U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 22IM5PCOPR **Max Marks: 100**
Course: Operations Research

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	What is the methodology of Operation Research? A manufacturer produces nuts and bolts. It takes 1 hour of work on machine A and 3 hours on machine B to produce a package of nuts. It takes 3 hours on machine A and 1 hour on machine B to produce a package of bolts. He earns a profit of Rs 17.50 per package on nuts and Rs 7.00 per package on bolts. How many packages of each should be produced each day so as to maximize his profit, if he operates his machines for at the most 12 hours a day? i) Formulate a Linear programming model for this problem ii)Use graphical method to solve this problem	*CO1* *CO2*	*PO1* *PO2*	**10**
	b)	Solve the following LPP using simplex method and find the optimal solution Maximize $Z= 2 x_1 +5 x_2$ Subjected to constraints $x_1 \leq 4$, $x_2 \leq 3$, $x_1 + x_2 \leq 6$ and $x_2 \geq 0$	*CO2*	*PO2*	**10**
		OR			
2	a)	With an example describe how the primal can be converted into the dual problem in LPP	*CO1*	*PO1*	**08**
	b)	Solve the following LPP by dual simplex method Min $Z = 5 x_1 + 6 x_2$ Subjected to constraints $x_1 + x_2 \geq 2$ $4x_1 + x_2 \geq 4$ and $x_1, x_2 \geq 0$	*CO2*	*PO2*	**12**

			UNIT - II			
	3	a)	The transportation problem with the supply and demand for following matrix is given in the below table, find the initial basic feasible solution only by using Vogel's approximation method |	1	2	3	4	Supply
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A	19	30	50	12	**7**
B	70	30	40	60	**10**
C	40	10	60	20	**18**
Demand	**5**	**8**	**7**	**15**		 *CO3*	*PO2*	**08**
		b)	A small garment making has five designers designing five different types of garments, All the five designers are capable of designing all the five types of garments. The output per day per designer and the profit (₹) for each type of garment is given below. | Designers	Garments				
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	1	2	3	4	5
A	**7**	**9**	**4**	**8**	**6**
B	**4**	**9**	**5**	**7**	**8**
C	**8**	**5**	**2**	**9**	**8**
D	**6**	**5**	**8**	**10**	**10**
E	**7**	**8**	**10**	**9**	**9**
Profit (₹)per garment	2	3	2	3	4	 Which type of garment should be assigned to which designer in order to maximize the profit, assuming that there are no other constraints? *CO4*	*PO2*	**12**
			OR			
	4	a)	In the modification of a plant layout of a factory four new machines M1, M2, M3 and M4 are to be installed in a machine shop. There are five vacant places A, B, C, D and E available. Because of limited space, machine M2 cannot be placed at C and M3 cannot be placed at A. The cost of locating a machine at a place (in hundred rupees) is as follows: *CO3*	*PO2*	**10**

					Location					
					A	B	C	D	E	
			Machine	M1	9	11	15	10	11	
				M2	12	9	--	10	9	
				M3	--	11	14	11	7	
				M4	14	8	12	7	8	
			Find the optimal assignment that will result in minimum total cost.							
	b)	Determine the optimal route that minimizes the route cost.							*CO3*	*PO2*	**10**

	A	*B*	*C*	*D*	*E*
A	M	5	8	4	5
B	5	M	7	4	5
C	8	7	M	8	6
D	4	4	8	M	8
E	5	5	6	8	M

		UNIT - III			
5	a)	Describe the Kendall's notation for representing queuing model.	*CO1*	*PO1*	**04**
	b)	A petrol station has two pumps. The time follows the exponential distribution but with mean of 4 minutes and cars arrive for service in a Poisson s distribution at the rate of 10 cars per hour. Find the probability that a customer has to wait for service. What proportion of time the pumps remain idle.	*CO4*	*PO2*	**08**
	c)	In a railway marshalling yard, goods train arrive at the rate of 30 trains per day. Assume that interarrival time follows an exponential distribution and the service time is also to be assumed as exponential with mean of 36 minutes. Calculate i) The probability that the yard is empty ii) The average queue length assuming that the line capacity of the yard is 9 trains	*CO4*	*PO2*	**08**
		OR			
6	a)	Hospital has three receptionists serving at the counter. The patients arrive in a Poisson fashion at the rate of 10 per hour. The service time for each patient is exponential with mean 10 minutes. Determine: (i) The probability that an arriving patient has to wait for service. (ii) The average number of patients waiting at the lobby? (iii) Utilization of the system	*CO4*	*PO2*	**08**

