U.S.N.										

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

Autonomous Institute Affiliated to VTU

May / June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VIII**

Branch: Institutional Elective **Duration: 3 hrs.**

Course Code: 22ME8OEORE **Max Marks: 100**

Course: Operation 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.

			CO	PO	Marks
		UNIT - I			
1	a)	Define Operation Research. Explain briefly about Operation Research.	CO1	PO1	**05**
	b)	Find all the basic solutions of the following problem: Maximize $: Z = x_1 + 3x_2 + 3x_3$ Subject to $x_1 + 2x_2 + 3x_3 = 4,\ \ 2x_1 + 3x_2 + 5x_3 = 7$ And hence find (i) Basic feasible solution. (ii) Degenerate basic solution (iii) Optimal basic feasible solution	CO1	PO1	**05**
	c)	Apply simplex method to solve the L.P.P : Maximize $Z = 3x_1 + 4x_2$, subject to $4x_1 + 2x_2 \le 80,\ 2x_1 + 5x_2 \le 80,\ \ x_1, x_2 \ge 0.$	CO2	PO2	**10**
		OR			
2	a)	Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paisa per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B and costs 20 paise per gram. The daily minimum requirements of vitamin A and vitamin B are 100 units and 120 units respectively. Find the minimum cost of product mix.	CO2	PO2	**06**
	b)	Apply Big-M method to Minimize: $Z = 4x_1 + x_2$ subject to $3x_1 + x_2 = 3,\ \ 4x_1 + 3x_2 \ge 6,\ \ x_1 + 2x_2 \le 4,\ \ x_{1,}\ \ x_2 \ge 0.$	CO2	PO2	**14**
		UNIT - II			
3	a)	Obtain initial basic feasible solution of the following transportation problem by North West Corner cell method.	CO2	PO2	**05**

		To			
		D1	D2	D3	Availability
From	S1	**1**	**2**	**6**	7
	S2	**0**	**4**	**2**	12
	S3	**3**	**1**	**5**	11
	Requirement	10	10	10	

	b)	(i) Apply Vogel approximation method to find the initial basic feasible solution to solve the following transportation problem and hence find the optimal solution by Modi's iteration method.	CO2	PO2	**15**

		Warehouses				Factory capacity
		W1	W2	W3	W4	
Factory	F1	**19**	**30**	**50**	**10**	7
	F2	**70**	**30**	**40**	**60**	9
	F3	**40**	**8**	**70**	**20**	18
	Warehouse requirement	5	8	7	14	

(ii) If a Company is spending Rs 1000 on this transportation problem of its units to four Ware houses from three factories. What can be the maximum saving by optimal scheduling.

OR

4	a)	Solve the following transportation problem to maximize the profit using Modi's iteration method. (Apply Vogel approximation method to obtain initial basic feasible solution)	CO2	PO2	**10**

	A	B	C	D	Availability
X	**15**	**51**	**42**	**33**	23
Y	**80**	**42**	**26**	**81**	44
Z	**90**	**40**	**66**	**60**	33
Requirement	23	31	16	30	

	b)	The Bombay transport company has trucks available at four different sites in the following numbers:	CO4	PO4	**10**

Site:	**A**	**B**	**C**	**D**
No of Trucks	**5**	**10**	**7**	**3**

Customers W, X, Y require trucks as shown below

Customers:	**W**	**X**	**Y**
No of Trucks	**5**	**8**	**10**

Variable costs of getting Trucks to the customers are as follows:

7	3	6
4	6	8
5	8	4
8	4	3

Solve this transportation problem by applying Modi's iteration method. (Use Vogel approximation method to obtain initial basic feasible solution)

UNIT - III

5	a)	Three machinists are to be assigned for five jobs that will result in maximum profit. Find the optimal solution.	CO4	PO4	**08**

		Jobs				
Machinist		A	B	C	D	E
	X	**6**	**8**	**5**	**10**	**7.5**
	Y	**7**	**8.5**	**6**	**7**	**6.5**
	Z	**5**	**6.5**	**9**	**8**	**8.5**

		b)	A team of 5 Horses and 5 riders is entering in a show in jumping contest. The number of wining points expected when each rider rides any horse is shown below. How should be horses be allocated to the rider such that the team gets maximum number of points.	*CO4*	*PO4*	**12**

		Riders				
		R1	R2	R3	R4	R5
Horses	H1	**8**	**13**	**9**	**0**	**7**
	H2	**6**	**0**	**13**	**7**	**5**
	H3	**2**	**3**	**1**	**1**	**0**
	H4	**0**	**9**	**6**	**1**	**3**
	H5	**8**	**13**	**5**	**0**	**9**

