



# MEASI INSTITUTE OF MANAGEMENT CHENNAI-14

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MAY 2015

P/ID 77731/MBN4D

Time : Three hours

Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE out of Eight questions.

1. Explain the concept of operations Research.
2. List down and explain the major sectors applying the operations research.
3. Solve the following LPP using graphical method:

$$\text{Minimize } z = 2x_1 + 3x_2$$

Subject to :

$$x_1 + x_2 \geq 6$$

$$7x_1 + x_2 \geq 14$$

$$x_1, x_2 \geq 0.$$



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4. Find the optimal solution for the following assignment problem.

		Job			
		I	II	III	IV
Workers	A	3	4	2	1
	B	5	6	3	2
	C	4	7	4	0
	D	3	1	6	4

5. Explain the concept of PERT with an example.
6. What are the limitations of CPM? Explain.
7. In a telephone booth the arrivals are the average of 10 minutes apart. A call on the average takes 3 minutes. If there is one phase, calculate the expected probability that an arrival will have to wait more than 10 minutes before the phase is free.
8. A demand for a certain item is 18,000 units per year. The holding cost per unit is Rs.1.20 per year and the cost of 1 procurement is Rs.400. No shortages are allowed :



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Determine:

- (a) Optimum order quantity
- (b) Number of orders per annum
- (c) Time between the orders
- (d) Total cost per year when the cost of one unit is Re.1.

PART B — (5 × 10 = 50 marks)

Answer any FIVE out of Eight questions.

9. Discuss the methodology and scope of operation research.

10. Use simplex method to solve the following LLP: Max

$$Z = 4x_1 + 10x_2$$

Subject to constraints

$$2x_1 + x_2 \leq 50$$

$$2x_1 + 5x_2 \leq 100$$

$$2x_1 + 3x_2 \leq 90$$

$$x_1 \geq 0 \text{ and}$$

$$x_2 \geq 0.$$



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11. Solve the following assignment problem:

	W	X	Y	Z
A	18	24	28	32
B	8	13	17	19
C	10	15	19	22

12. List down and explain the merits and demerits of PERT and CPM.

13. A super market has two girls running up sales at the counters. If the services time for each customer is exponential with mean 4 minutes, and if people arrive is a Poisson fashion at the rate of 10 an hour.

- (a) What is the probability of having to wait for service?
- (b) What is the expected percentage of idle time for each girl?

14. Consider a self service store with one cashier. Assume Poisson arrivals and exponential service times. Suppose that nine customers arrive on the average every 5 minutes and the cashier can serve 10 in 5 minutes. Find:



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- (a) The average number of customers queuing for service.
- (b) The probability of having more than 10 customers in the system.
- (c) The probability that a customer has to queue for more than 2 minutes.
15. Define “Replacement policy of Individual and group replacement”. And also write an essay on replacement model.
16. A fleet owner finds from his past records that the cost/year of running an equipment whose purchase price is Rs.6,000 are as given below.

Year:	1	2	3	4	5	6	7
Running cost (Rs.):	1,000	1,200	1,400	1,800	2,300	2,800	3,400
Resale Values (Rs.):	3,000	1,500	750	375	200	200	200

Determine at what age is replacement due?



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PART C — (1 × 20 = 20 marks)

Case:

17. A Confectioner sells confectionary items, past data of demand per week (in hundred kilogram) with frequency is given below:

Demand/Week: 1 5 10 15 20 25 Frequency:

2 11 8 21 5 3

Using the following sequence of random numbers, generate the demand for the next 10 weeks. Also find the average demand per week.

35, 52, 90, 13, 23, 73, 34, 57, 35, 83, 94, 56, 67, 66, 60.



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DECEMBER 2013

P/ID 37508/PBAH

Time : Three hours

Maximum : 80 marks

PART A — (5 × 5 = 25 marks)

Answer any FIVE questions.

