Course Code: **18ME0324** **R18**

SIDDARTHA INSTITUTE OF SCIENCE AND TECHNOLOGY:: PUTTUR
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Subject with Code : OPERATIONS RESARCH (18ME0324) **Course & Branch: B.Tech - ME**
Regulation: R18 **Year & Semester:** IV-B.Tech&I

QUESTION BANK (DESCRIPTIVE)
UNIT –I
INTRODUCTION TO OR AND LINEAR PROGRAMMING

1. Solve the following LPP Minimize Z= X_1-+ $3X_2+3X_3$ **L3 CO1 10M**
   Subjected to $3X_1-X_2+2X_3 \leq 7$, $2X_1+4X_2 \geq -12$,$-4X_1+3X_2+8X_3 \leq 10$ and $X_1,X_2, X_3 \geq 0$
2. Solve the following LPP **L3 CO1 10M**
   Maximize $Z=3X_1+5X_2+4X_3$,
   Subjected To: $2X_1+3X_2 \leq 8$, $2X_2+5X_3 \leq 10$, $3X_1+2X_2+4X_3 \leq 15$ and $X_1,X_2,X_3 \geq 0$
3. Solve the following Problem by Graphical method **L3 CO1 10M**
   Maximize $Z = 6X_1 + 10X_2$,
   Subjected to $X_1+X_2 \leq 70$, $X_1 \leq 40$, $X_2 \geq 20$, $2X_1 +3X_2 \leq 300$.
4. Solve the following by using Big-M **L3 CO1 10M**
   method Maximize $Z = 2X_1+3X_2+4X_3$,
   Subjected to $3X_1+X_2+4X_3 \leq 600$, $2X_1+4X_2+2X_3 \geq 480$,
   $2X_1+3X_2+3X_3 = 540$ and X_1 , X_2 ,$X_3 \geq 0$
5. Solve the following LPP by Simplex method **L3 CO1 10M**
   Minimize $Z = 3X_1+ 2X_2+5X_3$,
   Subjected to $X_1+2X_2+X_3 \leq 430$, $3X_1+2X_3 \leq 460$, $X_2+4X_2 \leq 420$ & X_1, X_2 & $X_3 \geq 0$
6. Solve the following Degeneracy in simplex method **L3 CO1 10M**
   Maximize $3X_1 + 9X_2$,
   Subjected to $X_1 +4X_2 \leq 8$, $X_1 + 2X_2 \leq 4$, X_1, $X_2 \geq 0$
7. Solve following by using Big-M Method Maximize $Z = 6X_1 +4 X_2$, **L3 CO1 10M**
   Subjected to $2X_1 + 3X_2 \leq 30$, $3X_1 + 2X_2 \leq 24$, $X_1 + X_2 \geq 3$, X_1, $X_2 \geq 0$

8. Find the Geometrical solution maximize z= 5X1+3X2, subject to the constraints
3X1+5X2 = 15, 5X1+ 2X2 = 10 . **L1 L6 CO1 10M**

9. Solve the following problem by using Big-M-method **L3 CO1 10 M**

Maximize $z = X_1+2X_2+3X_3-X_4$,

subjected to : $X_1+2X_2+3X_3=15$,

$2X_1+X_2+5X_3=20$, $X_1+2X_2+X_3+X_4= 10$ and $x_1, x_2, x_3, x_4 \geq 0$

10 A. Define operations research. How OR is useful for decision makers **L1 CO1 4M**

B. Discuss the importance model in the solution of OR problems **L6 CO1 3M**

C. What are the limitations of linear programming technique **L1 CO1 3M**

UNIT-II
TRANSPORTAION PROBLEM AND ASSIGNMENT PROBLEM

1. Determine the basic Feasible solution to the following Transportation problem using NWC ,VCM and VAM **L5 CO2 10M**

	A	B	C	D	E	SUPPLY
P	2	11	10	3	7	4
Q	1	4	7	2	1	8
R	3	9	4	8	12	9
DEMAND	3	3	4	5	6	

2. Solve the following transportation problem **L3 L5 CO2 10M**

	A	B	C	D	AVAILABLE
P	4	6	8	13	**50**
Q	13	11	10	8	**70**
R	14	4	10	13	**30**
S	9	11	13	8	**50**
REQUIRED	**25**	**35**	**105**	**20**	

