Advertising |
| Firm A | No Advertising | 10 | 5 | -2 |
| | Medium Advertising | 13 | 12 | 15 |
| | Heavy Advertising | 16 | 14 | 10 |

Suggest optimal strategies for the two firms and the net outcome thereof.

OR

***Q6)*** A ball bearing manufacturing company is planning to install an additional plant which will require leasing new equipment for monthly payment of Rs. 60,000. Variable cost would be Rs. 20 per item and each item would retail for Rs. 70. **[6]**

a) How many ball bearing units must be sold in order to break even?
b) What would be profit or loss if 1,000 items are made & sold in a month?
c) How many items must be sold to realize a profit of Rs. 40,000?

***Q7)*** a) The cost of parameters and other factors for a production inventory system of automobile pistons are given below. **[8]**

Demand per year = 6,000 units

Unit Cost = Rs. 40

Set-up Cost = Rs. 500

Production Rate per year = 36,000 units

Holding cost per unit per year = Rs. 8

Shortage cost per unit per year = Rs. 20

Find

i) optimal lot size

ii) number of shortage and

iii) manufacturing time and time between set-ups

b) The cost of machine is Rs. 6,100 and its scrap value is Rs. 100. The maintenance costs found from experience are as follows: **[8]**

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Maintenance Cost (Rs.) | 100 | 250 | 400 | 600 | 900 | 1,200 | 1,600 | 2,000 |

When should the machine be replaced?

OR

***Q8)*** a) A stockist has to supply 400 units of a product every Monday to his customers, He gets the product at Rs. 50 per unit from the manufacturer. The cost of ordering and transportation from the manufacturer is Rs. 75 per order. The cost of carrying inventory is 7.5% per year of the cost of product. Calculate: **[8]**

i) Economic order quantity

ii) total optimal cost

iii) total weekly profit if the item is sold for Rs. 55 per unit.

b) The following failure rates have been observed for a certain type of light bulbs: **[8]**

| End of week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Probability of failure to date | 0.05 | 0.13 | 0.25 | 0.43 | 0.68 | 0.88 | 0.96 | 1.00 |

The cost of replacing an individual failed bulb is Rs. 1.25. The decision is made to replace all bulbs simultaneously at fixed intervals, and also to replace individual bulbs as they fail in service. If the cost of group replacement is 30 paise per bulb, what is the best interval betwen group replacements? At what group replacement price per bulb would a policy of strictly individual replacement become preferable to the adopted policy?

***Q9)*** a) In a factory, the machines breakdown on an average rate of 10 machines per hour. The idle time cost of a machine is estimated to be Rs. 20 per hour. The factory works 8 hours a day. The factory manager is considering 2 mechanics for repairing the machines. The first mechanic A takes about 5 minutes, on an average, to repair a machine and demands wages at the rate of Rs. 10 per hour. The second mechanic B takes about 4 minutes in repairing a machine and demands wages at the rate of Rs. 15 per hour. Assuming that the rate of machine breakdown is Poisson distributed and the repair rate is exponentially distributed, which of the two mechanics should be engaged? **[8]**

b) A machine operator has to perform three operations: turning, threading and knurling on a number of different jobs. The time required to perform these operations (in minutes) for each job is known. Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs. Also find the idle times for the three operations. **[8]**

| Job | Time for turning (minutes) | Time for threading (minutes) | Time for knurling (minutes) |
|---|---|---|---|
| 1 | 3 | 8 | 13 |
| 2 | 12 | 6 | 14 |
| 3 | 5 | 4 | 9 |
| 4 | 2 | 6 | 12 |
| 5 | 9 | 3 | 8 |
| 6 | 11 | 1 | 13 |

OR

***Q10)***a) A super market has two sales girls at the sales counters. If the service time for each customer is exponential with a mean of 4 minutes, and if the people arrive in a Poisson fashion at the rate of an 10 hour, then calculate: **[8]**

i) Probability that a customer has to wait for being served?

ii) Expected percentage of idle time for each sales girl?

iii) If a customer has to wait, what is expected length of his waiting time?

b) A manufacturing company processes 6 different jobs on two machines A and B. Number of units of each job and its processing times on A & B are given in table. Find the optimal sequence, the total minimum elapsed time and idle time for either machine. **[8]**

| Job No. | No. of Units of each job | Processing time | |
|---|---|---|---|
| | | Machine A (minutes) | Machine B (minutes) |
| 1 | 3 | 5 | 8 |
| 2 | 4 | 16 | 7 |
| 3 | 2 | 6 | 11 |
| 4 | 5 | 3 | 5 |
| 5 | 2 | 9 | 7.5 |
| 6 | 3 | 6 | 14 |

***Q11)***a) The utility data for a network are given below. Determine the total, free, independent and interfering floats and identify critical path. **[10]**

| Activity | 0-1 | 1-2 | 1-3 | 2-4 | 2-5 | 3-4 | 3-6 | 4-7 | 5-7 | 6-7 |
|---|---|---|---|---|---|---|---|---|---|---|
| Duration | 2 | 8 | 10 | 6 | 3 | 3 | 7 | 5 | 2 | 8 |

b) A dentist schedules all her patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of work, their probabilities and the time needed to complete work. **[8]**

| Category | Time required (minutes) | Probability of category |
|---|---|---|
| Filling | 45 | 0.40 |
| Crown | 60 | 0.15 |
| Cleaning | 15 | 0.15 |
| Extraction | 45 | 0.10 |
| Checkup | 15 | 0.20 |

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well the idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrived times, starting at 8 a.m. Use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17 and 79.

OR

***Q12)***a) The time estimates (in weeks) for the activities of a PERT network are given below. **[12]**

| Activity | $t_0$ | $t_m$ | $t_p$ |
|---|---|---|---|
| 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 |

i) Draw the project network and identify all the paths through it.

ii) Determine the expected project length.

iii) Calculate the standard deviation and variance of the project length.

iv) What is the probability that the project will be completed?

1) At least 4 weeks earlier than expected time?

2) No more than 4 weeks later than expected time?

v) If the project due date is 19 weeks, what is the probability of not meeting the due date?

vi) The probability that the project will be completed on schedule if the scheduled completion time is 20 weeks.

vii) What should be the scheduled completion time for the probability of completion to be 90%?

b) What do you mean by Goal programming? Where is it applicable? **[6]**

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