1. Describe the significance of OR in modern management.
2. What is meant by sensitivity analysis?
3. What is meant by travelling salesman problem?
4. State pure strategies and mixed strategies.
5. Solve following LPP by using graphically

$$\text{Maximize } z = 3x_1 + 4x_2$$

$$\text{Subject to : } 5x_1 + 4x_2 \leq 200$$

$$3x_1 + 5x_2 \leq 150$$

$$5x_1 + 4x_2 \geq 100$$

$$8x_1 + 4x_2 \geq 80$$

$$x_1, x_2 \geq 0.$$



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6. Construct the network for the following activity data.

Activity : A B C D E F G H

Immediate predecessor: - - A B CEFF

Activity : I J K L

Immediate predecessor: H G,I D,G K

7. Describe the use of queuing process in marketing.  
8. Solve the following game by using dominance rule.

1 7 2

6 1 6

PART B — (4 × 10 = 40 marks)

Answer any FOUR questions.

9. Solve by simplex method the following LPP :

Minimize  $z = x_1 - 3x_2 + 3x_3$

Subject to :  $3x_1 - x_2 + 2x_3 \leq 7$

$2x_1 + 4x_2 \geq -2$

$-4x_1 + 3x_2 + 8x_3 \leq 10$

$x_1, x_2, x_3 \geq 0.$





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10. Find the optimal solution to the following transportation problem

				Availability	
	10	8	7	12	500
	12	13	6	10	500
	8	10	12	14	900
Demand	700	550	450	300	

11. Construct the network and find CPM for the given data.

Activity :	1-2	2-3	2-4	3-4	3-5	3-6	4-5	4-6	5-6
Duration :	3	3	2	0	3	2	7	5	6

12. Reduce the following game by dominance property and solve it

		Player B				
		1	3	2	7	4
Player A	3	4	1	5	6	
	6	5	7	6	5	
	2	0	6	3	1	

13. A company uses annually 50,000 units of an item, each costing Rs. 1.20. Each order cost Rs. 45 and inventory carrying cost 15% of the average inventory value. Find the EOQ. And, if the company operate 250 days a year and if the procurement time is 10 days and the safety stock is 500 units. Find the reorder level, maximum, minimum and average inventory.



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14. A barber with one man takes exactly 25 minutes to complete one hair cut. If customers arrive in a poisson fashion at an average rate of one every 40 minutes. How long on the average, must a customer wait for service.

PART C — (1 × 15 = 15 marks)

Compulsory

15. What were the Post-World War II factors so important that these lead to development of operation Research.
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**P/ID 77508/PMBH/  
PMB1H/PMBSJ**

Time : Three hours

Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE questions.

1. Use graphical method to solve the L.P.P

$$\text{Minimize } z = 3x_1 + 2x_2$$

$$\text{Subject to } 5x_1 + x_2 \geq 10$$

$$x_1 + x_2 \geq 6$$

$$x_1 + 4x_2 \geq 12 \text{ and } x_1, x_2 \geq 0$$

2. Five men are available to do five different jobs. From past records the time (in hrs) that each man takes to do each job is known and is given in the following tables.

		Jobs				
		1	2	3	4	5
Man	1	2	9	2	7	1
	2	6	8	7	6	1
	3	4	6	5	3	1
	4	4	2	7	3	1
	5	5	3	9	5	1



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3. Explain the method of numbering the nodes of an activity on arrow diagram.
4. Explain the terms queue discipline and system capacity.
5. A machine owner finds from his past records that the costs per year of maintaining a machine whose purchase price is Rs. 6000 are as given below.

Year:	1	2	3	4	5	6
Maintenance cost (Rs.)	1000	1200	1400	1800	2300	2800
Value (Rs.)		3000	1500	750	375	200

Determine at what age is replacement due?