OR

	6	a)	There are four jobs to be assigned one each to four machines. Find the minimum cost of the assignment.	*CO4*	*PO4*	**10**

	A	**B**	**C**	**D**
I	**1**	**4**	**6**	**3**
II	**9**	**7**	**10**	**9**
III	**4**	**5**	**11**	**7**
IV	**8**	**7**	**8**	**5**

		b)	A Machine operator process five types of items on his machine each Week and must choose sequence for them. The set-up cost per change depends on the items presently on the machine and item to be made according to the following table. If he produces each type of item once and only once each week, how should he sequence the item on his machine in order to minimize the total set-up cost.	*CO4*	*PO4*	**10**

	A	B	C	D	E
A	**-**	**4**	**7**	**3**	**4**
B	**4**	**-**	**6**	**3**	**4**
C	**7**	**6**	**-**	**7**	**5**
D	**3**	**3**	**7**	**-**	**7**
E	**4**	**4**	**5**	**7**	**-**

UNIT - IV

	7	a)	Consider the following table summarizing the details of a project involving 7 activities.	*CO3*	*PO3*	**10**

Activity	**Immediate Predecessors**	**Duration (weeks)**
A	-	3
B	-	4
C	A, B	5
D	B	6
E	D	7
F	C, E	8
G	D	9

i) Construct a CPM network

ii) Determine the critical path and project completion time.

iii) Compute the total floats and free floats for non critical activities.

b) The table lists the activities of a network with their time estimates — *CO3* | *PO3* | **10**

Activity[i-j]	Duration (Days)		
	Optimistic	Most likely	Pessimistic
A(1-3)	**1**	**3**	**5**
B(1-2)	**3**	**4**	**5**
C(3-5)	**4**	**5**	**6**
D(2-4)	**3**	**5**	**7**
E(4-5)	**5**	**6**	**13**
F(5-6)	**4**	**7**	**10**
G(4-6)	**6**	**8**	**10**

i. Draw the project network.

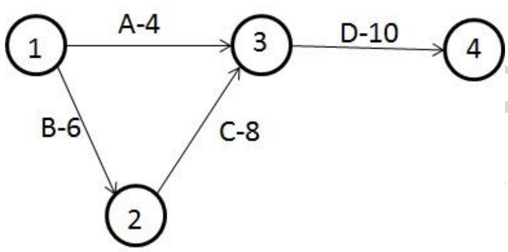
ii. Calculate the length and variance of the critical path.

iii. What is the approximate probability that the project will be completed within 20 days? Given $A(1.64)=0.0505$

OR

8 a) Define: (i) Total float (ii) Free float (iii) Independent float (iv)Critical path of the project network. — *CO3* | *PO3* | **08**

b) Consider the project network below with activity times given in days — *CO4* | *PO4* | **12**



The normal and crash data for this project are as follows

Activity	Normal time (Days)	Crash time (Days)	Normal cost ($)	Crash cost ($)
A	4	3	80	105
B	6	4	180	250
C	8	5	200	320
D	10	6	350	530

i) Find the Critical path

ii) Find the project completion time and the corresponding cost.

iii) If we want to complete the project in 19 days, then find the best crash time and cost.

UNIT - V

9 a) Solve the following 4×5 game using dominance property. — *CO2* | *PO2* | **10**

		Player B				
		I	II	III	IV	V
Player A	I	**3**	**-4**	**4**	**6**	**7**
	II	**-1**	**8**	**2**	**4**	**12**
	III	**16**	**8**	**6**	**14**	**12**
	IV	**1**	**11**	**-4**	**2**	**1**

		b)	Solve the game graphically:	*CO2*	*PO2*	**10**
			OR			
	10	a)	Define (i)Value of the Game (ii)Saddle point (iii) Pay off matrix (iv) Pure strategy (v) Mixed strategy	*CO2*	*PO2*	**10**
		b)	Consider the 4×4 game which represents the pay-off matrix of the player A. Solve it optimally.	*CO2*	*PO2*	**10**

Solve the game graphically (Q9 b):

		Player B	
		B1	B2
Player A	A1	**-6**	**7**
	A2	**4**	**-5**
	A3	**-1**	**-2**
	A4	**-2**	**5**
	A5	**7**	**-6**

Q10 b):

		Player B			
		I	II	III	IV
Player A	I	**3**	**2**	**4**	**0**
	II	**3**	**4**	**2**	**4**
	III	**4**	**2**	**4**	**1**
	IV	**3**	**4**	**3**	**4**

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