Reg. No.																

Question Paper Code	12972

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Fourth Semester

Computer Science and Business Systems

20BSMA405 - OPERATIONS RESEARCH WITH LABORATORY

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	In Degenerate solution, the value of objective function (a) increases infinitely (b) basic variables are nonzero (c) decreases infinitely (d) One or more basic variables are zero	1	K1	CO1
2.	Graphical method of linear programming is useful when the number of decision variables is (a) 2 (b) 3 (c) finite (d) infinite	1	K1	CO1
3.	In Linear Programming Problem, maximization case if $(Zj - Cj) \geq 0$, then (a) It has basic feasible solution (b) Basic feasible solution is optimum (c) Infeasible solution (d) Unbounded solution	1	K1	CO1
4.	If an artificial variable is present in the basic variable column of optimal simplex table, then the solution is (a) alternative (b) bounded (c) no solution (d) infeasible	1	K1	CO1
5.	The concept of duality in Linear Programming involve (a) Solving a problem twice for verification (b) Solving two related linear programming problems where the solution to one provides information about the other (c) Using two types of variables in the same problem (d) Converting a linear problem to a non-linear problem	1	K1	CO2
6.	An optimal solution of an assignment problem can be obtained only if (a) Each row & column has only one zero element (b) Each row & column has at least one zero element (c) The data is arrangement in a square matrix (d) The data is arrangement in a non-square matrix	1	K1	CO2
7.	The solution to a transportation problem with m-rows (supplies) and n-columns (destination) is feasible if the number of positive allocations are (a) $m+n$ (b) $m \times n$ (c) $m+n-1$ (d) $m+n+1$	1	K1	CO2
8.	An optimal solution of an assignment problem can be obtained only if (a) Each row & column has only one zero element (b) Each row & column has at least one zero element (c) The data is arrangement in a square matrix (d) The data is arrangement in a non-square matrix	1	K1	CO2
9.	In ABC analysis, which category represents items that have the highest annual consumption value? (a) Category A (b) Category B (c) Category C (d) Category D	1	K1	CO3
10.	What does EOQ (Economic Order Quantity) aim to minimize? (a) Production costs (b) The total cost of inventory, including ordering and holding costs (c) Shipping costs (d) Stock out costs	1	K1	CO3

11. In the Production Order Quantity (POQ) model, inventory is: *1 K1 CO3*
    (a) Delivered all at once
    (b) Produced and added gradually over time
    (c) Reordered in fixed quantities
    (d) Always kept at a safety stock level
12. In queuing theory, the term "arrival rate" represent *1 K1 CO4*
    (a) The number of customers served by the system per unit time.
    (b) The average time a customer spends in the queue.
    (c) The rate at which customers arrive at the service facility.
    (d) The probability of a customer leaving the queue without being served.
13. A queuing system using Kendall's notation is expressed in the symbolic form as (M/M/3):(6/FCFS). The number of servers in the system is _____ *1 K2 CO4*
    (a) 3 (b) 6 (c) 9 (d) infinity
14. In a given (M/M/1):(∞/FCFS) queue, $\rho = 0.7$, The mean number of customers in the system is_____ *1 K2 CO4*
    (a) 2.33 (b) 0.41 (c) 0.3 (d) 3.33
15. In $(M/M/c)$: $(\infty/FIFO)$ queueing model, Waiting time in the queue W_q =_____ *1 K1 CO4*
    (a) $L_q + \lambda$ (b) $L_q - \lambda$ (c) $L_q \lambda$ (d) $\frac{L_q}{\lambda}$
16. An activity which starts immediately after one or more of the other activities are completed is known as _____ *1 K1 CO5*
    (a) Successor activity (b) Predecessor activity (c) Dummy activity (d) activity event
17. Critical path method is good for _____ *1 K1 CO5*
    (a) Small project only (b) Large project only
    (c) Both small and large projects equally (d) Neither small nor large project
18. PERT is used in the preparation of _____ *1 K1 CO5*
    (a) Budgeting (b) Scheduling (c) Evaluating (d) Finalizing
19. _____ is a type of activity that does not require any resources or time. *1 K1 CO6*
    (a) there is no activity (b) a dummy activity (c) the preceding activity (d) unique action
20. " If t_0, t_m and t_p are the optimistic time, most likely time and pessimistic time estimates of an activity then the expected time duration t_e is given by *1 K1 CO6*
    (a) $\frac{t_0+4t_m+t_p}{6}$ (b) $t_0 + 4t_m + t_p$ (c) $\frac{t_0+4t_m+t_p}{4}$ (d) $\frac{t_0+4t_m+t_p}{2}$

