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10EE661

# Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## Operation Research

Time: 3 hrs. Max. Marks:100

**Note:** *1. Answer FIVE full questions, selecting atleast TWO questions from each part.*
*2. Missing data, if any, may be suitably assumed.*



### PART – A

1 a. Company wants to engage casual labours to assemble its product daily. The company works for only one shift which consists of eight hours and six days a week. The casual labours consists of two categories, viz. skilled and semi-skilled. The daily production per skilled labour is 80 and that of semi-skilled labour is 60 assembles. The rejection rate of the assemblies produced by the skilled labour is 5% and that of the semi-skilled labours is10%. The loss to the company for rejecting an assembly is Rs.25. The daily wage per labour of the skilled and semi-skilled labours are Rs.240 and Rs.160, respectively. The required weekly production is 1,86,000 assemblies. The company wants to limit the number of semi-skilled labours per day to utmost 400. Develop a linear programming model to determine the optimal mix of the casual labours to be employed so that the total cost is minimized. **(10 Marks)**

b. Use two-phase simplex method, solve the following LPP :

Minimize $Z = 2x_1 + 3x_2 + 2x_3 - x_4 + x_5$
Subject to $3x_1 - 3x_2 + 4x_3 + 2x_4 - x_5 = 0$
$x_1 + x_2 + x_3 + 3x_4 + x_5 = 2$
$x_1 \geq 0 : i = 1.2 \ldots 5;$ **(10 Marks)**

2 a. With respect to simplex method, explain degeneracy, alterate optimal solutions, unbounded solutions, non-existing optimal solutions. **(08 Marks)**

b. Write the dual problem for the following primal problem and solve the dual problem. If required use Big-m method.

Maximum $Z = 5x_1 + 2x_2 + 3x_3$
Subject to $x_1 + 5x_2 + 2x_3 = 30$
$x_1 - 5x_2 - 6x_3 \leq 40$
$x_1 \geq 0; i = 1, 2, 3.$ **(12 Marks)**

3 Using revised Simplex method, find the maximum of function :

$Z = 4x_1 - x_2 - 2x_3$
Subject to $2x_1 - 3x_2 + 2x_3 \leq 12$
$-5x_1 + 2x_2 + 3x_3 \geq 4$
$3x_1 - 2x_3 = -1$
$x_1, x_2, x_3 \geq 0.$ **(20 Marks)**

4 a. A college is having a degree programme for which the effective semester time available is very less and the programme requires field work. Hence, a few hours can be saved from the total numbers of class hours, and can be utilized for the field work. Based on past experience, the college has estimated the number of hours required to teach each subject by each faculty. The course in its present semester has "5" subjects and the college has considered "6" existing faculty members to teach these courses. The objective is to assign the best five teachers out of these six faculty members to teach five different subjects so that the total number of class hours required is minimized. The data of this is summarized in Table Q4(a) solve this problem optimally. **(10 Marks)**

Table Q4(a)

| Faculty \ Subjects | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 30 | 39 | 31 | 38 | 40 |
| 2 | 43 | 37 | 32 | 35 | 38 |
| 3 | 34 | 41 | 33 | 41 | 34 |
| 4 | 39 | 36 | 43 | 32 | 36 |
| 5 | 32 | 49 | 35 | 40 | 37 |
| 6 | 36 | 42 | 35 | 44 | 32 |

b. A company has a team of four salesmen and there are four districts where the company wants to start its business. After taking into account the capabilities of salesman and the nature of districts, the company estimates that the profit per day in rupees for each salesman in each district is given in the Table Q4(b). Find the assignment of salesman to various districts which will yield maximum profit. **(10 Marks)**

Table Q4(b)

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| A | 16 | 10 | 14 | 11 |
| B | 14 | 11 | 15 | 15 |
| C | 15 | 15 | 13 | 12 |
| D | 13 | 12 | 14 | 15 |

## PART – B

5 a. Consider the following transportation problem Table Q5(a) involving three sources ad four destinations. The cell entries represent the cost of transportation per unit.

