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Question Paper Code	12417
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**B.E. / B.Tech. -DEGREE EXAMINATIONS, NOV / DEC 2023**  
Fourth Semester  
**Computer Science and Business Systems**  
**20BSMA405 - OPERATIONS RESEARCH WITH LABORATORY**  
(Regulations 2020)

Duration: 3 Hours

Max. Marks: 100

**PART-A (10 × 2 = 20 Marks)**

Answer ALL Questions

- |   | <i>Marks,<br/>K-Level, CO</i> |
|---|-------------------------------|
| 1. What is the role of decision making in operations research? Explain with suitable example.   | 2,K2,CO1                      |
| 2. Define feasible solution and optimal solution to the linear programming problem.   | 2,K1,CO1                      |
| 3. Define degeneracy in a transportation problem?   | 2,K1,CO3                      |
| 4. How do you convert an unbalanced assignment problem into a balanced?   | 2,K1,CO3                      |
| 5. Explain, what is ABC analysis?   | 2,K2,CO4                      |
| 6. A company uses rivets at the rate of 5000kg per year, rivets costing Rs.2 per Kg. It costs Rs.20 to place an order and carrying cost of inventory is 10% per year. How frequently should the order for rivets be placed and by how much? | 2,K2,CO4                      |
| 7. Define Balking in queuing system.  | 2,K1,CO5                      |
| 8. Explain Kendall's Notation.  | 2,K2,CO5                      |
| 9. State the differences between PERT and CPM.  | 2,K2,CO6                      |
| 10. Explain the term (i) Optimistic time (ii) pessimistic time  | 2,K1,CO6                      |

**PART - B (5 × 16 = 80 Marks)**

Answer ALL Questions

11. a) Garden Ltd. has two products Rose and Lotus. To produce one unit of Rose, 2 units of material X and 4 units of material Y are required. To produce one unit of Lotus, 3 units of material X and 2 units of material Y are required. At least 16 units of each material must be used in order to meet the committed sales of Rose and Lotus Cost per unit of material X and material Y are Rs.2.50 per unit and Rs.0.25 per unit respectively. You are required.
- (i) To formulate mathematical model.
- (ii) To solve it for the minimum cost (Graphically).

**OR**

- b) Solve the following Linear Programming Problem by Simplex Method 16,K3,CO1

$$\text{Minimise } Z = 16x_1 + 16x_2$$

Subject to

$$2x_1 + 4x_2 \geq 3$$

$$3x_1 + 2x_2 \geq 4$$

$$x_1, x_2 \geq 0$$

12. a) A company has four factories from which it ships its product units to four warehouses  $W_1, W_2, W_3$  and  $W_4$  which are the distribution centres. Transportation costs per unit between various combinations of factories ( $F_1, F_2, F_3$  &  $F_4$ ) and warehouses are given below 16,K3,CO3

	<b>W<sub>1</sub></b>	<b>W<sub>2</sub></b>	<b>W<sub>3</sub></b>	<b>W<sub>4</sub></b>	<b>Availabilities</b>
<b>F<sub>1</sub></b>	48	60	56	58	<b>140</b>
<b>F<sub>2</sub></b>	45	55	53	60	<b>260</b>
<b>F<sub>3</sub></b>	50	65	60	62	<b>360</b>
<b>F<sub>4</sub></b>	52	64	55	61	<b>220</b>
<b>Requirements</b>	<b>200</b>	<b>320</b>	<b>250</b>	<b>210</b>	

Find an Optimal Solution for this Transportation Problem.

**OR**

- b) Solve the following Assignment Problem of minimizing total time for doing all jobs 16,K3,CO3

<b>Operator</b>	<b>Job</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>1</b>	6	2	5	2	6
<b>2</b>	2	5	8	7	7
<b>3</b>	7	8	6	9	8
<b>4</b>	6	2	3	4	5
<b>5</b>	9	3	8	9	7
<b>6</b>	4	7	4	6	8

13. a) (i) A manufacturer has to supply his customer with 600 units of his product per year. Shortages are not allowed and storage cost amounts to 60 paise per unit per year. The set up cost is Rs.80, Find 8,K3,CO4
- EOQ
  - Minimum Average Yearly Cost
  - The Optimum number of order per day
  - The Optimum period of Supply per Optimum order
- The increase in the total cost associated with ordering 20% higher than EOQ.
- (ii) ABC manufacturing company purchase 9,000 parts of a machine for its annual requirement, ordering one month's usage at a time. Each part costs Rs. 20/-. The ordering cost per order is Rs. 15/- and the 8,K3,CO4

inventory carrying charges are 15% of the average inventory per year. You have been asked 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.

**OR**

- b) Find the optimal order quantity for a product for which the price breaks are as follows: 16,K3,CO4

Quantity	Price in Rs. Per unit
$0 \leq q < 100$	20
$100 \leq q < 200$	18
$200 \geq q$	16

The monthly demand for the product is 400 units. The storage cost is 20% of the unit cost and the ordering cost is Rs.25 per order.

14. a) Customers arrive at a one-man barber shop according to a Poisson process with a mean inter arrival time of 12 minutes. Customers spend an average of 10 minutes in the barber's chair. 16,K3,CO5
- (i) What is the expected number of customers in the barber's shop and in the queue?
  - (ii) Calculate the percentage of time an arrival can walk straight into the barber's chair without having to wait.
  - (iii) How much time can a customer expect to spend in the barber's shop?
  - (iv) Management will provide another chair and hire another barber, when a customer's waiting time in the shop exceeds 1.25 hour. How much must the average rate of arrivals increase to warrant a second barber?
  - (v) What is the average time customers spent in the queue?

**OR**

- b) In a railway marshalling yard, good train arrives at the rate of 30 trains per day. Assume that the inter arrival time follows an exponential distribution and the service time is also to be assumed as exponential with a mean of 36 minutes. Calculate (a) The probability that the yard is empty, (b) The average length assuming that the line capacity of the yard is 9 trains. 16,K3,CO5

15. a) A project consists of 9 jobs A to I with the following precedence relations and estimates of time. Draw the project network, Calculate the Critical Path and duration of the project. 16,K3,CO6

Job	A	B	C	D	E	F	G	H	I
<b>Predecessor</b>	-	-	A,	A,	B	D,	C,	D,	G,
<b>Time( in</b>	15	10	10	10	5	5	20	10	15

**OR**

- b) The activities of a project have the following PERT time estimates. *16,K3,CO6*  
Draw the project network and calculate the length and variance of the critical path.

<b>Job</b>	<b>Optimistic time</b>	<b>Most likely time</b>	<b>Pessimistic time</b>
1-2	3	6	15
1-6	2	5	14
2-3	6	12	30
2-4	2	5	8
3-5	5	11	17
4-5	3	6	15
6-7	3	9	27
5-8	1	4	7
7-8	4	19	28