

25 (2) OPRE 205

2011

OPERATION RESEARCH

Paper : 205

( Old Syllabus )

Full Marks : 70

Time : 3 hours

*The figures in the margin indicate full marks  
for the questions*

Answer any **five** questions

- 1.** The Holiday Meal firm is considering buying two different brands of cattle feed and blending them to provide a good, low-cost diet for its cattle. Each feed contains, in varying proportions, some or all of the three ingredients essential for fattening cattle. Each kg of Brand 1 purchased contains 5 units of ingredient A, 4 units of ingredient B and  $\frac{1}{2}$  unit of ingredient C. Each kg of Brand 2 contains 10 units of ingredient A, 3 units of ingredient B but no ingredient C. The brand 1 feed costs the firm Rs 2 per kg and brand 2 feed costs Rs 3 per kg. The minimum monthly intake requirements for ingredients A, B and C are 90 units, 48 units and  $1\frac{1}{2}$  units respectively. The owner of the firm would like to determine the lowest-cost diet

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( Turn Over )

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that meets the minimum monthly intake requirements for each nutritional ingredient. Assist the owner to meet his objective.

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2. (a) "The assignment problem is a special case of linear programme." Explain.

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(b) Frontier Tyres Ltd. has four facilities located at Delhi (D), Lucknow (L), Bhopal (B) and Kanpur (K). The company has four major sources of raw materials for its plant at Chennai (C), Kolkata (KOL), Bangalore (BANG) and Mumbai (M).

The table below shows the annual requirements of the plants and annual capacity of raw material supplier along with the transportation cost of a unit load of raw material from a raw material supplier to a plant.

| Destination →<br>Source ↓ | D    | L    | B    | K    | Availability |
|---------------------------|------|------|------|------|--------------|
| C                         | 500  | 300  | 400  | 150  | 3500         |
| KOL                       | 700  | 600  | 300  | 450  | 1000         |
| BANG                      | 100  | 600  | 250  | 550  | 4500         |
| M                         | 200  | 700  | 400  | 750  | 2000         |
| Requirement               | 2500 | 1500 | 3000 | 4000 | 11000        |

(i) Using VAM, find the initial solution to the transportation problem.

(ii) Is the solution obtained in (i) optimal?

7+3=10

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Solve the following LPP using the simplex method :

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Maximize  $Z = 2x_1 + 4x_2$

Subject to

$2x_1 + x_2 \leq 18$

$3x_1 + 2x_2 \geq 30$

$x_1 + 2x_2 = 26$

$x_1, x_2 \geq 0$

4. (a) For an activity in a PERT network, the following information is available :

Expected time = 9.5 days

Optimistic time = 5 days

Variance = 6.25 days<sup>2</sup>

Calculate the most likely and pessimistic times of this activity.

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(b) The critical activities of a project, their expected durations and standard deviations (in weeks) are given as :

|                    |   |     |     |   |     |     |   |
|--------------------|---|-----|-----|---|-----|-----|---|
| Activity           | : | B   | E   | G | H   | K   | L |
| Expected Duration  | : | 12  | 3   | 8 | 7   | 5   | 6 |
| Standard Deviation | : | 2/3 | 1/3 | 2 | 5/3 | 4/3 | 0 |

Find the probability that the project will be completed in 45 weeks.

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(c) The following pairwise comparison matrices relate to two stocks A and B and two criteria, viz., Yield and Risk for evaluating the two stocks. You are required to compute the priorities for each pairwise comparison matrix :

|       | Criterion |      |
|-------|-----------|------|
|       | Yield     | Risk |
| Yield | 1         | 2    |
| Risk  | 1/2       | 1    |

|   | Yield |   |
|---|-------|---|
|   | A     | B |
| A | 1     | 3 |
| B | 1/3   | 1 |

|   | Risk |     |
|---|------|-----|
|   | A    | B   |
| A | 1    | 1/2 |
| B | 2    | 1   |

5. (a) What is an Integer Programming Problem? Give an example each of a 'pure' and 'mixed' integer linear programming problem. Describe a 0-1 integer programming problem.  $2+2+3=$
- (b) Determine the optimal sequence of performing 5 jobs on 4 machines. The machining of each job is required in the order ABCD and the process timings are as follows :

| Job | Machine |   |   |   |
|-----|---------|---|---|---|
|     | A       | B | C | D |
| 1   | 8       | 3 | 4 | 7 |
| 2   | 9       | 2 | 5 | 5 |
| 3   | 6       | 4 | 5 | 8 |
| 4   | 12      | 5 | 1 | 9 |
| 5   | 7       | 1 | 2 | 3 |

Also calculate the total elapsed time.

(a) Alpha construction company has five crews. The skills of the crews differ from one another because of the difference in the composition of the crews. The company has five different projects on hand. The times (in days) taken by different crews to complete different projects are summarized in the following table. Find the best assignment of the crews to different projects such that the total time taken is minimized :

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|      |   | Project |    |    |    |    |
|------|---|---------|----|----|----|----|
|      |   | A       | B  | C  | D  | E  |
| Crew | 1 | 20      | 30 | 25 | 15 | 35 |
|      | 2 | 25      | 10 | 40 | 12 | 28 |
|      | 3 | 15      | 18 | 22 | 32 | 24 |
|      | 4 | 29      | 8  | 34 | 10 | 40 |
|      | 5 | 35      | 23 | 17 | 26 | 45 |

(b) Higgins plumbing and Heating sells heaters to home owners. Data on sales over the past 50 weeks is as follows :

|                                     |   |   |   |   |    |   |   |    |
|-------------------------------------|---|---|---|---|----|---|---|----|
| Sales per week                      | : | 4 | 5 | 6 | 7  | 8 | 9 | 10 |
| No. of weeks (in which it was sold) | : | 6 | 5 | 9 | 12 | 8 | 7 | 3  |

Using the random numbers given below, simulate demand for 10 weeks and answer the following question :

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Random Numbers : 10 24 03 32 23 59 95 34 51 08

If Higgins maintain a constant supply of 8 heaters in any given week, how many times will there be stock-out?

7. Write short notes on (any two) :  $7 \times 2 = 14$

- (a) Sensitivity analysis in linear programming
- (b) Time-cost trade off in network analysis
- (c) Goal programming
- (d) Economic interpretation of the dual

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