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Course Code

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Seventh Semester B.E. Degree Examinations, February 2025

OPERATIONS RESEARCH

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Missing data, if any, may be suitably assumed

| <u>Q. No</u> | <u>Question</u> | <u>Marks</u> | <u>(RBTL:CO:PI)</u> |
|------------------------|---|--------------|---------------------|
| <u>Module-1</u> | | | |
| 1. | a. Define operations research and lists its applications in decision-making. | 04 | (2 :1: 1.2.1) |
| | b. Old hens can be brought at Rs.50/- each and young hens can be brought at Rs.100/- each. The old hens lay 3 eggs/week and young hens 5/week. Each egg cost Rs. 2. A hen cost Rs. 5/week to feed, if a person has only Rs.2000 to spend for hens, formulate the problem to decide how many of each kind of hens should be buy? And he cannot house more than 40 hens, formulate the problem a LPP model. | 08 | (2 :1: 1.3.1) |
| | c. Solve the following LPP by graphical method. Minimize $Z = 2X_1 + 1.7X_2$ subject to constraints: $0.15X_1 + 0.10X_2 \geq 1.0$ $0.7X_1 + 1.70X_2 \geq 7.5$ $1.30X_1 + 1.10X_2 \geq 10$ $X_1, X_2 \geq 0$ | 08 | (2 :1: 1.3.1) |
| (OR) | | | |
| 2. | a. What is the significance of introducing slack, surplus and artificial variables in LPP? | 06 | (2 :1: 1.2.1) |
| | b. Use Simplex Method to solve the following LPP Max. $Z = 2x_1 + 10x_2 + x_3$ subjected to constraints $5x_1 + 2x_2 + x_3 + S_1 \leq 15$ $2x_1 + x_2 + 7x_3 + S_2 \leq 20$ $x_1 + 3x_2 + 2x_3 + S_3 \leq 25$ $x_1, x_2, x_3 \geq 0$ | 14 | (2 :1: 1.3.1) |
| <u>Module-2</u> | | | |
| 3. | a. What do you understand by balanced and unbalanced transportation problem? How an unbalanced problem tackled? | 06 | (2 :2: 1.2.1) |
| | b. Find the optimum distribution arrangement and the total costs in the following transportation matrix by VAM and MODI method. All the cost elements are in rupees. | 14 | (2 :2: 1.3.1) |

| | P | Q | R | Supply |
|--------|------|------|------|--------|
| A | 5 | 6 | 5.5 | 2000 |
| B | 7 | 4 | 7 | 6000 |
| C | 5 | 7 | 3 | 5000 |
| D | 4 | 3 | 5 | 4000 |
| Demand | 6000 | 5000 | 6000 | |

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

(OR)

4. a. Given below is the time required in days when a particular software program module is assigned to a particular programmer. **10** (1 :2: 1.3.1)

| Programmers | | | | | |
|-------------|---|----|----|----|----|
| Modules | | A | B | C | D |
| | 1 | 12 | 10 | 8 | 9 |
| | 2 | 8 | 9 | 11 | 7 |
| | 3 | 11 | 14 | 12 | 10 |
| | 4 | 9 | 9 | 8 | 9 |

Assign modules to the different programmer in such a way that the total computing time is least.

- b. A company has team of four salesman and there are four districts where the company wants to start its business. The company estimates that the profit/day is given below. Find the assignment of salesman to districts which gives maximum profit. **10** (1 :2: 1.3.1)

| Districts | | | | | |
|-----------|---|----|----|-----|----|
| Salesman | | I | II | III | IV |
| | A | 16 | 10 | 14 | 11 |
| | B | 14 | 11 | 15 | 15 |
| | C | 15 | 15 | 13 | 12 |
| | D | 13 | 12 | 14 | 15 |

Module-3

5. a. Define the following terms in PERT/CPM: **08** (1 :3: 1.2.1)
(i) Critical Path (ii) Float /Slack (iii) Event (iv) Activity
b. A project consists of the following jobs and their duration. **12** (1 :3: 1.3.1)

| Activity | Precedence | Duration (in days) |
|----------|------------|--------------------|
| A | -- | 10 |
| B | A | 9 |
| C | A | 6 |
| D | B | 7 |
| E | B | 5 |
| F | C, D | 9 |
| G | E, F | 8 |

- (i) Draw a network diagram (ii) Identify the critical path
(iii) Find the project duration
(iv) Calculate the floats- Total Float, free float, independent float, interference float. (v) Compute slack time for each event.

