(a) Calculate the variance and standard deviation of project length.
(b) What is the probability that the project will be completed 4 weeks earlier than expected?

Q.5 i. What are decision trees? How and in what type of situations are they employed for decision making? **4**

ii. A company management and the labour union are negotiating a new three year settlement. Each of these has 4 strategies: **6**

(a) Hard and aggressive bargaining (b) Reasoning and logical approach
(c) Legalistic strategy (d) Conciliatory approach

The cost to the company are given for every pair of strategy choice.

| Union Strategies | Company Strategies | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| I | 20 | 15 | 12 | 35 |
| II | 25 | 14 | 8 | 10 |
| III | 40 | 2 | 10 | 5 |
| IV | 5 | 4 | 11 | 0 |

What strategy will the two sides adopt? Also determine the value of game.

OR iii. What is simulation? Describe the Monte-Carlo method of simulation. Also, briefly describe its application to inventory problem. **6**

Q.6 Attempt any two:

i. State whether the following statements are correct: (Justify your comment in brief) **5**
(a) To protect against stock-outs a large batch size is required.
(b) EOQ is based on a balancing between inventory carrying cost and shortage cost.

ii. A company purchases 9000 parts of a machine for its annual requirement, ordering one month's usage at a time. Each part cost Rs.20. The ordering cost per order is Rs.15 and the carrying charges are 15% of the average inventory per year. As a materials manager, you are to suggest a more economical purchasing policy for the company. What advice would you offer and how much would it save the company per year? **5**

iii. The annual consumption of an item is 2000 items. The ordering cost is Rs.100 per order. The carrying cost is Rs0.80 per unit per year. Assuming working days as 200 lead time 20 days, and safety stock 100 units. Calculate: **5**
(a) EOQ
(b) The number of orders per year.
(c) Reorder level.
(d) The total annual ordering and carrying cost

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*Total No. of Questions: 6* *Total No. of Printed Pages:4*

**Enrollment No.....**

# Faculty of Engineering

## End Sem (Odd) Examination Dec-2019

## ME3EI02 Operations Research

Programme: B.Tech. Branch/Specialisation: ME

**Duration: 3 Hrs.** **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Who coined the term Operations Research? **1**
(a) J.F. McCloskey (b) F.N. Trefethen (c) P.F. Adams (d) Both (a) and (b)

ii. A minimization problem can be converted into a maximization problem by changing the sign of coefficients in the _____. **1**
(a) Constraints (b) Objective Functions
(c) Both (a) and (b) (d) None of these

iii. The solution of any transportation problem is obtained in how many stages? **1**
(a) Five (b) Four (c) Three (d) Two

iv. To make an unbalanced assignment problem balanced, what are added with all entries as zeroes? **1**
(a) Dummy rows (b) Dummy columns (c) Both (a) and (b) (d) Dummy entries

v. Which technique is used in finding a solution for optimizing a given objective, such as profit maximization or cost minimization under certain constraints? **1**
(a) Quailing Theory (b) Waiting Line
(c) Both (a) and (b) (d) Linear Programming

vi. Dummy activities: **1**
(a) Are found in both AOA and AON networks.
(b) Are used when two activities have identical starting and ending events.
(c) Have a duration equal to the shortest non-dummy activity in the network.
(d) Cannot be on the critical path.

vii. Game theory models are classified by the:
(a) Number of players (b) Sum of all payoffs
(c) Number of strategies (d) All of these

viii. What happens when maximin and minimax value of the game are same?
(a) No solution exists (b) Solution is mixed
(c) Saddle point exists (d) None of these

ix. The inventory management system where we receive orders on a regular schedule, but the quantity received varies is called_____. **1**

P.T.O.

(a) EOQ/ROP (b) Economic Lot Size
(c) Single Period Model (d) None of these

x. Which of the following actions would likely reduce a company's need for decoupling inventory? **1**
(a) Increasing the number of raw material suppliers.
(b) Determining whether customers would accept a smaller selection of merchandise.
(c) Implementing a preventative maintenance program.
(d) Reducing the incidence of shrinkage.

Q.2 i. What is unbound solution, and how does it occur in graphical method? **2**

ii. How a multiple optimal solution is recognized when using the simplex algorithm. **3**

iii. Solve the following LP graphically: **5**

Maximize z= 8000x1 + 7000x2

Subject to:

$3x1 + x2 \leq 66$

$x1 + x2 \leq 45$

$x1 \leq 20$

$x2 \leq 40$

$x1, x2 \geq 0$

OR iv. Solve the following LP problem using simplex method. **5**

Maximize z = 3x1 + 2x2 + 5x3

Subject to:

$x1 + 2x2 + x3 \leq 430$

$3x1 + 2x3 \leq 460$

$x1 + 4x2 \leq 420$

$x1, x2, x3 \geq 0$

Q.3 i. What is the difference between Assignment Problem and Transportation Problem? **2**

ii. A company has factories at F1, F2 & F3 which supply warehouses W1, W2 and W3. Weekly factory capacities are 200, 160 and 90 units respectively. Weekly warehouses requirements are 180, 120 and 150 units respectively. Unit shipping costs (in rupees) are as follows: **8**

Warehouse

| Factory | W1 | W2 | W3 | Supply |
|---|---|---|---|---|
| F1 | 16 | 20 | 12 | 200 |
| F2 | 14 | 8 | 18 | 160 |
| F3 | 26 | 24 | 16 | 90 |
| Demand | 180 | 120 | 150 | |



Determine the optimum distribution for this company to minimize the shipping cost.

