Reg. No.															

Question Paper Code	12756

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Fourth Semester

Computer Science and Business Systems

20BSMA405 - OPERATIONS RESEARCH WITH LABORATORY

Regulations - 2020

(Use of Statistical Table is permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Solve the following LPP problem by graphical method: Max z = 6x + 4y s.t. $x + y \leq 5, y \geq 8,\ x, y \geq 0$.	2	K3	CO1
2.	Define slack and surplus variables.	2	K1	CO1
3.	Obtain the dual of the following L.P.P. Max $z = 30x_1 + 23x_2 + 29x_3$ subject to $6x_1 + 5x_2 + 3x_3 \leq 26, 4x_1 + 2x_2 + 5x_3 \leq 7,\ x_1, x_2, x_3 \geq 0$.	2	K3	CO2
4.	How will you identify that a Transportation Problem has got an alternate optimal solution?	2	K2	CO2
5.	Define the following terms: Lead time, shortage cost.	2	K1	CO3
6.	Calculate the EOQ in units for an item A whose ordering cost is Rs. 5, Unit price is Re. 1, holding cost is 10% of the cost of the item, annual demand is 400 items and shortage cost is not allowed?	2	K3	CO3
7.	Customers arrive at a sales counter manned by a single person according to a Poisson process with a mean rate of 20 per hour. The time required to serve a customer has an exponential distribution with a mean of 100 seconds. Find the average waiting time of a customer in the system.	2	K3	CO4
8.	State Little's formula.	2	K1	CO4
9.	A Project consists of a series of tasks labelled A, B,…. , I with the following relationships. Draw the network diagram $A < D, E\ ;\ B, D < F\ ;\ C < G\ ;\ B < H\ ;\ F, G < I$.	2	K3	CO5
10.	Explain the concept of crashing.	2	K2	CO5

PART - B (5 × 16 = 80 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Solve the following Linear Programming Problem: Maximize $Z = 3x_1 + 2x_2 + 5x_3$ subject to $x_1 + x_2 + x_3 \leq 9;$ $2x_1 + 3x_2 + 5x_3 \leq 30;$ $2x_1 - x_2 - x_3 \leq 8;$ $x_1, x_2, x_3 \geq 0.$	16	K3	CO1

Find the alternate solution if exists.

OR

b) Solve the following linear programming problem: *16 K3 CO1*

Maximize $Z = 2x_1 + x_2 + x_3$

subject to $4x_1 + 6x_2 + 3x_3 \leq 8$,

$3x_1 - 6x_2 - 4x_3 \leq 1$,

$2x_1 + 3x_2 - 5x_3 \geq 4$;

$x_1, x_2, x_3 \geq 0$.

Find the alternate solution if exists.

12. a) Solve the following transportation problem: A company operates three coal mines A,B and C which provide 400, 500, 700 ton respectively per week. Orders for 500, 400, 300,300 and 600 ton per week have been received from customers C_1, C_2, C_3, C_4 and C_5 respectively. Transportation cost in Rs. per ton from each mine to each customer are given below: *16 K3 CO2*

	C_1	C_2	C_3	C_4	C_5	supply
A	4	16	1	16	14	400
B	18	10	8	12	12	500
C	6	1	4	13	2	700
Demand	500	400	300	300	600	

Find the weekly shipping schedule which minimizes the total expenses.

OR

b) A company operates in four territories, and four salesmen available for an assignment. The territories are not equally rich in their sales potential. It is estimated that a typical salesman operating in each territory would bring in the following annual sales: *16 K3 CO2*

Territory	I	II	III	IV
Annual Sales (Rs.)	126000	105000	84000	63000

The four salesmen also differ in their ability. It is estimated that, working under the same conditions, their yearly sales would be proportionately as follows:

Salesmen:	A	B	C	D
Proportion:	7	5	5	4

Find the maximum expected total sales using the assignment technique.