6. Explain various types of inventory.
7. Explain the rules for Dominance property.

8. Using graphically method solve

$$\begin{cases} 2x + 7y = 11 \\ 3x + 5y = 2 \end{cases}$$

2 P/ID 77508/PMBH/  
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PART B — (5 × 10 = 50 marks)

Answer any FIVE questions.

9. Use simplex method to solve the L.P.P

$$\text{Maximize } Z = 4x_1 + 10x_2$$

$$\text{Subject to } 2x_1 + x_2 \leq 50$$

$$2x_1 + 5x_2 \leq 100$$

$$2x_1 + 3x_2 \leq 90 \text{ and } x_1, x_2 \geq 0.$$

10. Find the optimal transportation cost of the following matrix using least cost method for finding the critical solution.

		Market					
		A	B	C	D	E	Available
	P	4	1	2	6	9	100
Factory	Q	6	4	3	5	7	120
	R	5	2	6	4	8	120
		90	90				

11. Calculate the earliest start, earliest finish, latest start and latest finish of each activity of the project given below and determine the critical path of the project.

Activity	1-2	1-3	1-5	2-3	2-4	3-4	3-5	3-6	4-6	5-6
Duration (in weeks)	8	7	1	2	4	3	5	1	7	4

3 **P/ID 77508/PMBH/  
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12. On an average 96 patients per 24 hour day require the service of an emergency clinic. Also on average, a patient required 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs. 100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost Rs. 10 per patient treated, how much would have to be budgeted by the clinic to decrease

the average size of the queue from  $1\frac{1}{3}$  patients to  $\frac{1}{2}$  patient?

13. Find the cost per period of individual replacement policy of an installation of 300 light bulbs given the following:
- (a) Cost of replacing individual bulb is Rs. 3
- (b) Conditional probability of failure is given below.

Week No:	0	1	2	3	4
Conditional prob. Of failure:	0	$\frac{1}{10}$	$\frac{1}{3}$	$\frac{2}{3}$	1

4 **P/ID 77508/PMBH/  
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14. A company uses rivets at a rate of 5000 kg per year, rivets costing Rs. 2.00 /kg. It costs Rs. 20 to place an order and carrying cost of inventory is 10% per year. How frequently should the order for rivets be placed and how much?
15. Find the sequence that minimizes the total elapsed time required to complete the following tasks on the machine in the order 1-2-3. Find also the minimum total elapsed time (hours) and the idle times on the machines.

Task	A	B	C	D	E	F	G
Time on Machine 1	3	8	7	4	9	8	7
Machine 2	4	3	2	5	1	4	3
Machine 3	6	7	5	11	5	6	12

16. Solve the following game using dominance property.

		B		
		I	II	III
A	I	1	7	2
	II	6	2	7
	III	6	1	6

5 P/ID 77508/PMBH/  
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PART C — (1 × 20 = 20 marks)

Compulsory.

17. A project consists of the following activities and time estimates.

Activity:	1-2	2-3	1-4	2-5	2-6	3-6	4-7	5-7	6-7
Least time (days):	3	2	6	2	5	3	3	1	2
Greatest time (days):	15	14	30	8	17	15	27	7	8
Most likely time (days):	6	5	12	5	11	6	9	4	5

- Draw the Network
- What is the probability that the project will be completed in 27 days?





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Time : Three hours

Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE questions.

1. Explain the following.
  - (a) Slack variable.
  - (b) Surplus variable.
  - (c) Artificial variable.
2. Give a mathematical model for transportation problem.
3. A firm manufactures three products A,B and C. their profits per unit are Rs. 300, Rs. 200 and Rs. 400 respectively. The firm has two machines and the required processing time in minutes on each machine for each product is given in the following table.

Machine	Product		
	A	B	C
1	4	3	5
2	2	2	4



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Machines 1 and 2 have 2000 and 2500 machine – minute respectively. The upper limit for the production volumes of the product A, B and C are 100 units, 200 units and 50 units, respectively. But, the firm must produce a minimum of 50 units of the product A. Develop a LP model for this manufacturing situation to determine the production volume of each product such that the total profit is maximized.

