MARATHWADA INSTITUTE OF TECHNOLOGY, AURANGABAD

DEPARTMENT OF MASTER OF COMPUTER APPLICATION

OPERATION RESEARCH

QUESTION BANK

SYMCA
2013-14 Part-II

OR Assignment Questions

Unit-I

1) What is OR techniques? Where it can be used?
2) What is OR? List out various applications of OR.
3) Explain how operation research helps management in decision making.
4) Define following terms.
   i) Solution
   ii) Feasible solution
   iii) Optimum solution
   iv) Degenerate solution
   v) Basic solution
5) Explain the term.
   i) Non negative restrictions
   ii) Objective function
   iii) Feasible region
6) What are basic & non basic variables?
7) What is degeneracy in case of LPP?
8) Convert in dual problem & solve by Simplex Method
9) Explain the concept of Duality? How it is helpful in solving LPP? Explain with a small example.
10) How LPP is solved using graphical method?
11) An Advertising company is planning a media campaign for a client, willing to spend Rs.2000000 to promote a new fuel economy model of a pressure cooker. The client wishes to limit his campaign media to a daily newspaper, radio and prime time television .The agency's own research data on cost effectiveness of advertising media suggest the following:

Advertising Media	Cost per unit (Rs)	Estimated number of housewives Exposed to each advertising unit
Newspaper	20,000	1,00,000
Radio	40,000	5,00,000
Television	1,00,000	10,00,000

12) The client wishes that at least 50,000 housewives should be exposed to T.V. advertising .Also the expense on newspaper advertising must not exceed Rs.5,00,000.Formulate the problem as a linear programming problem