Table 5(a)

| Source \ Destination | 1 | 2 | 3 | 4 | Supply |
|---|---|---|---|---|---|
| 1 | 3 | 1 | 7 | 4 | 300 |
| 2 | 2 | 6 | 5 | 9 | 400 |
| 3 | 8 | 3 | 3 | 2 | 500 |
| Demand | 250 | 350 | 400 | 200 | |

Obtain the initial basic feasible solution using the following methods.
i) Least cost cell method ii) Vogel's approximation method. **(10 Marks)**

b. A company has four warehouses and six stores. The warehouses together have a surplus of 22 units of a given commodity divided among them as follows :

| Warehouses | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Surplus | 5 | 6 | 2 | 9 |

The six stores together need 22 unties of the commodity. Individual requirements at stores 1, 2, 3, 4, 5 and 6 are 4, 4, 6, 2, 4 and 2 units respectively cost of shipping one unit of commodity from warehouses "i" to stores "j" in rupees is given in the matrix below. How should the products be shipped from the warehouses to the stores so that the transformation cost is minimum? Also, in context of this problem, explain the degeneracy if such type of solution is exists. The transportation cost matrix is given in TableQ5(b). Obtain basic feasible solution by VAM. **(10 Marks)**

Table Q5(b)

| | | | | | |
|---|---|---|---|---|---|
| 9 | 12 | 9 | 6 | 9 | 10 |
| 7 | 3 | 7 | 7 | 5 | 5 |
| 6 | 5 | 9 | 11 | 3 | 11 |
| 6 | 8 | 11 | 2 | 2 | 10 |

6 a. Players "A" and "B" play a game in which each player has three coins (20p, 25p, 50p). Each of them selects a coin without the knowledge of the other person. If the sum of the values of the coins is an even number, A wins B's coin. If that sum is an odd number, B wins A's coin: i) Develop a payoff matrix with respect to player A
ii) Find the optimal strategies for the players. **(10 Marks)**

b. Consider the payoff matrix of player "A" as shown in Table Q6(b) and solve it optimally using graphical method. **(10 Marks)**

| | | Player B | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Player A | 1 | 3 | 0 | 6 | –1 | 7 |
| | 2 | –1 | 5 | –2 | 2 | 1 |

Table Q6(b)

7 a. A project has the following time schedule for the activities :
i) Draw the project network diagram :
ii) Find the critical path
iii) Draw the project network in tabular form. **(10 Marks)**

| Activity (i – j) | Duration in days |
|---|---|
| 10 – 20 | 6 |
| 10 – 30 | 8 |
| 20 – 30 | 3 |
| 20 – 40 | 8 |
| 30 - 40 | 6 |
| 30 – 50 | 10 |
| 30 – 60 | 12 |
| 40 – 60 | 8 |
| 50 – 60 | 6 |
| 50 – 70 | 12 |
| 60 – 70 | 8 |
| 70 – 80 | 7 |

Table Q7(a)

b. From the data given below, draw the network diagram and find :
i) Critical path.
ii) Probability of node occurring at the proposed completion date, if the original contract time of completing the project is 41.5 weeks
iii) Number of weeks required to have probability of 95%. **(10 Marks)**

| Task | Estimated times | | |
|---|---|---|---|
| | $t_0$ | $t_p$ | $t_m$ |
| 1 – 2 | 5 | 10 | 8 |
| 1 – 3 | 18 | 22 | 20 |
| 1 – 4 | 26 | 40 | 33 |
| 2 – 5 | 16 | 20 | 18 |
| 2 – 6 | 15 | 25 | 20 |
| 3 – 6 | 6 | 12 | 9 |
| 4 – 7 | 7 | 12 | 10 |
| 5 – 7 | 7 | 9 | 8 |
| 6 – 7 | 3 | 5 | 4 |

TableQ7(b)

8 a. Explain how economic life of a machine is determined. **(10 Marks)**

b. Define and explain : i) Money value ii) Present worth factor iii) Discount rate. **(10 Marks)**

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