4. Consider the assignment problem as show below. In this problem, five different jobs are to be assigned five different Operators such that the total processing time is minimized. The matrix entries represent processing times in hours. Develop a Zero-one programming model for the above problem.

	Operator				
	1	2	3	4	5
Job	1	5	6	8	6
	4	8	7	7	5
	3	7	7	4	5
	4	6	5	6	7
	5	4	7	8	6

5. Distinguish between CPM and PERT.

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6. Give the classification of queueing system using Kendall notation.
7. Write short notes on queueing simulation.
8. What is dominance property? Explain its rules. PART

B — (5 × 10 = 50 marks)

Answer any FIVE questions.

9. Solve the following LP problem graphically.

$$\text{Maximize } Z = 60x_1 + 90x_2$$

Subject to :

$$x_1 + 2x_2 \leq 40$$

$$2x_1 + 3x_2 \leq 90$$

$$x_1 - x_2 \geq 10$$

$$x_1, \text{ and } x_2 \geq 0.$$

10. Solve the following LP problem using simplex method.

$$\text{Maximize } Z = 5x_1 + 3x_2 + 7x_3$$

Subject to :

$$x_1 + x_2 + 2x_3 \leq 22$$

$$3x_1 + 2x_2 + x_3 \leq 26$$

$$x_1 + x_2 + x_3 \leq 18$$

$$x_1, x_2 \text{ and } x_3 \geq 0.$$



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11. A manufacturing company has three factories  $F_1$ ,  $F_2$  and  $F_3$  with monthly manufacturing capacities of 7000, 4000 and 10,000 units of a product. The product is to be supplied to seven stores. The manufacturing cost in these factories are slightly different but the important factor is the shipping cost from each factory to a particular store. The following table represents the factory capacities, store requirements and unit cost (in rupees) of shipping for each factory to each store. Here slack is the difference between the total capacity and the total requirement. Find the optimal transformation plan so as to minimize the transportation cost.

Factory	Stores							Factory Capacity
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	
F <sub>1</sub>	5	6	4	3	7	5	4	7,000
F <sub>2</sub>	9	4	3	4	3	2	1	4,000
F <sub>3</sub>	8	4	2	5	4	8	3	10,000
Store demand	1,500	2,000	4,500	4,000	2,500	3,500	3,000	

4 P/ID 77731/MBN4D/

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12. A College is having an undergraduate programme for which the effective semester time available is very less and the degree course requires field work. Hence, the saving in the total number of class hours handled can be utilized for such field work. Based on past experience, the college has established the number of hours required by each faculty to teach each subject. The course in its present semester has 4 subjects and the college has considered 6 existing faculty to teach these courses. The objective is to assign the best 4 teachers out of these 6 faculty to teach 4 different subjects such that the total number of class hours required is minimized. The data for this problem is summarized below. Solve and optimize the assignment problem.

		Subject			
		1	2	3	4
Faculty 1	25	44	33	35	
Faculty 2	33	40	40	43	
Faculty 3	40	35	33	30	
Faculty 4	44	45	28	35	
Faculty 5	45	35	38	40	
Faculty 6	4	49	40	46	

5      **P/ID 77731/MBN4D/  
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13. Consider the following table summarizing the details of a project.

Activity	Predecessor (s)	Duration (weeks)		
		a	m	b
A	-	4	4	10
B	-	1	2	9
C	-	2	5	14
D	A	1	4	7
E	A	1	2	3
F	A	1	5	9
G	B,C	1	2	9
H	C	4	4	4
I	D	2	2	8
J	E,G	6	7	8
K	F,H	2	2	8
L	F,H	5	5	5
M	I,J,K	1	2	9
N	L	6	7	8

- (a) Find the critical path and expected project completion time.
- (b) What is the probability of completing the project on or before 35 weeks?