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Write the scope of Operations Research. *2 K1 CO1*
22. Explain Slack Variable in Linear Programming Problem. *2 K1 CO1*
23. Define balanced & unbalanced assignment problem. *2 K1 CO2*
24. Define basic feasible solution of a transportation problem. *2 K1 CO2*
25. Define lead time. *2 K1 CO3*
26. Write any two limitation of EOQ formula. *2 K1 CO3*
27. Write the Little's formula for Monrovian models of infinite capacity. *2 K1 CO4*
28. State the various disciplines in queuing model. *2 K1 CO4*
29. Distinguish between PERT and CPM. *2 K2 CO5*
30. Define independent float. *2 K1 CO6*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Solve the following Linear Programming Problem by graphical method. *10 K3 CO1*
    Max $Z = 3x_1 + 2x_2$
    Subject to, $-2x_1 + x_2 \leq 1$, $x_1 \leq 2$, $x_1 + x_2 \leq 3$ and $x_1, x_2 \geq 0$

OR

b) Solve the LPP using Big M method: *10 K3 CO1*

Maximize $Z = 2x_1 + x_2 + x_3$
subject to,
$4x_1 + 6x_2 + 3x_3 \leq 8$,
$3x_1 - 6x_2 - 4x_3 \leq 1$,
$2x_1 + 3x_2 - 5x_3 \geq 4$
$x_1, x_2, x_3 \geq 0$.

32. a) Apply principle of duality to solve the LPP *10 K3 CO2*

Maximize $Z = 3x_1 + 2x_2$
subject to,
$x_1 + 2x_2 \leq 10$,
$x_1 + x_2 \leq 7$,
$x_1 + x_2 \geq 1$,
$x_2 \leq 3$,
$\boldsymbol{x_1, x_2 \geq 0}$ **.**

OR

b) Using dual simplex method solve the LPP *10 K3 CO2*

Maximize $Z = 6x_1 + 4x_2 + 4x_3$
subject to
$3x_1 + x_2 + 2x_3 \geq 2$,
$2x_1 + x_2 - x_3 \geq 1$,
$-x_1 + x_2 + 2x_3 \geq 1$,
$x_1, x_2, x_3 \geq 0$.

33. a) A marketing manager has five salesmen and five sales districts. Considering the capabilities of the salesmen and the nature of districts, the marketing manager estimates that the sales per month (in hundred rupees) for each salesman in each district would be as follows: *10 K3 CO3*

	Districts					
		A	B	C	D	E
Salesmen	1	32	38	40	28	40
	2	40	24	28	21	36
	3	41	27	33	30	37
	4	22	38	41	36	36
	5	29	33	40	35	39

Find the assignment of salesmen to districts that will result in maximum sales.

OR

b) Determine basic feasible solution to the following transportation problem using Least cost method. *10 K3 CO3*

	A	B	C	D	Supply
P	1	2	1	4	30
Q	3	3	2	1	50
R	4	2	5	9	20
Demand	20	40	30	10	

34. a) 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 *10 K3 CO4*

(i) the economic lot size,
(ii) the number of orders per year,
(iii) the time between orders
(iv) the total cost per year if the cost of one unit is Re. 1.

OR

b) Find the optimal quantity for a product where the annual demand for the product is 500 units. The cost of shortage per unit per year is 10% of the unit cost and the ordering cost per order is Rs.180. The unit costs are given below. *10 K3 CO4*

Quantity	Unit cost (Rs)
$0 \leq q_1 \leq 500$	25
$500 \leq q_2 < 1500$	24.80
$1500 \leq q_3 < 3000$	24.60
$3000 \leq q_4$	24.40

35. a) 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, *10 K3 CO5*
   (i) What is the probability that a person arriving at the booth will have to wait in the queue?
   (ii) Find the average number of persons waiting in the system.
   (iii) Estimate the fraction of a day that the phone will be idle.
   (iv) What is the average length of the queue that forms from time to time?
   (v) What is the probability that the waiting time in the system is more than 10 minutes?

OR

b) A supermarket has 2 girls attending to sales at the counters. If the service time for each customer is exponential with mean 4 min and if people arrive in Poisson fashion at the rate of 10 per hour, *10 K3 CO5*
   (i) What is the probability that a customer has to wait for service?
   (ii)What is the expected percentage of idle time for each girl?
   (iii) If the customer has to wait in the queue, what is the expected length of his waiting time?

36. a) Construct the network for the project whose activities are given below. *10 K3 CO6*

Activity	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration (Weeks)	15	15	3	5	8	12	1	14	3	14

Compute Total, free and independent float of each activity and hence determine the Critical Path.

OR

b) The following time-cost table (Time in Days, Cost in Rs.) applied to a project. Use it to arrive at the network associated with completing the project in minimum time at minimum cost. *10 K3 CO6*

Activity	**Normal**		**Crash**	
	Time	**Cost**	**Time**	**Cost**
1 – 2	2	800	1	1400
1 – 3	5	1000	2	2000
1 – 4	5	1000	3	1800
2 – 4	1	500	1	500
2 – 5	5	1500	3	2100
3 – 4	4	2000	3	3000
3 – 5	6	1200	4	1600
4 – 5	3	900	2	1600

Find the least duration to complete project and its associated cost.