Reg. No.															

Question Paper Code	13580

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

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 (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	A solution in which none of the basic variables is zero is called as (a) Degenerate (b) Non degenerate (c) Bounded (d) convex	1	K1	CO1
2.	The feasible region of an LPP is always (a) Convex (b) Concave (c) Bounded (d) Unbounded.	1	K1	CO1
3.	Degeneracy in a $m \times n$ transportation problem occurs when the number of occupied cells is (a) More than $m+n-1$ (b) Less than $m+n-1$ (c) Equal to $m+n-1$ (d) less than $m+n$	1	K1	CO2
4.	An alternative optimal solution to a minimization transportation problem exists whenever opportunity cost corresponding to unused route of transportation is: (a) Positive & greater than zero (b) Positive with at least one equal to zero (c) Negative with at least one equal to zero (d) None of the above	1	K1	CO2
5.	The formula for EOQ under purchasing model without shortages is (a) $EOQ = \sqrt{\frac{2C_3R}{C_1}}$ (b) $EOQ = \sqrt{2C_1C_3R}$ (c) $EOQ = \sqrt{\frac{2C_1R}{C3}}$ (d) $EOQ = \sqrt{\frac{2C_3}{C_1R}}$	1	K1	CO3
6.	The following classes of costs are usually involved in inventory decisions except (a) Cost of ordering (b) Carrying Cost (c) Cost of shortages (d) Machining cost	1	K1	CO3
7.	A person who leaves the queue by losing his patience to wait is said to be (a) Reneging (b) Balking (c) Jockeying (d) Collusion.	1	K1	CO4
8.	The expected waiting time in the system of $(M/M/1)$: $(\infty/FIFO)$ is (a) $W_s = \frac{L_s}{\lambda}$ (b) $W_s = \frac{L_q}{\lambda}$ (c) $W_s = \frac{\mu}{\mu-\lambda}$ (d) $W_s = \frac{\lambda}{\mu-\lambda}$	1	K1	CO4
9.	The activities A, B and C are the direct precursors of Y. Then the earliest starting time for Y if the three activities' earliest finishing times are 12, 15, and 10 is (a) 10 (b) 15 (c) 12 (d) Impossible to say	1	K1	CO5
10.	A PERT stands for (a) Programme Evaluation Review Technique (b) Evaluation of Programme and Robotics (c) Technology of Programme Evaluation and Rating (d) Critical Path method	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	Use the graphical method to solve the following LPP: $Max\ Z = 8x + y$ $subject\ to\ x + y \le 40,\ 2x + y \le 60,\ x, y \ge 0.$	2	K2	CO1
12.	What are the characteristic of LPP?	2	K1	CO1

13.	With reference to simplex table, when does a unique optimal solution exist?	2	K2	CO1
14.	What are the methods used in transportation problem to obtain the initial basic feasible solution?	2	K1	CO2
15.	How do you convert an unbalanced transportation problem into a balanced?	2	K2	CO2
16.	What are the costs involved in inventory?	2	K1	CO3
17.	Define lead time, Reorder level.	2	K1	CO3
18.	The annual demand for an item is 3200 units. The unit cost is Rs.6 and inventory carrying charges are 25% per annum. If the cost of the procurement is Rs.150, determine economic order quantity.	2	K2	CO3
19.	What are the characteristics of a queuing system?	2	K1	CO4
20.	State the Kendal's notation for representing Queuing models.	2	K1	CO4
21.	Differentiate between PERT and CPM.	2	K2	CO5
22.	Define Free float, Independent float and Total float.	2	K1	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Use Simplex method to solve the LPP — 11 K3 CO1

Maximize $Z = 3x_1 + 2x_2 + 5x_3$

Subject to $x_1 + 4x_2 \leq 420$,

$3x_1 + 2x_3 \leq 460$,

$x_1 + 2x_2 + x_3 \leq 430$,

$x_1, x_2, x_3 \geq 0$.

OR

b) Solve the LPP: — 11 K3 CO1

Maximize $Z = 2x_1 + 3x_2 + 4x_3$

subject to

$3x_1 + x_2 + 4x_3 \leq 600$,

$2x_1 + 4x_2 + 2x_3 \geq 480$,

$2x_1 + 3x_2 + 3x_3 = 540$; $x_1, x_2, x_3 \geq 0$.