OR iii. The Atal Indore transport service limited has different buses from 'A' to 'E' to cover five different routes, 'I' to 'V'. The cost operation per passenger in terms in rupees/km, in case of different buses and different routes is given below: **8**

| Bus | Routes | | | | |
|---|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** | **V** |
| **A** | 32 | 38 | 40 | 28 | 40 |
| **B** | 40 | 24 | 28 | 21 | 36 |
| **C** | 41 | 27 | 33 | 30 | 37 |
| **D** | 22 | 38 | 41 | 36 | 36 |
| **E** | 29 | 33 | 40 | 35 | 39 |

Suggest an assignment policy for different buses to different routes for minimize the total cost.

Q.4 i. Under what conditions would you recommend scheduling by PERT? **3**

ii. A typist at an office receives on the average 22 letters per day for typing. The typist works 8 hours a day and it takes on the average 20 minutes to type a letter. The company has determined that the cost of a letter waiting to be mailed (opportunity cost) is 80 paisa per hour and the equipment operating cost plus the salary of the typist will be Rs. 40 per day. **7**
(a) What is the typist's utilization rate?
(b) What is the average number of letters waiting to be typed?
(c) What is the average waiting time needed to have a letter typed?
(d) What is total daily cost of waiting letters to be mailed?

OR iii. A small project is composed of seven activities whose time estimates are listed in the table as follows: **7**

Estimated duration (weeks)

| Activity | Optimistic | Most likely | Pessimistic |
|---|---|---|---|
| 1-2 | 1 | 1 | 7 |
| 1-3 | 1 | 4 | 7 |
| 2-4 | 2 | 2 | 8 |
| 2-5 | 1 | 1 | 1 |
| 3-5 | 2 | 5 | 14 |
| 4-6 | 2 | 5 | 8 |
| 5-6 | 3 | 6 | 15 |

Draw the project network, and find the following:

# Marking Scheme
# ME3EI02 Operations Research

Q.1 i. Who coined the term Operations Research? **1**
(d) Both (a) and (b)

ii. A minimization problem can be converted into a maximization problem by changing the sign of coefficients in the _____. **1**
(b) Objective Functions

iii. The solution of any transportation problem is obtained in how many stages? **1**
(a) Five

iv. To make an unbalanced assignment problem balanced, what are added with all entries as zeroes? **1**
(c) Both (a) and (b)

v. Which technique is used in finding a solution for optimizing a given objective, such as profit maximization or cost minimization under certain constraints? **1**
(d) Linear Programming

vi. Dummy activities: **1**
(b) Are used when two activities have identical starting and ending events.

vii. Game theory models are classified by the:
(d) All of these

viii. What happens when maximin and minimax value of the game are same?
(c) Saddle point exists

ix. The inventory management system where we receive orders on a regular schedule, but the quantity received varies is called_____. **1**
(d) None of these

x. Which of the following actions would likely reduce a company's need for decoupling inventory? **1**
(c) Implementing a preventative maintenance program.

Q.2 i. Unbound solution 1 mark **2**
It occur in graphical method 1 mark

ii. How a multiple optimal solution is recognized when using the simplex algorithm. **3**

iii. Solve the following LP graphically: **5**
Drawing graph 3 marks
Finding answers 2 marks

OR iv. Solve the following LP problem using simplex method. **5**
First IBFS 1 mark
Second Feasible solution 2 marks
Optimum solution 2 marks

Q.3 i. Difference between Assignment Problem and Transportation Problem **2**

ii. Determine the optimum distribution for this company **8**
Finding IBFS by any method 3 marks
Applying Modi method 4 marks
Optimum solution 1 mark

OR iii. Converting into minimization problem 1 mark **8**
Finding IBFS 3 marks
Revised cost matrix 2 marks
Final Solution 2 marks

Q.4 i. Conditions for scheduling by PERT **3**
At least three conditions 1 mark for each (1 mark * 3)

ii. A typist at an office receives on the average 22 letters per day for typing. The typist works 8 hours a day and it takes on the average 20 minutes to type a letter. The company has determined that the cost of a letter waiting to be mailed (opportunity cost) is 80 paisa per hour and the equipment operating cost plus the salary of the typist will be Rs. 40 per day. **7**
(a) Typist's utilization rate 1 mark
(b) Average number of letters waiting to be typed 2 marks
(c) Average waiting time needed to have a letter typed 2 marks
(d) Total daily cost of waiting letters to be mailed 2 marks

OR iii. (a) Calculate the variance and standard deviation of project length 2 marks **7**
(b) Probability that the project will be completed 4 weeks earlier than expected
Drawing table 3 marks
Standard deviation 1 mark
Finding probability 1 mark

Q.5 i. Decision trees 2 marks **4**
Type of situations 2 marks

ii. Finding Union best strategy 2 marks **6**
Finding company's best strategy 2 marks
Finding value of game 2 marks

OR iii. Definition of simulation 2 marks **6**
Describing Monte-Carlo method 2 marks
Describing its application 2 marks

Q.6 Attempt any two:

i. (a) Explanation 2.5 marks **5**
(b) Explanation 2.5 marks

| | | | |
|---|---|---|---|
| ii. | EOQ | 1 mark | **5** |
| | Cmin (Corresponding annual cost) | 1 mark | |
| | Optimum ordering interval | 1 mark | |
| | Total annual cost | 1 mark | |
| | Net saving | 1 mark | |
| iii. | Calculate: | | **5** |
| | (a) EOQ | 1 mark | |
| | (b) The number of orders per year. | 1 mark | |
| | (c) Reorder level. | 1 mark | |
| | (d) The total annual ordering and carrying cost | 2 marks | |