- **Solve by Simplex Method.**

13) Maximize (Z) = $3x_1+2x_2+5x_3$

Subject to Constraints $x_1+x_2+x_3\leq 9$

$2x_1+3x_2+5x_3\leq 30$

$2x_1-x_2-x_3\leq 8$

$x_1 , x_2,x_3\geq 0$

14) Minimize (Z) = 25x+30y

Subject to Constraints $2/3\ x+1/2y\geq 10$

$1/3x+1/2y\geq 6$

$x , y\geq 0$

15) Minimize (Z) = x_1+x_2

Subject to Constraints $2x_1+x_2\geq 4$

$x_1+7x_2\geq 7$

$x_1 , x_2\geq 0$

16) Maximize (Z) = $2x_1+3x_2+4x_3$

Subject to Constraints $x_1+x_2+x_3\leq 1$

$x_1+x_2+2x_3=2$

$3x_1+2x_2+x_3\geq 4$

$x_1 , x_2,x_3\geq 0$

17) Maximize (Z) = $4x_1+10x_2$

Subject to Constraints $2x_1+x_2\leq 10$

$2x_1+5x_2\leq 20$

$2x_1+3x_2\leq 18$

$x_1 , x_2\geq 0$

18) Maximize (Z) = 3x1+5x2+4x3

Subject to Constraints $2x1+3x2\leq 8$

$2x1+3x2 \leq 8$

$2x2+5x3 \leq 10$

$3x1+2x2+4x3 \leq 15$

$x1,x2,x3 \geq 0$

19) Maximize (Z) = $x1+x2+x3$

Subject to Constraints $3x1+2x2+x3 \leq 3$

$2x1+x2+2x3 \leq 2$

$x1,x2,x3 \geq 0$

- **Solve by Graphical Method**

20) Maximize (Z) = $30x_1+15x_2$

Subject to Constraints $x_1+3/2x_2 \leq 200$

$2x_1+x_2 \leq 200$

$3x_1 \leq 200$

$x_1 , x_2 \geq 0$

21) Maximize (Z) = $5x_1+7x_2$

Subject to Constraints $x_1+x_2 \leq 4$

$3x_1+8x_2 \leq 24$

$10x_1+7x_2 \leq 35$

$x_1 , x_2 \geq 0$

22) Minimize (Z) = $2x_1+2x_2$

Subject to Constraints $x_1+3x_2 \leq 12$

$3x_1+x_1 \geq 13$

$x_1 - x_2 = 3$

$x_1 , x_2 \geq 0$

23) Maximize (Z) = x_1+x_2

Subject to Constraints $x_1+2x_2 \leq 2000$

$x_1+x_2 \leq 1500$

$x_2 \leq 600$

$x_1 , x_2 \geq 0$

24) Maximize (Z) = $6x_1-2x_2+3x3$

Subject to Constraints $2x_1-x_2+2x3 \leq 2$

$x_1+4x_3 \leq 4$

$x_2 \leq 600$

$x_1 , x_2, x_3 \geq 0$

25) Maximize (Z) = $5x_1+7x2$

Subject to Constraints $x1+x2 \leq 4$

$3x_1+8x_2 \leq 24$

$10x_1+7x_2 \leq 35$

$x_1 , x_2 \geq 0$

26) Maximize (Z) = $300x_1+400x2$

Subject to Constraints $5x1+4x2 \leq 200$

$3x_1+5x_2 \leq 150$

$5x_1+4x_2 \geq 100$

$8x_1+4x_2 \geq 80$

$x_1 , x_2 \geq 0$

- **Convert in dual problem & solve by Simplex Method**

27) Minimize (Z) = $2x_1+3x_2$

Subject to Constraints $2x_1+x_2 \geq 6$

$x_1+2x_2 \geq 4$

$x_1 +x_2 \geq 5$

x_1 , x_20

28) Minimize (Z) = $2x_1+3x_2$

Subject to Constraints $x_1+x_2 \geq 5$

$x_1+2x_2 \geq 6$

$x_1 , x_2 \geq 0$

29) Maximize (Z) = $3x_1+2x_2$

Subject to Constraints $x_1+x_2 \leq 5$

$x_1-x_2 \leq 2$

$x_1 , x_2 \geq 0$

30) Maximize (Z) = $6x_1+7x_2+3x_3+5x_4$

Subject to Constraints $5x_1+6x_2-3x_3+4x_4 \geq 12$

$x_2+5x_3-6x_4 \geq 10$

$2x_1+5x_2+x_3+x_4 \geq 8$

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

Unit-II

Transportation Problems

1) Explain Transportation problem? Explain degeneracy in transportation problem?
2) Explain in detail 'Stepping stone method' for transportation problem with illustration.
3) Explain the steps used to solve transportation problem using MODI method.
4) What is unbalanced transportation problem? Does any extra cost required to considered in case of such type of problem?
5) Write down the steps of North West Corner Method for solving transportation problem.
6) Explain with example how Initial Basic Feasible Solution for transportation problem using Least Cost Method .
7) Explain the steps of Vogel's Approximation Method with example.
8) Solve by North West Corner Method

Plants	**Warehouses**				**Supply**
	W1	**W2**	**W3**	**W4**	
P1	6	2	6	12	120
P2	4	4	2	4	200
P3	13	8	7	2	80
Demand	50	80	90	180	400

9) Find the initial feasible solution for the following problem using North West Corner Method. Optimize solution using stepping stone.

Consumption centers	**Warehouses**				**Requirements (Units)**
	P1	**P2**	**P3**	**P4**	
C1	10	4	9	5	25
C2	6	7	8	7	25
C3	3	8	6	9	25
Capacity	9	28	20	18	

10) Find the initial feasible solution for the following problem using North West Corner Method. Optimize solution using MODI method.

Plants	**Machines**				**Requirements (Units)**
	M1	**M2**	**M3**	**M4**	
A	8	5	7	10	25
B	4	5	9	12	40
C	11	2	6	5	10
Capacity	20	18	30	07	

11) Solve by Vogel's Approximation Method.

Plants	Warehouses					Supply
	W1	W2	W3	W4	W5	
P1	20	28	32	55	70	50
P2	48	36	40	44	25	100
P3	35	55	22	45	48	150
Demand	100	70	50	40	40	300

12) A company has three plants that supplies to four marketing areas are given below:
Find Basic feasible solution using VAM. Is the solution obtained is optimal?

Plants	Warehouses				Supply
	W1	W2	W3	W4	
P1	19	30	50	10	1600
P2	70	30	40	60	1200
P3	40	8	70	20	1700
Demand	1000	1500	800	1200	

13) Solve the following Transportation problem.

	A	B	C	Supply
1	17	31	45	5
2	12	14	23	8
3	46	32	13	7
4	38	16	19	5
Demand	5	11	5	

14) Find the initial feasible solution for the following problem using least cost method.

Plants	Warehouses				Supply
	W1	W2	W3	W4	
P1	1	2	1	4	30
P2	3	3	2	1	50
P3	4	2	5	9	20
Demand	20	40	30	10	

15) Find the minimum shipping cost for the following transportation problem using VAM.

Plants	Warehouses				Supply
	A	B	C	D	
P	10	12	15	08	130
Q	14	12	09	10	150
R	20	05	07	18	170
Demand	90	100	140	120	

16) Find the minimum shipping cost for the following transportation problem using VAM.

