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Roll No. : .....

**337556(37)**

**B. E. (Fifth Semester) Examination, Nov.-Dec. 2021**

**(New Scheme)**

**(Mech. Engg. Branch)**

**OPERATIONS RESEARCH**

***Time Allowed : Three hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note : Attempt all questions. Part (a) of each question is compulsory. Solve any two parts from the remaining. Assume suitable data if required.***

1. (a) (i) Why is the study of operation research important to the decision makes?
- (ii) Write the limitation of Operation Research.

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(b) A tape recorder company manufactures model  $A$ ,  $B$  and  $C$  which have profit contributions per unit ₹ 15, ₹ 40 and ₹ 60 respectively. The weekly minimum production requirement are 25 units for model  $A$ , 130 units for model  $B$  and 55 units for model  $C$ . Each type of recorder requires a certain amount of time for manufacturing of components parts for assembling and for packing. Specifically a dozen units of model  $A$  requires 4 hrs for manufacturing, 3 hrs for assembling and 1 hour for packaging. The corresponding fig for a dozen unit of model  $B$  are 2.5, 4 and 2 and for a dozen unit of model  $C$  are 6, 9 and 4. During forthcoming week the company has available 130 hours of manufacturing, 170 hrs of assembling and 52 hours of packaging. Formulate the LPP model to maximize the total profit of the company.

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(c) By using Simplex method solve the LPP problem.

$$\text{Max}^m \quad Z = 4x_1 + x_2 + 3x_3 + 5x_4$$

Subjected to

$$4x_1 - 6x_2 - 5x_3 + 4x_4 \geq -20$$

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$$3x_1 - 2x_2 + 4x_3 + x_4 \leq 10$$

$$8x_1 - 3x_2 + 3x_3 + 2x_4 \leq 20$$

where  $x_1, x_2, x_3, x_4 \geq 0$

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(d) By using Big M method solve the LPP problem.

$$\text{Min} \quad Z = 3x_1 - x_2$$

Subjected to

$$2x_1 + x_2 \geq 2$$

$$x_1 + 3x_2 < 3$$

$$x_2 \geq 4$$

where  $x_1, x_2 \geq 0$

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2. (a) (i) Explain how to resolve degeneracy in a transportation problem.

(ii) Explain how to modify an effectiveness matrix in an assignment problem if a particular assignment is prohibited.

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(b) A manufacturer wants to ship 8 loads of his product shown in table the matrix gives to mileage from origin to destination. Shipping cost are ₹ 10 per load per mile what shipping schedule should be used.

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	$D_1$	$D_2$	$D_3$	Supply
$O_1$	50	30	220	1
$O_2$	90	45	170	3
$O_3$	250	200	50	4
Demand	4	2	2	

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(c) A head of a department has the problem to assign courses for teachers to have maximum educational qualify in the department. Head has one professor, two Associate Professor, one Teaching Assistant, four course must be offered after appropriate evaluation he has following rating regarding the ability of each instruction to teach the courses.

	Course 1	Course 2	Course 3	Course 4
Prof. 1	60	40	60	70
Prof. 2	20	60	50	70
Prof. 3	20	30	40	60
TA 4	30	10	20	40

How should be assign to courses to realize his objectives?

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(d) A Bus Route from Chandigarh to Delhi takes 6 hrs and time table shown both side.

Depart. from Chandigarh	Route	Arrival at Delhi
06.00	a	12.00
07.30	b	13.30
11.30	c	17.30
19.00	d	01.00
00.30	e	06.30

Arrival at Chandigarh	Route	Depart. from Delhi
11.30	1	05.30
15.00	2	09.00
21.00	3	15.00
00.30	4	18.30
06.00	5	00.00

There are 5 crew members constraints are every crew member should be provided with 4 has rest before nest trip should not wait more than 24 hours for return trip. Comapny has flats at Delhi and Chandigarh. Suggest an optimal assignment.

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[ 6 ]

3. (a) (i) What are the basic assumption underlying the expected time estimates?

(ii) Explain Service Mechanism.

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(b) A fertilizer company distributes its product by trucks loaded in loading station. It was found that on an average every 5 minutes the truck arrived and the average loading time was 3 minutes. 40 percent of truck belongs to contractor. Making suitable assumption determine :

(i) Probability that a truck has to wait.

(ii) Waiting time of a truck that waits.

(iii) Expected waiting time of customer trucks per day.

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(c) The following table gives data on normal time and cost, crash time, cost for a project.

Activity	Normal		Crash	
	Time (week)	cost	Time (week)	cost
1-2	3	300	2	400
2-3	3	30	3	30
2-4	7	420	5	580

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2-5	9	720	7	810
3-5	5	250	4	300
4-5	0	0	0	0
5-6	6	320	4	410
6-7	4	400	3	470
6-8	13	780	10	900
7-8	10	1000	9	1200

Indirect cost ₹ 50 per week.

(i) Draw network dia. Identify critical path.

(ii) Crash the relevant activities systematically and determine the optimal project completion time and cost.

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(d) Table shows man power requirement :

Activity	Man power required	
	Normal time (Days)	(Days)
1-2	10	2
1-3	11	3
2-4	13	4
2-6	14	3

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3-4	10	1
4-5	7	3
4-6	17	3
5-7	13	5
6-7	9	8
7-8	1	11

- (i) Draw network diagram.  
 (ii) Find total float and free float for each activity. 8

4. (a) (i) Write an application of Simulation.  
 (ii) What are Dominance Property Rule?  
 (iii) What are stochastic simulation and random numbers? 6

(b) A book store wishes to carry a particular book in stock. Demand is not certain and there is a lead time 2 days for stock. The probability of demand are given

Demand (units/day)	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

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Each time an order is placed store in carry an ordering cost of ₹ 10 per order. Store also in carry a carrying cost of ₹ 0.5 per book per day. Manager of book store wishes to compare two options.

- (i) Order 5 books when present inventory plus any outstanding order falls below 8 books.  
 (ii) Order 8 books when present inventory plus any outstanding order falls below 8 books.

Stock has 8 books 6 books ordered two days ago are expected to arrive in two days. Simulation run for 10 days. Random No. are given 89, 34, 78, 63, 61, 81, 39, 16, 13, 73. 14

Or

In a town there are only two discount stores ABC and XYZ. Both stores run annual pre Diwali sales. Sales are advertised through local newspapers with the aid of an advertising from ABC stores constructed following payoff matrix in units of ₹ 1,00,000. Find the optimal strategies for both stores and values of the game. 14

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Store XYZ

Store ABC	B1	B2	B3
A1	1	-2	1
A2	-1	3	2
A3	-	-2	3