U.S.N.										

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

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VIII**
Branch: Institutional Elective **Duration: 3 hrs.**
Course Code: 19MD8OE3OR **Max Marks: 100**
Course: Operations Research **Date: 06.07.2023**

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

		UNIT - I	CO	PO	Marks
1	a)	What are the different phases of OR? Briefly explain them.	CO1	PO1	**06**
	b)	Use simplex method to solve the LPP: Maximize**:** $Z = 3x_1 + 4x_2$ Subject to $x_1 - x_2 \le 1$ $-x_1 + x_2 \le 2$ $x_1, x_2 \ge 0$	CO1	PO2	**07**
	c)	Use graphical method to solve the following. Maximize**:** $Z = 3x_1 + 2x_2$, Subject to $5x_1 + x_2 \ge 10$ $x_1 + x_2 \ge 6$, $x_1 + 4x_2 \ge 12$ $x_1 \ge 0\ x_2 \ge 0$	CO1	PO2	**07**
		OR			
2	a)	Use simplex method to solve the following LPP, Minimize: $Z = x_1 - 3x_2 + 2x_3$ Subject to $3x_1 - x_2 + 2x_3 \le 7$, $-2x_1 + 4x_2 \le 12$, $-4x_1 + 3x_2 + 8x_3 \le 10$ $x_1, x_2, x_3 \ge 0$	CO1	PO2	**10**
	b)	Solve the following LPP by Big -M method Minimize: $Z = 4x_1 + x_2$, Subject to $3x_1 + x_2 = 3$, $4x_1 + 3x_2 \ge 6$, $x_1 + 2x_2 \le 4$ $x_1, x_2 \ge 0$	CO1	PO2	**10**

			UNIT - II			
	3	a)	Determine an initial basic feasible solution to the following transportation problem by North-West corner rule and least cost method.	*CO2*	*PO2*	**10**

		To			
		D1	D2	D3	
From	O1	2	7	4	**5**
	O2	3	3	1	**8**
	O3	5	4	7	**7**
	O4	1	6	2	**14**
		7	**9**	**18**	**34**
		Demand			

Supply

		b)	Determine the optimal solution by MODI method to the transportation problem of above example Q No.3, considering initial basic feasible solution obtained by Vogel's approximation method.	*CO2*	*PO2*	**10**
			UNIT - III			
	4	a)	Determine an optimum assignment schedule to the following problem.	*CO3*	*PO2*	**10**

Job

Person	**1**	**2**	**3**	**4**	**5**
A	8	4	2	6	1
B	0	9	5	5	4
C	3	8	9	2	6
D	4	3	1	0	3
E	9	5	8	9	5

		b)	Solve the following travelling salesman problem.	*CO3*	*PO2*	**10**

To / From	**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			
	5	a)	A project consists of 12 activities. Table below shows the duration for each activity in days. a) Draw the network of the project and number the events as per Fulkerson's rule. b) Establish the critical path and determine the project duration.	*CO4*	*PO2*	**10**

Activity	Preceded by	Duration	Activity	Preceded by	Duration
A	-	5	G	E	3
B	A	9	H	E	9
C	A	7	J	A	7
D	A	5	K	H	9
E	C	12	L	F	5
F	C	9	M	G,K	5

	b)	Fusion Engineering Inc. is designing a new product for welding two different alloys. The company has limited time and resources to complete the project. The following activity information is available.	*CO4*	*PO2*	**10**

Activity	Immediate Predecessors	Normal Time (Days)	Normal Cost($)	Crash Cost/ Day($)	Crash Time (Days)
A	-	4	400	125	3
B	A	5	800	200	4
C	A	4	520	150	2
D	B	3	600	225	2
E	C	3	255	100	2
F	B,E	4	600	175	2

(i)Draw the project network and find the critical path.
(ii)Find the project completing time and corresponding cost.
(iii)What is the total cost, if the project deadline is 12 days.

		OR				
	6	a)	A building project consists of ten activities whose precedence relationships are identified by their node numbers.	*CO4*	*PO2*	**10**

Activity	Initial node	Final node	Time days	Activity	Initial node	Final node	Time days
A	1	2	5	F	4	5	2
B	2	3	2	G	4	7	3
C	2	4	6	H	6	8	8
D	3	6	4	I	5	8	7
E	3	5	4	J	7	8	2

Determine i) Activity times ii) Total float iii) Critical path.

b) Table below shows jobs, normal and crash time and cost of a project. *CO4* *PO2* **10**

Job	T_n (days)	C_n (Rs.)	T_c (days)	C_c (Rs.)
1-2	6	1400	4	1900
1-3	8	2000	5	2800
2-3	4	1100	2	1500
2-4	3	800	2	1400
3-4	Dummy	-------	------	-------
2-5	6	900	3	1600
4-6	10	2500	6	3500
5-6	3	500	2	800

Indirect cost for the project is Rs. 300/- per day.

a) Draw the network. b) What is the normal duration and cost of the project. c) Find optimum duration and minimum project cost.

UNIT - V

7 a) Solve the following game. *CO5* *PO2* **08**

		B			
		I	II	III	IV
	I	1	9	6	0
	II	2	3	8	-1
A	III	-5	-2	10	-3
	IV	7	4	-2	-5

b) Use dominance to solve the following game. *CO5* *PO2* **12**

		B					
		I	II	III	IV	V	VI
	I	0	0	0	0	0	0
A	II	4	2	0	2	1	1
	III	4	3	1	3	2	2
	IV	4	3	7	-5	1	2
	V	4	3	4	-1	2	2
	VI	4	3	3	-2	2	2

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