Determine the Shipping scheme by the Northwest corner Rule and Test the above solution for Optimality

3. Solve the following transportation problem to maximize profit **L3 CO2 10M**

	A	B	C	D	SUPPLY
P	40	25	22	23	**100**
Q	44	35	30	30	**30**
R	38	38	28	30	**70**
DEMAND	**40**	**20**	**60**	**30**	

4. A as salesman has visits of Five cities A,B,C,D and E the distance between the five cities is as Follows. If the salesman starts from city A and has to come back to his starting point, which route is should be select So that the total distance travelled in minimum. **L6 CO2 10M**

	A	B	C	D	E
A	-	7	6	8	4
B	7	-	8	5	6
C	6	8	-	9	7
D	8	5	9	-	8
E	4	6	7	8	-

5. A department has 5 employees and five jobs are to be performed. The time each man will take to perform each job is given in the following table below. How the job should be allocated one per employee, so as to minimize the total man-hours. **L1 CO2 10M**

<u>MACHINES</u> JOBS	A	B	C	D	E
1	9	3	10	13	4
2	8	17	13	20	5
3	5	14	8	11	6
4	11	13	9	12	3
5	12	8	14	16	7

6. Find the minimum transportation cost for the following data **L1 L6 CO2 10M**

		A	B	C	D	E	F	Available
Factory	**1**	9	12	9	6	9	10	5
	2	7	3	7	7	5	5	6
	3	6	5	9	11	3	11	2
	4	6	8	11	2	2	10	9
	Requirement	4	4	6	2	4	2	

7. There are three parties who supply the following quantities of coal and three consumers who require the coal as follows Find the minimum transportation cost **L1 L6 CO2 10M**

Party 1:	14 tons	consumer A :	6 tons
Party 2:	12 tons	consumer B :	10 tons
Party 3:	5 tons	consumer C :	15 tons

The cost Matrix is as shown below

	A	B	C
1	6	8	4
2	4	9	3
3	1	2	6

8 The processing time in hours for the jobs when allocated to the different machines is indicated below. Assign the machines for the jobs so that the total processing time in min.

L3 CO2 10M

MACHINES

JOBS

	1	**2**	**3**	**4**	**5**
1	9	22	58	11	19
2	43	78	72	50	63
3	41	28	91	37	45
4	74	42	29	49	39
5	36	11	57	22	25

9. Consider the problem of assigning five operators to five machines. The assignment costs are given in following Table **L1 L3 CO2 10M**

	M 1	M 2	M 3	M 4	M 5
A	7	7	-	4	8
B	9	6	4	5	6
C	11	5	7	-	5
D	9	4	8	9	4
E	8	7	9	11	11

Operator A cannot be assigned to machine M3 and operator C cannot be assigned to machine M4. Find the optimum assignment schedule

10 A What is transportation problem **L1 CO2 4M**

B What do you mean by balanced transportation problem **L1 CO2 3M**

C What is travelling salesman problem **L1 CO2 3M**

UNIT-III
GAME THEORY AND QUEING THEORY

1. A. Find the saddle point following GAME

Player A	Payer B				
	I	II	III	IV	V
I	9	3	1	8	0
II	6	5	4	6	7
III	2	4	4	3	8
IV	5	6	2	2	1