		b)	Ships arrive at a part at the rate of one in every 4 hours with exponential distribution of inter arrival times. The time a ship occupies a berth for unloading has exponential distribution with an average of 10 hours. If the average delay of ships waiting for berths is to be kept below 14 hours, how many berths should be provided at the port?	*CO4*	*PO2*	**08**
		c)	List the characteristics of Queuing systems	*CO1*	*PO1*	**04**
			UNIT - IV			
	7	a)	When could be the graphical method useful in game theory? Explain.	*CO1*	*PO1*	**04**
		b)	Use the relation of dominance to solve the game whose payoff matrix is given in the table.	*CO2*	*PO2*	**10**
		c)	Describe the risk, certainty, uncertainty conditions existing in decision theory	*CO1*	*PO1*	**06**
			OR			
	8	a)	List essential features of Games Theory	*CO1*	*PO1*	**04**
		b)	Two players A and B play a game in which each has 20P, 25p and 50p coins. Each of them selects a coin without the knowledge of the other player. If the sum of the value of coins is an even number. A wins B's coin and if the sum is odd number B wins A's coin. (i) Develop a payoff matrix w.r.t player A (ii) Find the optimal strategies for player and the value of the game.	*CO2*	*PO2*	**08**
		c)	Mr. Sinha has to decide whether or not to drill a well on his farm. In his village, only 40% of the wells drilled were successful at 200 feet of depth. Some of the farmers who did not get water at 200 feet drilled further up to 250 feet but only 20% struck water at 250 feet. Cost of drillings is Rs. 50/- per foot. Mr. Sinha estimated that he would pay Rs. 18000/- during a 5-year period in the present value terms, if he continues to buy water from the neighbor rather than go for the well which would have life of 5 years. Mr. Sinha has three decisions to make: (a) Should he drill up to 200 feet? (b) If no water is found at 200 feet, should he drill up to 250 feet? (c) Should he continue to buy water from his neighbour? Draw up an appropriate decision tree and determine its optimal decision.	*CO2*	*PO2*	**08**

		Player B			
		I	II	III	IV
Player A	I	20	15	12	35
	II	25	14	8	10
	III	40	2	19	5
	IV	5	4	11	0

			UNIT - V			
	9	a)	Differentiate between CPM and PERT	*CO1*	*PO1*	**06**
		b)	A project schedule has following characteristics with precedence activities as shown below	*CO4*	*PO3*	**14**

Activity	Immediate Predecessor	Duration in days
A	-	10
B	-	15
C	B	5
D	A, B	10
E	A, B	6
F	C, D	12
G	E, F	12
H	C, D	10

i) Draw the network for the above activities.
ii) Identify the critical path and the project duration
iii) Calculate earliest start and earliest finish time, latest start and latest finish time for each activity.
iv) Determine total float, free float and independent float for these activities.

			OR			
	10	a)	What is meant by crashing of a project? Explain it in brief.	*CO1*	*PO1*	**05**
		b)	The following table shows the jobs of a network along with their time estimation in days	*CO4*	*PO3*	**15**

Activity (Days)	1-2	1-3	1-4	2-5	3-5	4-6	5-6
t_o	5	1	2	3	1	2	1
t_m	6	1	4	6	1	2	4
t_p	7	7	12	15	1	8	7

i) Draw the project network.
ii) Identify the critical path and find the duration of the path
iii) Calculate the variance and standard deviation of the project
iv) What is the probability of completing the project in 5 days later than expected?

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