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10EE661

# Sixth Semester B.E. Degree Examination, June / July 2014
# Operations Research

Time: 3 hrs. Max. Marks:100

**Note: 1.** ***Answer FIVE full questions, selecting at least TWO questions from each part.***
**2.** ***Use of Quantitative / Statistical / Normal distribution Tables permitted.***



## PART – A

1 a. Explain the following with respect to simplex method:
i) Dealing with unrestricted variables.
ii) Degeneracy and how it can be resolved. **(06 Marks)**

b. Explain the formulation of dual when primal problem contains constraints with,
i) Equal sign.
ii) Unrestricted variable. **(04 Marks)**

c. Solve the following linear programming problem using Charne's penalty method:
Maximize $z = -2x_1 - x_2$
Subjected to, $3x_1 + x_2 = 3$
$4x_1 + 3x_2 \geq 6$
$x_1 + 2x_2 \leq 4$
$x_1, x_2 \geq 0$ **(10 Marks)**

2 a. A farmer has 100 acre land. He can sell all tamotoes and radishes he can raise. The price he can obtain is Rs.1.0 per kg for tomotoes and Rs.2.0 per kg for radishes. The average yield per acre is 2000 kgs of tomotoes and 1000 kgs of radishes. Fertilizer is available at Rs.0.5 per kg and the amount required per acre is 100 kgs for tomotoes and 50 kgs for radishes. Labour required for sowing, cultivating and harvesting per acre is 5 man days for tomotoes and 6 man days for radishes. A total of 400 man days of labour are available at Rs.20 per man day. Formulate this problem as linear programming problem to maximize the farmers total profit. Also solve the problem using graphical method. **(10 Marks)**

b. Using two phase simplex method solve the following linear programming problem:
Maximize $z = 3x_1 - x_2$
Subjected to, $2x_1 + x_2 \geq 2$
$x_1 + x_2 \leq 2$
$x_2 \leq 4$
$x_1, x_2 \geq 0$ **(10 Marks)**

3 a. Solve the LPP given below using revised simplex method.
Maximize $z = 6x_1 - 2x_2 + 3x_3$
Subjected to, $2x_1 - x_2 + 2x_3 \leq 2$
$x_1 + 4x_3 \leq 4$
$x_1, x_2, x_3 \geq 0$ **(15 Marks)**

b. Explain in brief, the essence of parametric programming in operations research. **(05 Marks)**

4 a. Indian cricket team has five very good batsmen with five batting positions needs to be assigned. Following table gives batting averages of each of these batsmen in all five batting positions. How should the batting position be allocated so as to minimize match loosing percentage? **(10 Marks)**

| Batting Positions / Batsman | I | II | III | IV | V |
|---|---|---|---|---|---|
| SACHIN | 59.49 | 61.52 | 56.97 | 18.55 | 50.43 |
| KOHLI | 60.62 | 58.23 | 40.37 | 32.28 | 49.40 |
| PUJARA | 34.50 | 50.89 | 51.85 | 48.10 | 43.54 |
| DHONI | 45.54 | 58.05 | 54.12 | 36.41 | 44.83 |
| SEHWAG | 31.42 | 49.43 | 51.09 | 59.57 | 43.57 |

b. Solve the traveling salesman problem, given the cost matrix as shown below: **(10 Marks)**

| | | To City | | | |
|---|---|---|---|---|---|
| | | A | B | C | D |
| From City | A | - | 46 | 16 | 40 |
| | B | 41 | - | 50 | 40 |
| | C | 82 | 32 | - | 60 |
| | D | 40 | 40 | 36 | - |