6 P/ID 77731/MBN4D/  
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14. Vehicles are passing through a toll gate at the rate of 70 per hour. The average time to pass through the gate is 45 seconds. The arrival rate and service rate follow Poisson distribution. There is a complaint that the vehicles wait for long duration. The authorities are willing to install one more gate to reduce the average time to pass through the toll gate to 35 seconds if the idle time of the toll gate is less than 9% and the average queue length at the gate is more than 8 vehicles. Check whether the installation of the second gate is justified.

15. Consider the following two machines and six jobs flow shop problem.

Job	Machine 1	Machine 2
1	5	7
2	10	8
3	8	13
4	9	7
5	6	11
6	12	10

Obtain the optimal schedule and the corresponding makespan for the above problem.

16. For a product to be manufactured within the Company, the details are as follows :  
Consumption rate = 36,000 units/year, production rate = 72,000 units/year.  $C_o = \text{R. } 250$  per set-up and  $C_c = \text{Rs. } 25/\text{unit/year}$ . Find the economic Batch quantity and cycle time.



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PART C — (1 × 20 = 20 marks)

Compulsory

17. An electronic equipment contains 1000 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is Rs. 1,000/-. If all the resistors are replaced at the same time, the cost per resistor is Rs. 400/-. The present surviving  $S(i)$  at the end of month  $i$  is given below. What is optimum replacement plan.?

$i$ :	0	1	2	3	4	5	6
$S(i)$ :	100	96	89	68	37	13	0





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Time : Three hours

Maximum : 100 marks

PART A – (5 × 6 = 30 marks)

Answer any FIVE questions.

1. Use the graphical method to solve the following L.P.P

$$\text{Maximize } Z = 3x_1 + 2x_2$$

Subject to the restrictions,

$$2x_1 + x_2 \leq 40$$

$$x_1 + x_2 \leq 24$$

$$2x_1 + 3x_2 \leq 60 \text{ and}$$

$$x_1, x_2 \geq 0$$

2. Suggest optimum solution to the following assignment problem and also the maximum sales.

Salesman	Markets (sales in lakhs Rs.)			
	I	II	III	IV
A	44	80	52	60
B	60	56	40	72
C	36	60	48	48
D	52	76	36	40



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3. What are the three main phases of a project?
4. Describe the queueing models M/M/1 and M.M.1/K.
5. The cost of a machine is rs. 6,100 and its scrap value is Rs. 100. The maintenance costs found from experience are as follows :

Year :	1	2	3	4	5	6	7	8
Main cost (Rs.) :	100	250	400	600	900	1200	1600	200

When should the machine be replaced?

6. Discuss briefly the reasons for maintaining inventory in business management and industry.
7. Explain some applications of O.R. in business.
8. Use dominance property to solve :

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

2

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PART B – (5 × 10 = 50 marks)

Answer any FIVE questions.

9. Solve the following :

$$\text{Maximize } 15x_1 + 6x_2 + 9x_3 + 2x_4$$

Subject to :

$$2x_1 + x_2 + 5x_3 + 6x_4 \leq 20$$

$$3x_1 + x_2 + 3x_3 + 25x_4 \leq 24$$

$$7x_1 + x_4 \leq 70$$

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

10. Solve the transportation problem :

	1	2	3	4	Supply
I	21	16	25	13	11
II	17	18	14	23	13
III	32	27	18	41	129
Demand	6	10	12	15	

11. Calculate the total float, free float and independent float  
for the project whose activities are given below :

Activity :	1-2	1-3	1-5	2-3	2-4	3-4
Duration (in weeks) :	8	7	12	4	10	3
Activity :	3-5	3-6	4-6	5-6		
Duration (in weeks) :	5	10	7	4		

3      **P/ID 77508/PMBH/  
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12. In a public Telephone booth the arrivals are on the average 15 per hour. A call on the average takes 3 minutes. If there is just one phone, find

(a) expected number of callers in the booth at any time

(b) the proportion of the time the booth is expected to be idle.