(OR)

6. a. Define (i) Optimistic Time (ii) Pessimistic Time (iii) Most likely time. **06** (1 :3: 1.2.1)
b. The following table gives the activities in a construction project and other information: **14** (1 :3: 1.3.1)

| Activity | t _o | t _m | t _p | Activity | t _o | t _m | t _p |
|----------|----------------|----------------|----------------|----------|----------------|----------------|----------------|
| 1-2 | 1 | 2 | 3 | 5-7 | 4 | 5 | 6 |
| 2-3 | 1 | 2 | 3 | 6-7 | 6 | 7 | 8 |
| 2-4 | 1 | 3 | 5 | 7-8 | 2 | 4 | 6 |
| 3-5 | 3 | 4 | 5 | 7-9 | 4 | 6 | 8 |
| 4-5 | 2 | 3 | 4 | 8-10 | 1 | 2 | 3 |
| 4-6 | 3 | 5 | 7 | 9-10 | 3 | 5 | 7 |

(i) Draw a pert network (ii) identify the critical path and all the critical activities. (iii) Expected completion time of the project (iv) Find the probability that project will be completed in 30 days (v) what is the probability that project will be completed 3 days later than expected (vi) what is the probability that project will be completed 2 days earlier than expected.

Module-4

7. a. A Commercial bank has 3 cash paying assistants customers are found to arrive in a Poisson fashion at an average rate of 6/hr for business transaction. The service time is found to have an E.D with a mean of 18 min's. The customers are processed on FCFS basis. Calculate
 (i) Average number of customers in the system
 (ii) Average time a customer spends in the system
 (iii) Average queue length
 (iv) How many hours a week can a cash paying assistant spend with the customers. **10** (1 :4: 1.3.1)
- b. Arrivals at a telephone booth are considered to be Poisson at an average time of 8 min between our arrival and the next. The length of the phone call is distributed exponentially, with a mean of 4 min. Determine
 (i) Expected fraction of the day that the phone will be in use.
 (ii) Expected number of units in the queue.
 (iii) Expected waiting time in the queue.
 (iv) Expected number of units in the system.
 (v) Expected waiting time in the system. **10** (1 :4: 1.3.1)

(OR)

8. a. Solve the game by graphical method **10** (1 :4: 1.3.1)
- | | | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|
| | B1 | B2 | B3 | B4 | B5 |
| A1 | -5 | 5 | 0 | -1 | 8 |
| A2 | 8 | -4 | -1 | 6 | -5 |
- b. Solve the following payoff matrix for player A and B using dominance rule. **10** (1 :4: 1.3.1)

| | | | | |
|----------------|----------------|----------------|----------------|----------------|
| | B ₁ | B ₂ | B ₃ | B ₄ |
| A ₁ | 5 | -10 | 9 | 0 |
| A ₂ | 6 | 7 | 8 | 1 |
| A ₃ | 8 | 7 | 15 | 1 |
| A ₄ | 3 | 4 | -1 | 4 |

Module-5

9. a. Define the following: (i) Processing time (ii) Idle time of Machine (iii) Total elapsed time (iv) No passing rule. **08** (1 :5: 1.2.1)
- b. Find the sequence that minimizes the total elapsed time required to complete the following jobs. Each job processed in the order ACB. Processing time in hours. **12** (1 :5: 1.3.1)

| Job | A | B | C |
|-----|----|---|---|
| 1 | 12 | 7 | 3 |
| 2 | 6 | 8 | 4 |
| 3 | 5 | 9 | 1 |
| 4 | 11 | 4 | 5 |
| 5 | 5 | 7 | 2 |
| 6 | 7 | 8 | 3 |
| 7 | 6 | 3 | 4 |

(OR)

10. a. State the assumptions made while applying Johnson's rule for n jobs two machines. **06** (1 :5: 1.2.1)
- b. Use the graphical method to minimize the time needed to process the following jobs on the machines shown below. i.e. for each machine find the job which should be done first. Also calculate the total time needed to complete both the jobs. **14** (1 :5: 1.3.1)

| | | | | | | |
|--------------|------------------------------|----------|----------|----------|----------|----------|
| Job 1 | Sequence of Machines: | A | B | C | D | E |
| | Time | 2 | 3 | 4 | 6 | 2 |
| Job 2 | Sequence of Machines: | C | A | D | E | B |
| | Time | 4 | 5 | 3 | 2 | 6 |

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