## PART – B

5 a. Karnataka power corporation has three electric power plants that supply the needs of five cities. Each power plant can supply the following numbers of kWh of electricity:
Sharavathi plant : 8 million units
Raichur plant : 12 million units
Varahi plant : 14 million units
The peak power demands of these five cities are as follows (in kWh):
Bangalore : 4 million units
Mysore : 4 million units
Mangalore : 6 million units
Tumkur : 8 million units
Davanagere : 8 million units
The cost of sending 1 million kWh of electricity from different plants to each city is given in table below. To minimize the cost of meeting each city's peak power demand, formulate a balanced transportation problem. Obtain initial basic feasible solution by VAM method and optimal solution by MODI method. **(14 Marks)**

| | Bangalore | Mysore | Mangalore | Tumkur | Davangere |
|---|---|---|---|---|---|
| Sharavathi plant | 4 | 2 | 3 | 2 | 6 |
| Raichur plant | 5 | 4 | 5 | 2 | 1 |
| Varahi plant | 6 | 5 | 4 | 7 | 3 |

b. i) List out the differences between transportation and assignment problem.
ii) Write any three differences between a balanced and an unbalanced transportation problem. **(06 Marks)**

6 a. What is a game strategy? Explain in brief, pure strategy and mixed strategy as applicable to game theory. **(05 Marks)**

b. Write any three properties of a competitive game. **(03 Marks)**

c. Define the following with respect to game theory:
i) Pay off matrix.
ii) Game of choice. **(02 Marks)**

6 d. Two players Prakruthi and Sudheeksha play a game in which each has thre coins: a 5 paise, a 10 paise and 20 paise. Each selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount Prakruthi wins Sudheeksha's coins. If the sum is even Sudheeksha wins Prakruthi's coins.

i) Develop a pay off matrix with respect to player Prakruthi.

ii) Find the optimal strategies for the players. What is the value of the game?

**(10 Marks)**

7 a. A project consists of a series of tasks labelled A, B, .....H, I with the following relationships.[w < x, y means x and y cannot start untill w is completed) with this notation, construct the network diagram having the following constraints:

A < D, E; B, D < F; C < G; B < H; F, G < I

Find also the minimum time of completion of the project when the time (in days) of completion of each task is as follows:

| Task: | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Time: | 23 | 8 | 20 | 16 | 24 | 18 | 19 | 4 | 10 |

Further determine

i) Earliest start time [ES] ii) Earhest Finish time [EF]

iii) Latest start time [LS] iv) Latest finish time [LF]

v) Total Float time [TF]

**(08 Marks)**

b. A small project is composed of seven activities whose time estimates are listed in table below:

| Activity | | 1 – 2 | 1 – 3 | 1 – 4 | 2 – 5 | 3 – 5 | 4 – 6 | 5 – 6 |
|---|---|---|---|---|---|---|---|---|
| Estimated Duration in Weeks | Optimistic | 1 | 1 | 2 | 1 | 2 | 2 | 3 |
| | Most likely | 1 | 4 | 2 | 1 | 5 | 5 | 6 |
| | Pessimistic | 7 | 7 | 8 | 1 | 14 | 8 | 15 |

i) Draw the project network.

ii) Find the expected duration and variance of each activity.

iii) Calculate early and late occurance times for each event, what is the expected project length?

iv) Calculate the variance and standard deviation of project length? What is the probability that the project will be completed?

- at least 4 weeks earlier than expected?
- Not more than 4 weeks earlier than expected.

v) If the project due date is 19 weeks, what is the probability of meeting the due date.

**(12 Marks)**

8 a. The data on running costs per year and resale price of equipment A whose purchase price is 2 lakhs are as follows:

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Running costs in Lakhs | 0.30 | 0.38 | 0.46 | 0.58 | 0.72 | 0.90 | 1.10 |
| Resale value in Lakhs | 1 | 0.50 | 0.25 | 0.12 | 0.08 | 0.08 | 0.08 |

i) What is the optimum period of replacement?

ii) When equipment A is two years old, equipment B which is new model for the same usage is available. The optimum period for replacement is 4 years with an average cost of Rs.72000. Should equipment A be changed with equipment B? If so, when?

**(12 Marks)**

b. Why do we need to replace machines? List out different replacement strategies. Also explain in brief, various types of failures which are responsible for replacement of machines.

**(08 Marks)**

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