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 & Management **Duration: 3 hrs.**
Course Code: 23IM5PCOPR **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.
3. Use of Statistical permitted.

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)	A firm can produce three types of cloth say A, B and C. Three kinds of wool are required for it, say red wool, green wool and blue wool. One-unit length of type A cloth needs 2 yards of red wool and 3 yards of blue wool; one unit length of type B cloth needs 3 yards of red wool, 2 yards of green wool and 2 yards of blue wool; and one unit of type C cloth needs 5 yards of green wool and 4 yards of blue wool. The firm has only a stock of 8 yards of red wool, 10 yards of green wool and 15 yards of blue wool. It is assumed that the income obtained from one-unit length of type A cloth is Rs. 3.00, of type B cloth is Rs. 5.00 and of type C cloth is Rs. 4.00. Formulate the problem as linear programming problem.	*CO2*	*PO2*	**10**
	b)	Any one standard definition of Operations Research and brief explanation on OR's Scope	*CO1*	*PO1*	**05**
	c)	With respect to LPP explain the following with a neat diagram: i) In feasible region (ii) Degeneracy in LPP	*CO1*	*PO1*	**05**
		OR			
2	a)	The simplex table below represents one of the iterations leading towards optimality.	*CO2*	*PO2*	**10**

C_j	X_1 2	X_2 1	X_3 0	X_4 0	X_5 0	ratio
0 X_3	4	3	1	0	0	12 / 4
0 X_4	4	1	0	1	0	8 / 4
0 X_5	2	- 1	0	0	1	4 / 2
Z_j - C_j	- 2	- 1	0	0	0	Z_{Max} = 0

(i) Find the Optimal solution from the above table
(ii) Is the solution non – unique? comment

	b)	Solve the following LPP by Dual-Simplex Method:	*CO2*	*PO2*	**10**

$$Minimize\ Z = 2x_1 + 3x_2$$

Subject to

$$2x_1 - 3x_2 - x_3 \geq 3$$

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

$$x_1, x_2, x_3 \geq 0$$

UNIT - II

3 a) Explain degeneracy in transportation problems. How degeneracy can be resolved in transportation problems. — *CO3* *PO2* **04**

b) Consider the following transportation problem: — **12**

	D1	D2	D3	D4	D5	D6	Supply
S1	7	5	7	7	5	3	60
S2	9	11	6	11	x	5	20
S3	11	10	6	2	2	8	90
S4	9	10	9	6	9	12	50
Demand	60	20	40	20	40	40	

It is not possible to transport any quantity from S2 to D5.

Determine:

(i) Initial solution by Vogel's approximation method

(ii) Optimum basic feasible solution

c) With respect to Transportation Model, explain the following terms: — *CO1* *PO1* **04**

(i) Assumptions considered in formulation of TRP

(ii) Multiple Solutions

OR

4 a) The distance between the surplus and deficit cities (in km) is given in the following table: — *CO3* *PO2* **10**

Deficit cities

Surplus cities	a	b	c	d	e
A	85	75	65	125	75
B	90	78	66	132	78
C	75	66	57	114	69
D	80	72	60	120	72
E	76	64	56	112	68

Determine the optimal assignment schedule

b) The table shows the distance (in kilometres) between various cities. The home city is city E. Use appropriate method to determine the tour that will minimize the total distance of visiting all cities and returning home. — *CO3* *PO2* **10**

To City

		A	B	C	D	E
From City	A	M	375	600	150	190
	B	375	M	300	350	175
	C	600	300	M	350	500
	D	160	350	350	M	300
	E	190	175	500	300	M