L1 CO3 5M

B. Find the optimal strategy of following GAME

Player A	Payer B		
	I	II	III
I	-3	-2	6
II	2	0	2
III	5	-2	-4

L1 CO3 5M

2. A Find the saddle point following GAME

Player A	Payer B		
	B_1	B_2	B_3
A_1	-3	-1	6
A_2	2	0	2
A_3	5	-2	-4

L1 CO3 5M

B Solve the following GAME whose payoff matrix to the player A

Player A	Payer B		
	B_1	B_2	B_3
A_1	1	7	2
A_2	6	2	7
A_3	5	2	6

L3 CO3 5M

3. Solve the following GAME, using the Dominance Principle **L3 CO3 10M**

FirmA	Firm B				
	4	6	5	10	6
	7	8	5	9	10
	8	9	11	10	9
	6	4	10	6	4

4. Use the relation of Dominance to solve the rectangular game matrix **L3 CO3 10M**

	I	**II**	**III**	**IV**
I	18	4	6	4
II	6	2	13	7
III	11	5	17	3
IV	7	6	12	2

5. Solve the following game, using the Dominance Principle. **L3 CO3 10M**

		Firm B					
		B1	B2	B3	B4	B5	B6
FirmA	A1	4	2	0	2	1	1
	A2	4	3	1	3	2	2
	A3	4	3	7	-5	1	2
	A4	4	3	4	-1	2	2
	A5	4	3	3	-2	2	2

6. Consider a self-service store with one cashier. Assume Poisson arrivals and exponential service times. Suppose that 9 customers arrive on the average every 5 minutes and the cashier can serve 10 in 5 minutes, Find **a)** Average number of customers queuing for service **b)** Probability of having more than 10 customers in the system. **c)** Probability that a customer has to queue for more than 2 minutes **L1 L3 CO3 10M**

7. In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day, assuming that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average of 36 minutes. Calculate a).Expected queue size b).Probability that the queue size exceeds 10. If the input of trains increases to an average of 33 per day what will be the change in (a) and (b). **L3 L5 CO3 10M**

8. A TV repairman finds that time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in an order in which they come in and if the arrival of set is approximately poison with an average rate of 10 per 8- hour day, what is the repairman's Expected idle time each day and how many jobs are ahead of the average set just brought in. **L1 CO3 10M**

9. A. State briefly the applications of queuing models. **L1 CO3 5M**

B What are the limitations for Applications of queuing Theory **L1 CO3 5M**

10 A. What is game theory? What are the various types of games? **L1 CO3 4M**

B What is Queuing Theory and what are the elements of Queuing system? **L1 CO3 3M**

C Explain Pure strategy and Mixed strategy **L2 CO3 3M**

UNIT-IV

PERT & CPM

1 A project has the following schedule. Construct PERT network and compute the totalfloat for each activity. Find critical path with its duration **L1 L3 CO4 10M**

Activity	Time in month	Activity	Time in month	Activity	Time in month
1-2	2	3-6	8	6-9	5
1-3	2	3-7	5	7-8	4
1-4	1	4-6	3	8-9	3
2-5	4	5-8	1		

2. A. List similarities and differences between PERT and CPM **L1 CO4 2M**

   B. State the rules for drawing network diagram. **L1 CO4 4M**
   C. What is line of balance and Define total elapsed time **L1 CO4 4M**

3. A project has the following schedule. Construct PERT network and compute the total float for each activity. Find critical path and its duration .Also calculate Total Float, Free Float, Construct PERT network and compute the total float for each activity. Find critical path withits duration. **L1 L6 CO4 10M**

Activity	Time in month	Activity	Time in month	Activity	Time in month
1-2	2	3-6	1	6-9	3
1-4	2	4-5	5	7-8	3
1-7	1	4-8	8	8-9	3
2-3	4	5-6	4		

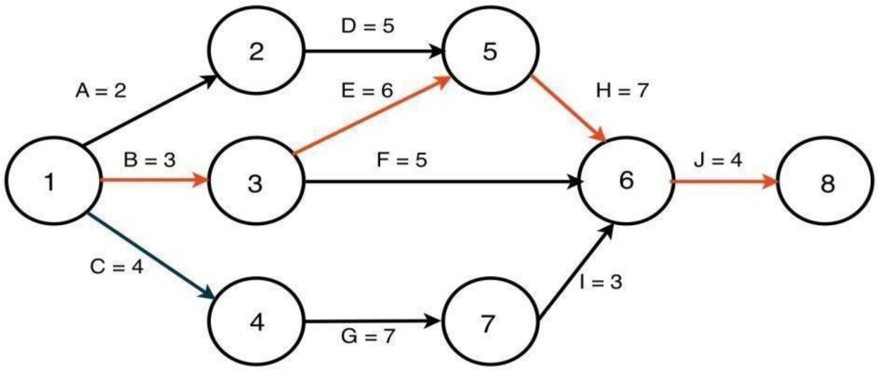
4. A project has the following schedule. Construct PERT network & compute the total float for each activity. Find critical path and its duration .Also calculate Total Float, Free Float
L1 L6 CO4 10M