13. The following failure rates have been observed for a certain type of light bulbs :

End of week :	0	1	2	3	4
Prob. of failure to date :	.05	.13	.25	.43	.68
End of week :	5	6	7	8	
Prob. of failure to date :	.88	.96	.96	1.00	

The cost of replacing an individual bulb is Rs. 2.25. the decision is made to replace all bulbs simultaneously at fixed intervals, also replace individual bulbs as they fail. If the cost of group replacement is 60 paise per bulb and the total number of bulbs is 1000, what is the best interval between group replacement?

4

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14. A manufacturer has to supply his customer with 600 units of his products per year. Shortage are not allowed and storage cost amounts to 60 paise per unit per year. The set up cost is Rs. 80.00 find :
- (a) The economic order quantity
  - (b) The minimum average yearly cost
  - (c) The optimum number of orders per year
  - (d) The optimum period of supply per optimum order.
15. Find the sequence that minimizes the total elapsed time required to complete the following tasks on machines  $M_1$  and  $M_2$  in the order  $M_1, M_2$ . Also, find the minimum total elapsed time.

Task :	A	B	C	D	E	F	G	H	I
$M_1$ :	2	5	4	9	6	8	7	5	4
$M_2$ :	6	8	7	4	3	9	3	8	11

16. A and B play a game in which each has three coins, a 5p and 10 p and 20 p. Each selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, A wins B's coin. If the sum is even B wins A's coin. Find the best strategy for each player and the value of the game.



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PART C – (1 × 20 = 20 marks)

Compulsory.

17. Construct the network for the project whose activities and the three time estimates of these activities (in weeks) are given below. Compute :
- (a) expected duration of each activity
  - (b) expected variance of each activity
  - (c) expected variance of the project length.

Activity :	1-2	2-3	2-4	3-5	4-5	4-6	5-7	6-7
$t_o$ :	3	1	2	3	1	3	4	6
$t_m$ :	4	2	3	4	3	5	5	7
$t_p$ :	5	3	4	5	5	7	6	8
Activity :	7-8	7-9	8-10	9-10				
$t_o$ :	2	1	4	3				
$t_m$ :	4	2	6	5				
$t_p$ :	6	3	8	7				



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Time : Three hours

Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE questions.

1. Solve the L.P.P. using graphical method

$$\text{Maximize } Z = 3x_1 + 4x_2$$

Subject to

$$x_1 + x_2 \leq 450$$

$$2x_1 + x_2 \leq 600$$

2. What are the essential characteristics of linear programming model?
3. Give the guidelines for constructing network.
4. Find the critical path for the following data :  
A : 1-2 1-3 2-3 2-4 3-4 4-5 4-6 5-6  
T: 4 6 3 10 10 8 10 6
5. Explain the cost aspects in quecing theory.



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6. A branch of bank has one typist. The typing rate is randomly distributed approximately a Poisson distribution with mean service rate of 8 letters per hour. The letters arrive at a rate of 5 per hour during the entire 8-hours work day. Determine.
- (a) Equipment utilization
  - (b) Average system time.
7. Specify the necessity for maintaining inventory.
8. Solve the game where payoff matrix if

		y	
	x	3	1
1			6

PART B — (5 × 10 = 50 marks)

Answer any FIVE questions.

