Reg. No.												

Question Paper Code	12013

17 JUL 2023

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 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

		Marks, K-Level, CO
1.	State the limitations of the graphical method of solving a linear programming problem.	*2,K1,CO1*
2.	Define Slack and Surplus Variables.	*2,K1,CO1*
3.	Write the dual of the following primal Linear programming problem. Minimize $Z = 2x_1 + x_2$ Subject to, $3x_1 + x_2 \geq 3$, $4x_1 + 3x_2 \geq 6$, $x_1 + 2x_2 \geq 3$, *and* $x_1, x_2 \geq 0$.	*2,K2,CO2*
4.	What do you mean by balanced and unbalanced transportation problem?	*2,K2,CO2*
5.	Define Lead time in Inventory Control.	*2,K1,CO3*
6.	Define EOQ model.	*2,K1,CO3*
7.	State Kendall's Notation.	*2,K1,CO4*
8.	What is meant by queue discipline?	*2,K2,CO4*
9.	Define Pessimistic time in project network.	*2,K1,CO5*
10.	Construct the network diagram for the project whose activities are given below.	*2,K2,CO5*

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	3	8	12	6	3	3	8	5	3	8

PART - B (5 × 16 = 80 Marks)

Answer ALL Questions

11.	a)	Solve the following problem graphically Max $Z = 80x_1 + 55x_2$ Subject to $4x_1 + 2x_2 \leq 40$, $2x_1 + 4x_2 \leq 32$, $x_1 \geq 0, x_2 \geq 0$.	*16,K3,CO1*

OR

b) Solve the following LPP by simplex method *16,K3,CO1*

Maximize $Z = 2x - 3y + z$

Subject to,

$3x + 6y + z \leq 6$,

$4x + 2y + z \leq 4$,

$x - y + z \leq 3$,

$x \geq 0, y \geq 0, z \geq 0$.

12. a) Find the initial basic solution using the least cost method and Vogel's approximation method for the following transportation problem. *16,K3,CO2*

Factory	Stores				Demand
	S1	S2	S3	S4	
F1	1	3	4	5	28
F2	2	7	8	3	43
F3	1	4	5	7	37
Supply	27	32	24	25	

OR

b) A department has five employees with five jobs to be performed. The time (in hours) each man will take to perform each job is given in the matrix. Find the optimal assignment for employees. *16,K3,CO2*

Persons	Machines				
	M1	M2	M3	M4	M5
1	10	5	13	15	16
2	3	9	18	13	6
3	10	7	2	2	2
4	7	11	9	7	12
5	7	9	10	4	12

13. a) Find the optimal order quantity for a product for which the price breaks are as follows: *16,K3,CO3*

Quantity	**Unit Cost (Rs.)**
$0 < q < 100$	20.00
$100 \leq q < 200$	18.00
$q \geq 200$	16.00

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

OR

b (i) An aircraft company uses rivets at an approximate customer rate of 2,500kg per year. Each unit costs Rs 30 per kg and the company personnel estimate that it costs Rs 130 to place an order and that the carrying cost of inventory is 10 per cent per year. How frequently should orders for rivets be placed? Also, determine the optimum size of each order. *8,K3,CO3*

(ii) The daily demand of bread at a bakery follows a discrete distribution as follows: *8,K3,CO3*

S.No	Demand	Probability
1	25	0.2
2	26	0.11
3	27	0.1
4	28	0.09
5	29	0.08
6	30	0.12
7	31	0.14
8	32	0.05
9	33	0.04
10	34	0.04
11	35	0.03

The purchase price of the bread is Rs. 8 per packet. The selling price is Rs.11 per packet. If the bread packets are not sold within the day of purchase, they are sold Rs.4 per packet to hotels for secondary use. Find the optimal order size of the bread.

14. a) A petrol station has 4 pumps. The service times follow the exponential distribution with a mean of 6 minutes and cars arrive for service in a Poisson process at the rate of 30 cars per hour. *16,K3,CO4*
(i) What is the probability that an arrival would have to wait in line?
(ii) Find the average waiting time in the queue.
(iii) Find average time spent in the system.
(iv) Find the average number of cars in the system.

OR

b) Customers arrive at one-man barber shop according to a Poisson process with a mean Inter arrival time of 12 min. customers spend an average of 10 min. in the barber's chair. *16,K3,CO4*
1) What is the excepted number of customers in the barber shop and in the queue?
2) Calculate the percentage of time of arrival, can walk straight into the barber's chair without having to wait.
3) How much time can customer expect to spend in the Barber's shop?

15. a) Construct the network diagram for the project whose activities are given below. *16,K3,CO5*

Activity	1-2	1-3	1-5	2-3	2-4	3-4	3-5	3-6	4-6	5-6
Duration	8	7	12	4	10	3	5	10	7	4

Calculate the total float, free float and independent float for the project. Hence determine the critical path and project duration.

OR

b) Construct the network for the project whose activities and the three-time estimates of these activities (in weeks) are given below. Compute *16.K3.CO5*

1) Expected duration of each activity,
2) Expected variance of each activity,
3) Expected variance of the project length.

Activity	t_0	t_m	t_p
1 – 2	3	4	5
2 – 3	1	2	3
2 – 4	2	3	4
3 – 5	3	4	5
4 – 5	1	3	5
4 – 6	3	5	7
5 – 7	4	5	6
6 – 7	6	7	8
7 – 8	2	4	6
7 – 9	1	2	3
8 – 10	4	6	8
9 – 10	3	5	7