13. a) i) A particular item has a demand of 9000 units per year. The cost of one procurement is Rs. 100 and the holding cost per unit is Rs. 2.40 per year. The replacement is instantaneous and no shortages are allowed. Determine *8 K3 CO3*

(1) the economic lot size,

(2) the number of orders per year,

(3) the time between orders

(4) the total cost per year if the cost of one unit is Rs. 1.

a) ii) A firm uses every year 12000 units of a raw material costing Rs. 1.25 per unit. Ordering cost is Rs. 15 per order and the holding cost is 5% per year of average inventory. *8 K3 CO3*

(1) Find the economic order quantity.

(2) The firm follows E.O.Q. purchasing policy. It operates for 300 days per year. Procurement time is 14 days and safety stock is 400 units. Find the reorder point, the maximum inventory and the average inventory.

OR

b) i) A particular item has a demand of 9,000 units / year. The cost of one procurement is Rs. 100 and holding cost per unit is Rs. 2.40 per year. The replacement is instantaneous, and the shortage cost is Rs. 5 per unit per year. Determine *8 K3 CO3*

(1) the economic lot size

(2) the number of orders per year

(3) the time between orders

(4) the total cost per year if the cost of one unit is Re. 1.

b) ii) The annual demand for a product is 64000 units. The buying cost per order is Rs.10 and the estimated cost of carrying one unit in stock for a year is 20%. The normal price of the product is Rs.10 per unit. However, the supplier offers a quantity discount of 2% on an order of at least 1000 units at a time, and a discount of 5% if the order is for at least 5000 units. Suggest the most economic purchase quantity per order. *8 K3 CO3*

14. a) i) Arrivals at a telephone booth are considered to be Poisson, with an average of time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean 3 minutes. Then, *8 K3 CO4*

(1) What is the probability that a person arriving at the booth will have to wait in the queue?

(2) Find the average number of persons waiting in the system and in the queue.

(3) Find the average waiting time of customers in the queue and system

(4) The telephone department will install a second booth, when convinced that an arrival has to wait on the average for at least 3 minutes of the phone. By how much the flow of arrivals should increase in order to justify a second booth?

ii) A dress shop has 3 sales persons. Assume that the arrivals follow Poisson pattern with an average of 10 minutes between arrivals. Also assume that any salesperson can provide the desired service for any customer. If the time to provide service for a customer is exponentially distributed with a mean of 20 minutes per customer, calculate $E(N_s)$, $E(N_q)$, $E(W_s)$, $E(W_q)$ and P_n for $n=0, 1, 2$. *8 K3 CO4*

OR

b) i) A TV repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in the order in which they came in and if the arrival of sets is approximately Poisson with an average rate of 10 sets per 8 hours a day. *8 K3 CO4*

1. What is the repairman's expected idle time each day?
2. How many jobs are ahead on the average for the set just brought in?
3. What is the average waiting time of a new arrival in the system?

ii) Patients arrive at a clinic according to Poisson distribution at the rate of 30 per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate 20 per hour. *8 K3 CO4*

1. Find the effective arrival rate at the clinic.
2. What is the probability that an arriving patient will not wait?
3. What is the expected waiting time until a patient is discharged from the clinic?

15. a) Draw a network diagram corresponding to the following information. Find the critical path. Compute total, free and independent floats. *16 K3 CO5*

Activity	1 – 2	1 – 3	2 – 6	3 – 4	3 – 5	4 – 6	5 – 6	5 – 7	6 – 7
Duration (Days)	4	6	8	7	4	6	5	19	10

OR

b) The following table gives the data for the activities of a small project: *16 K3 CO5*

Job (i – j)	Time in days		
	t_o	t_m	t_p
1 - 2	1	4	7
1 - 3	5	10	17
2 - 4	3	3	3
2 - 6	1	4	7
3 - 4	8	15	26
3 - 5	2	4	8
4 - 5	5	5	5
5 - 6	2	5	8

1. Draw the network and find the expected project completion time.
2. What is the probability that it would take 5 days more than the expected duration?
3. Find the project completion time which will have 95% confidence.
4. Calculate the standard deviation and variance of the project length.