9. Maximize  $Z = 2x_1 + 3x_2 + x_3 + 7x_4$

Subject to

$$8x_1 + 3x_2 + 4x_3 + x_4 \leq 6$$

$$2x_1 + 6x_2 + x_3 + 5x_4 \leq 3$$

$$x_1 + 4x_2 + 5x_3 + 2x_4 \leq 7$$

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

2

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10. Assign 4 trucks to six vacant space to minimize distance

	1	2	3	4
1	4	7	3	7
2	8	2	5	5
3	4	9	6	9
4	7	5	4	8
5	6	3	5	4
6	6	8	7	3

11. The following table represents a set of activity times for a PERT network. Determine expected time and S.D. for each activity

Activity :	A	B	C	D	E	F	G	H	I	J	K	L
t <sub>o</sub> :	10	12	8	4	0	12	6	9	4	0	5	9
t <sub>m</sub> :	13	15	11	7	0	18	12	12	6	0	8	12
t <sub>p</sub> :	22	18	20	16	0	36	18	27	8	0	11	33

12. Given are some project details :

Job	Normal duration	Minimum duration	Cost/day
1-2	9	6	20
1-3	9	5	25
1-4	15	10	30
2-4	5	3	10

3      **P/ID 77508/PMBH/  
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Job	Normal duration	Minimum duration	Cost/day
3-4	10	6	15
4-5	2	1	40

What is normal project length and minimum project length? Overhead cost is Rs. 60 per day. What is the optimal project schedule?

13. A repairman is to be hired to repair machines which breakdown at an average rate of 3/hr which follows Poisson distribution. Non-production time of a machine is Rs. 10/hr. Two repairmen have been interviewed –one is slow but cheap other is fast and expensive. Slow man charges Rs. 5/hr and services machine at the rate of 4/hr. The fastman demand 7/hr and his rate of service is 6/hr. Which repairman should be hired?
14. A company producing three items has limited storage space of averagely 750 items of all types determine the optimal production quantities for each item separately, for the given information

Product 1 2 3

Holding cost	0.05	0.02	0.03
Setup cost	50	40	60
Demand rate	100	120	75

4

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15. Schedule the given four jobs in three machines. Given are the processing time. Calculate the total elapsed time idle time for the three machines.

Job	Shaping	Prilling	Tapping
1	13	3	18
2	18	8	4
3	8	6	13
4	23	6	8

16. Find the optimum strategies Y and the value of the game

		$y$			
4				-1 4	
				-1 2	
	$x$	2	2	3	-4 2
1				-3 1	
				0 -4	

PART C — (1 × 20 = 20 marks)

Compulsory.

17. A company has factories at four different places which supply warehouses A, B, C, D and E. Monthly factory capacities are 200, 175, 150 and 325 respectively. Monthly warehouse requirements are 110, 90, 120, 230 and 160. Unit shipping costs are.



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	A	B	C	D	E
1	13	–	31	8	20
2	14	9	17	6	10
3	25	11	12	17	15
4	10	21	13	–	17

Determine the optimum shipping cost.

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## Unit I

1. What is operations research?
2. Explain the characteristics of Operations Research.
3. Discuss the limitations of Operations Research.
4. Enumerate with Brief Description some of the techniques of OR.
5. Explain briefly the different phases of operations research.
6. Discuss the importance of operations research in decision-making process.
7. Discuss the significance and scope of operation research in modern management.
8. Discuss the various types OR Models.
9. State the principles of modeling?
10. Discuss the methodology of O.R.
11. Discuss the scope of O.R.
12. Briefly describe the application area of O.R.
13. Define operation & explain the steps of solving O.R models.
14. Discuss the origin of development of O.R

## Unit - II

15. Discuss the industrial application of L.P.P.
16. List and explain assumptions of L.P.P.
17. What are the limitations of O.R? Suggest three advantages if O.R approach in decision making?
18. State the assumptions in L.P.P and its limitations.
19. Define the following
  - i. Black variable
  - ii. Surplus variable
20. Write a L.P.P formulation of transportation problem.
21. Define a general L.P.P. explain the following terms with reference to a L.P.P
  - iii. Objective function
  - iv. Basic feasible solution
  - v. Degenerate basic feasible solution
22. State the general form of L.P.P and explain the assumption of their problems.
23. Explain the following with reference to a L.P.P
  - vi. Black & Surplus variable
  - vii. Basic feasible solution
  - viii. Degenerate solution
  - ix. Unfounded solution