Activity	**1-2**	**1-3**	**2-4**	**3-4**	**3-5**	**4-9**	**5-6**
Time in weeks	4	1	1	1	6	5	4
Activity	5-7	6-8	7-8	8-9	8-10	9-10	
Time in weeks	8	1	2	1	8	7	

5. The following table lists the jobs of a network with their estimates
   i) Draw the project network ii) Calculate the length and variance of the critical path and
   iii) What is the approximate probability that the jobs on the critical path will be completed in 41 Days **L1 L6 CO4 10M**

JOBS	Optimistic (t_o)	Most likely (t_m)	Pessimistic (t_p)
1-2	3	6	15
1-6	2	5	14
2-3	6	12	30
2-4	2	5	8
3-5	5	11	17
4-5	3	6	15
6-7	3	9	27
5-8	1	4	7
7-8	4	19	28

6. Find the critical path and calculate the Total float , Free float **L1 L6 CO4 10M**

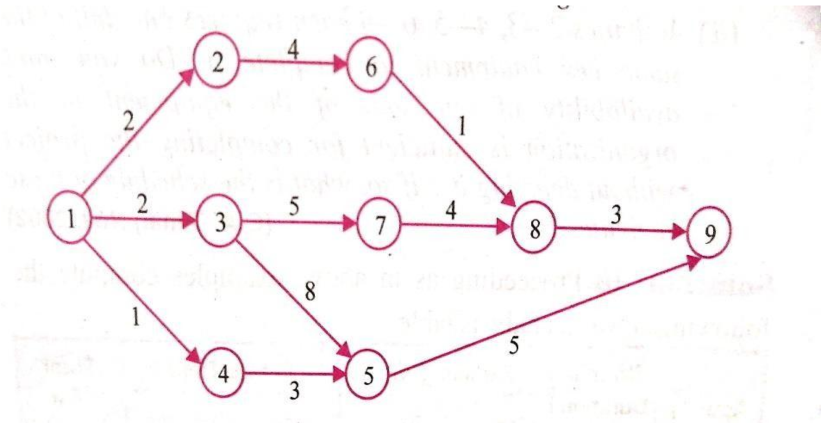


7. A project schedule has the following characteristics **L1 L6 CO4 10M**

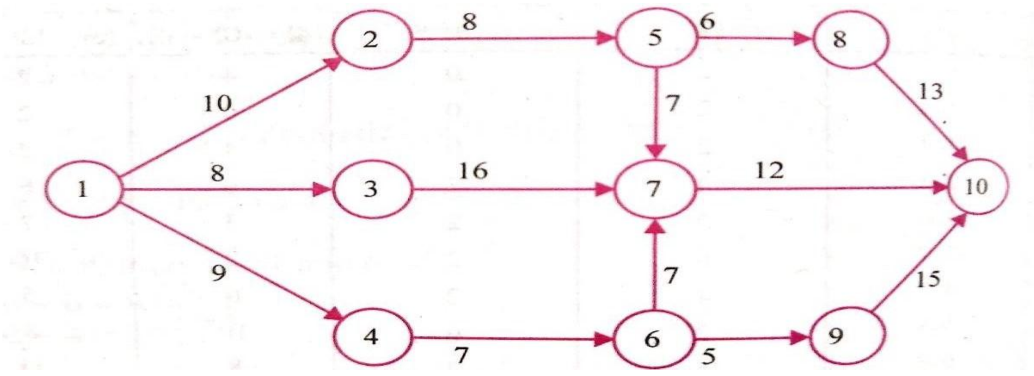
Activity	Time	Activity	Time
1-2	2	4-8	8
1-4	2	5-6	4
1-7	1	6-9	3
2-3	4	7-8	3
3-6	1	8-9	5
4-5	5		

Construct the PERT network and find critical path and Time duration of the project.