24. a) Solve the transportation problem — 11 K3 CO2

		Destination				
Origin		1	2	3	4	Supply
	1	21	16	25	13	11
	2	17	18	14	23	13
	3	32	27	18	41	19
	Demand	6	10	12	15	

OR

b) Use dual simplex method to solve — 11 K3 CO2

Maximize $z = -2x_1 - x_3$

subject to

$x_1 + x_2 - x_3 \geq 5$

$x_1 - 2x_2 + 4x_3 \geq 8$

x_1 , x_2 , $x_3 \geq 0$.

25. a) A manufacturer has to supply his customer with 600 units of his product per year. Shortage is not allowed and storage cost amounts to 60 paise per unit per year. The set up cost is Rs.80. Find *11 K3 CO3*
(i) the economic order quantity
(ii) the minimum average yearly cost
(iii) the optimum number of orders per year
(iv) the optimum period of supply per optimum order.

OR

b) The demand for an Item is 18,000 units per year. The holding cost per unit time is Rs.120 and the cost of shortage is Rs.5.00, the production cost is Rs. 400. Assuming that replenishment rate is Instantaneous, determine the optimal order quantity. *11 K3 CO3*

26. a) Cars arrive at a petrol pump, having one petrol unit, in Poisson fashion with an average of 10 cars per hour. The service time is distributed exponentially with a mean of 3 minutes. Find (i) average number of cars in the system (ii) average waiting tie in the Queue (iii) average Queue length (iv) the probability that the number of cars in the system is 2. *11 K4 CO4*

OR

b) A supermarket has two girls ringing up sales at the counters. If the service time for each customer is exponential with mean 4 minutes, and if the people arrive in a Poisson fashion at the rate of 10 per hour. *11 K4 CO4*
(i) What is the probability of having to wait for service?
(ii) What is the expected percentage of idle time for each girl?
(iii) If a customer has to wait, what is the expected length of his waiting time?

27. a) Construct the network for the project whose activities are given below and compute the total, free and independent flow of each activity and hence determine the critical path and the project duration. *11 K4 CO5*

Activity	1-2	1-3	1-5	2-3	2-4
Duration (in weeks)	8	7	12	4	10
Activity	3 - 4	3-5	3-6	4-6	5-6
Duration (in weeks)	3	5	10	7	4

OR

b) Construct the network for the project whose activities and the three time estimates of these activities (in weeks) are given below. Compute *11 K4 CO5*
(i) Expected duration of each activity
(ii) Expected variance of each activity
(iii)What is the probability that the project will be completed in 27 days

Activity	1-2	1-3	1-4	2-5	2-6	3-6	4-7	5-7	6-7
t_0	3	2	6	2	5	3	3	1	2
t_m	6	5	12	5	11	6	9	4	5
t_p	15	14	30	8	17	15	27	7	8

28. a) (i) A batch of 4 jobs can be assigned to 5 different machines. The set up time in hours for each job on various machines is given below: *6 K3 CO2*

Jobs	Machines					
		A	B	C	D	E
	1	10	11	4	2	8
	2	7	11	10	14	12
	3	5	6	9	12	14
	4	13	15	11	10	7

Find the optimal assignment of jobs to machines which will minimize the total set up time.

(ii) A petrol station with only one pump can accommodate 5 cars. The arrival of cars is Poisson with a mean rate of 10 per hour. The service time is exponentially distributed with a mean 2 minutes. *5 K3 CO4*

(a) How many cars are in the petrol pump on an average?

(b) Find the expected number of cars waiting for service.

OR

b) (i) The processing time in hours for the jobs when allocated to the different machines is indicated below. Assign the machines for the jobs so that the total processing time is minimum. *6 K3 CO2*

Jobs	Machines					
		M_1	M_2	M_3	M_4	M_5
	J_1	9	22	58	11	19
	J_2	43	78	72	50	63
	J_3	41	28	91	37	45
	J_4	74	42	27	49	39
	J_5	36	11	57	22	25

(ii) One-person barber shop has 6 chairs to accommodate people waiting for a haircut. Assume that customers who arrive when all the 6 chairs are full leave without entering the barber shop. Customers arrive at the average rate of 3 per hour and spend an average of 15 minutes in the barber's chair which is exponentially distributed. *5 K3 CO4*

(a) What is the probability that a customer can get directly into the barber's chair upon arrival?

(b) What is the expected number of customers waiting for a haircut?