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- x. Optimum basic feasible solution
- 24. Explain with e.g., a L.P.P which has no feasible solution
- 25. Discuss the assumption of L.P.P with e.g.,
- 26. What do you mean by unbounded solutions illustrate it with an e.g.,
- 27. What do you mean by alternate optimum in L.P.P? Illustrate it with an example graphically
- 28. List and explain the assumptions of L.P.P.
- 29. State the general L.P.P. Enumerate and explain the assumption of L.P.P.
- 30. Distinguish between a feasible solution, basic feasible solution, a degenerate basic feasible solution and unbounded solution and unbounded solutions of L.P.P.

## Unit - III

- 31. What is an Assignment Problem? Explain its features and characters.
- 32. What is unbalanced transportation?
- 33. What is forbidden allocation?
- 34. Explain the Hungarian method of finding the optimal solution for an assignment problem.
- 35. Explain the mathematical model of an Assignment Problem.
- 36. Explain the meaning of transportation problem and its mathematical model.
- 37. Explain the method for maximization T.P to be solved
- 38. Explain least cost method for transportation problem with suitable e.g.
- 39. Write the steps of least-cost, cell method.
- 40. Write a mathematical model of assignment problem.
- 41. Write a linear programming formulation of transportation problem.
- 42. Differentiate between a transportation problem and an assignment problem.

## Unit - IV

- 43. What is EOQ and EBQ?
- 44. What are the various models of EBQ?
- 45. What is sequencing problem?
- 46. Discuss the Johnson's rule in sequencing.
- 47. What is replacement model and discuss its types?
- 48. Discuss the process of obtaining the optimal solution of individual and group replacement?
- 49. What is CPM and PERT?
- 50. Distinguish between CPM & PERT.



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51. Explain how the slacks of the events of the critical path are determined in PERT
52. Discuss the guideless for the construction of CPM network. Use suitable e.g. wherever necessary.
53. What is time- chart/grant – chart in CPM? Illustrate it with a simple example.
54. Define the following
  - a) Total hour
  - b) free hour
  - c) critical path
  - d) project
55. Assume that all the activities of a project network are critical.
56. Discuss the special steps to be taken in PERT as well as in crashing under such situation.
57. Briefly discuss the characteristics of the calling population in queuing model.
  - 1) Define the following
    - a) Total float
    - b) Free float
    - c) Critical path
    - d) Project
58. Discuss the various types of inventory model in practice
59. Explain the single window server model in queuing theory
60. What are the assumptions made in queuing theory
61. Explain the Johnson's rule or Johnson's Algorithm
62. What is idle time and total processing time?
63. What is mean arrival rate and mean service rate?

## Unit - V

64. With respect to the queue system, explain the following :
  - a. Poisson arrival and exponential service time
  - b. Erlangen service time distribution and its characteristics
65. Define the following terminologies of game theory
  - c. Strategy
  - b) maximum principle
  - c) saddle point
  - d) value of the game
  - e) two person zero-sum game.
66. "Game theory is quantitative technique in marketing applications" – elucidate.
67. Specify the essential feature of a queuing system.
68. Discuss the terminologies of a queuing theory
69. Define saddle point. Illustrate it with an e.g.
70. Explain the min-max & max-min principle in game theory. Solve the following game by applying this principle.
71. With reference to a queue system, explain the following.
72. Poisson process



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73. Steady & transient states
74. Traffic intensity
75. Capacity of the system
76. Define simulation. What are the advantages of simulation over using standard formulae for queuing system?
77. Define the following :
  - d. Pure strategy
  - e. Mixed strategy
  - f. Saddle point
  - g. Value of a games
78. What is a saddle point? Illustrate the existence of the saddle point with an e.g.
79. Explain two-person zero sum game

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