			UNIT - III			
	5	a)	With respect to customer's behaviour in queuing theory, Explain the following: (i) Kendall's notation (ii) Jockeying (iii) Reneging (iv) Queue discipline. (v) Traffic Intensity	*CO1*	*PO1*	**10**
		b)	A TV repairman finds that the time spent on his job has an exponential distribution with mean 30 mins. If he repairs sets in the order in which they come in, and if the arrival of sets is approximately poison with an average rate of 10 per 8-hour day. Calculate the following: (i) What is the repairman's expected idle time each day. (ii) How many jobs are ahead of the average set just brought in? (iii) What is the probability that queue size exceeds 10. (iv) What is the expected length of non-empty queue. (v) Probability of a TV set waiting for more than 3 mins before being served	*CO4*	*PO3*	**10**
			OR			
	6	a)	A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distribution for each deposits and withdrawals are exponential with mean service time 3 minutes per customer. Depositors are found to arrive in a Poisson fashion throughout the day with mean arrival rate 16 per hour. Withdrawers also arrive in a Poisson fashion with mean arrival rate of 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits. What would be the effect if this could be accomplished by increasing the service time to 3.5 minutes.	*CO4*	*PO3*	**10**
		b)	Briefly explain the characteristics of queening system.	*CO1*	*PO1*	**10**
			UNIT - IV			
	7	a)	Explain the following w.r.t. Games theory: (i) Pure and Mixed Strategy (ii) Payoff matrix (iii) Assumption for solving 2-person zero sum game	*CO1*	*PO1*	**06**

b) In a well-known children's game, each player says 'stone' or 'paper' or 'scissors'. If one says 'stone' and the other says 'scissors', then the former wins a rupee. Similarly, 'scissors' beats 'paper' and 'paper' beats 'stone', i.e. the player calling the former word wins a rupee. If the two players name the same item, then there is a tie i.e. there is no payoff. Formulate the payoff matrix for the said case. — *CO2* | *PO23* | **04**

c) Obtain the optimal strategies for both persons and the value of the game for two-person zero-sum game whose payoff matrix is as follows: — *CO2* | *PO2* | **10**

	Player B	
Player A	**B1**	**B2**
A1	1	-3
A2	3	5
A3	-1	6
A4	4	1
A5	2	2
A6	-5	0

OR

8 a) A food products' company is contemplating the introduction of a revolutionary new product with new packaging or replacing the existing product at much higher price (S1). It may even make a moderate change in the composition of the existing product, with a new packaging at a small increase in price (S2), or may mall a small change in the composition of the existing product, backing it with the word 'New' and a negligible increase in price (S3). The three possible states of nature or events are: (i) high increase in sales (N1), (ii) no change in sales (N2) and (iii) decrease in sales (N3). The marketing department of the company worked out the payoffs in terms of yearly net profits for each of the strategies of three events (expected sales). This is represented in the following table: — *CO4* | *PO3* | **10**

	States of Nature		
Strategies	N_1	N_2	N_3
S_1	7,00,000	3,00,000	1,50,000
S_2	5,00,000	4,50,000	0
S_3	3,00,000	3,00,000	3,00,000

Which strategy should the concerned executive choose on the basis of (a) Maximin criterion (b) Minimax regret criterion (c) Laplace criterion?

b) You are given the following estimates concerning a Research and Development programme: — *CO4* | *PO3* | **10**

Decision D_i	Probability of Decision Di Given Research R	Outcome Number	Probability of Outcome xi Given Di	Payoff Value of Outcome, xi(Rs ’000)
Develop	0.5	1 2 3	0.6 0.3 0.1	600 -100 0
Do not develop	0.5	1 2 3	0 0 1.0	600 -100 0

Construct and evaluate the decision tree diagram for the above data.

UNIT – V

9 a) Define the following w.r.t network analysis:
Path ii) Activity iii) Looping iv) Network (v) Fulkersons rule (any 4) — *CO1* | *PO1* | **10**

b) A small project consists activities for which the relevant data is given below: — *CO3* | *PO2* | **10**

Activity	A	B	C	D	E	F	G
Preceding Activity	-	-	-	A , B	A, B	C , D, E	C , D, E
Duration (Days)	4	7	6	5	7	6	5

i) Draw the network and find the project completion time
ii) Calculate earliest and latest times.
iii) Calculate the total float, free float and independent floats for each activity.

OR

10 a) Differentiate between PERT & CPM — *CO1* | *PO1* | **04**

b) Space agency is planning a project to launch manned mission to moon and has listed activities and are as follows: — *CO3* | *PO2* | **16**

Activity	Time estimates in Months		
1 - 2	7	1	1
1 – 3	7	1	4
1 – 4	8	2	2
2 – 5	1	1	1
3 – 5	14	2	5
4 – 6	8	2	5
5 - 6	15	3	6

(i) Draw the network and determine the critical path and variance
(ii) What is the probability that the project will be completed no more than 4 months later than the expected time?
(iii) What should be the scheduled completion time for the probability of completion to be 50%

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