8. Find the critical path and calculate the slack time for each event for the following PERT diagram **L1 L6 CO4 10M**



9. Determine the early start (T_E) and Late start (T_L) in respect of all node points and identify the critical path in respect of the following network. **L1 L6 CO4 10M**



10. A) Explain the following a) critical event b) critical activity c) Total float D) Free float
    B) What is meant by critical path and explain the main features of critical path

L1 L6 CO4 10M

UNIT-V
REPLACEMENT & SEQUENCING

1 A Explain the Bellman's principle of optimality **L2 CO5 5M**

B Describe the various types of replacement situations and Explain about group replacement **L1 CO5 5M**

2 The cost of a machine is Rs6100 and its scrap value is Rs.100.The maintenance costsfound From experience are as follows. When should the machine be replaced? **L5 CO5 10M**

Year (n)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Running M/C Cost in Rs	100	250	400	600	900	1200	1600	2000

3 A truck owner from his past records that the maintenance costs per year of a truck whose Purchase price is Rs.8000 are as given below. When should the machine be replaced? **L5 CO5 10M**

Year (n)	1	2	3	4	5	6	7	8
Running cost (MC)in Rs.	1000	1300	1700	2000	2900	3800	4800	6000
Resale Price(Rs)	4000	2000	1200	600	500	400	400	400

4 Assume that present value of one rupee to be spent in a years' time is Re.0.90 and C=Rs 6000, Capital cost of equipment .Running costs are given in the table below. When should the machine be replaced? **L5 CO5 10M**

Year (n)	1	2	3	4	5	6	7
Running cost (MC)in Rs.	1000	1200	1600	2000	2600	3200	4000

5 The yearly cost of 2 machines A and B when money value is neglected is as follows.

Year (n)	1	2	3	4	5
Machine A	1800	1200	1400	1600	1000
Machine B	2800	200	1400	1100	600

Find their cost patterns if money values is 10% per year and hence find which machine is most Economical **L1 L5 CO5 10M**

6 A manufacturer, finds from his past records that casts per year associated with a machine with a purchase price of Rs 50,000/- are as given below. Determine the optimum policy **L5 CO5 10M**

Year (n)	1	2	3	4	5	6	7	8
Running cost (MC)in Rs.	15000	16000	18000	21000	25000	29000	34000	40000
Scrap value	35000	25000	17000	12000	10000	5000	4000	4000

7. Determine the sequence for the jobs and the total elapsed time **L5 CO4 10M**

	A	B	C	D	E	F	G	H	I
Machine1	4	7	6	11	8	10	9	7	6
Machine2	8	10	9	6	5	11	5	10	13

8. Find the sequence that minimizes the total elapsed time required to complete the following Tasks on the machines in the order 1 – 2 – 3. Find also the minimum total elapsed time and the ideal times on the machines. **L1 L3 CO4 10M**

		A	B	C	D	E	F
Tasks time on Machines	**1**	3	8	7	4	9	8
	2	4	3	2	5	1	4
	3	6	7	5	11	5	6

9. A What is mean by sequencing Problem and Define total elapsed time **L1 CO4 4M**

B Determine the sequence for the jobs and the total elapsed time **L3 CO4 6M**

	A	B	C	D	E	F	G	H	I
Machine1	4	7	6	11	8	10	9	7	6
Machine2	8	10	9	6	5	11	5	10	13

10. Determine a sequence for Five jobs that will minimize the elapsed time T and also calculate the total idle time for machines in this period

L3 CO4 10M

Processing Time (hours)					
Job	1	2	3	4	5
Time for A	5	1	9	3	10
Time for B	2	6	7	8	4