Plants	Warehouses				Requirement
	a	b	c	d	
A	10	13	14	20	30
B	7	8	29	23	52
C	28	27	16	14	28
Capacity	12	18	40	30	

17) Solve the following transportation problem using VAM to minimize cost.

Factories	Warehouses				Availability
	W1	W2	W3	W4	
F1	48	60	56	58	140
F2	45	55	53	60	260
F3	50	65	60	62	360
F4	52	64	55	61	220
Capacity	200	300	250	210	

18) Solve the following Transportation problem using NWCM.

	W1	W2	W3	Demand
M1	25	38	52	200
M2	15	37	29	300
Supply	180	220	150	

19) Solve the following transportation problem by using Least Cost Method.

Factories	Warehouses				Availability
	M1	M2	M3	M4	
W1	19	30	50	10	7
W2	70	30	40	60	9
W3	40	8	70	20	18
Capacity	5	8	7	14	

20) Solve the following Transportation problem to get optimal cost using stepping stone.

	I	II	III	IV	V	VI	Capacity
A	5	3	7	3	8	5	3
B	5	6	12	5	7	11	4
C	2	1	2	4	8	2	2
D	9	6	10	5	10	9	8
Demand	3	3	6	2	1	2	

21) Find the initial feasible solution for the following problem using North West Corner Method. Optimize solution using stepping stone.

	P1	**P2**	**P3**	**Supply**
M1	5	8	11	100
M2	7	13	9	350
M3	18	22	17	500
Capacity	200	600	150	

22) Find the initial feasible solution for the following problem using North West Corner Method. Optimize solution using stepping stone.

	M1	**M2**	**M3**	**M4**	**Supply**
W1	10	6	8	3	40
W2	15	8	5	9	30
W3	8	10	5	9	20
Demand	25	15	15	35	

Unit-III

Assignment Problems

1) What are Assignment problems? Describe mathematical formulation of an assignment problem?
2) Enumerate the steps in the "Hungarian Method" used for solving assignment problem.
3) A departmental head has four subordinates and four task for completion. The subordinates differ in their capabilities and tasks differ in their capabilities and tasks differ in their work contents and intrinsic difficulties. His estimate of time for each subordinate and each task is given the matrix below:

Tasks	Subordinates			
	I	II	III	IV
	Processing Times(Hrs.)			
A	17	25	26	20
B	28	27	23	25
C	20	18	17	14
D	28	25	23	19

How should the tasks be assigned to minimize requirements of man-hours?

4) An engineering company has branches in Bombay. Calcutta, Delhi and Madras. A branch manager is to be appointed, one at each city, out of four candidates A, B, C and D Depending on the branch manager and the city varies in lakhs of rupees as per details below:

Branch Manager	City			
	Bombay	Calcutta	Delhi	Madras
	(Business Rs. In lakhs)			
A	2	3	1	1
B	5	8	3	3
C	4	9	5	1
B	8	7	8	4

Suggest which manager should be assigned to which city so as to get maximum total monthly Business .

5) The machine shop supervisor has four machines and four tasks for completion. Each of the machines can perform each of the four tasks .Time taken at each of the machines to complete the tasks is given in the matrix below:

Tasks	Machines			
	M1	M2	M3	M4
	Processing Times(Hrs.)			
1	31	62	29	42
2	12	19	39	55
3	17	29	50	41
4	35	40	38	42

How should the tasks be assigned to minimize total time required for processing.

6) Solve the following assignment problem:

	A	B	C	D	E
I	6.2	7.8	5.0	10.1	8.2
II	7.1	8.4	6.1	7.3	5.9
III	8.7	9.2	11.1	7.1	8.1
IV	4.8	6.4	8.7	7.1	8.0

7) Solve following assignment problem to minimize the cost.

	M1	M2	M3	M4
Sachin	31	62	29	42
Rajesh	12	19	39	55
Anil	17	29	50	41
Bharat	35	40	38	42

8) Solve following assignment problem to minimize the cost.

Operator	1	2	3	4	5
A	6	2	5	2	6
B	2	5	8	7	7
C	7	8	6	9	8
D	6	2	3	4	5
E	9	3	8	9	7
F	4	7	4	6	8

9) Solve following assignment using Hungarian Method.

Operator	1	2	3	4	5
A	90	101	89	77	54
B	82	59	62	94	67
C	45	73	66	58	49
D	103	67	72	88	93

10) Solve following assignment problem to minimize the cost.

Operator	1	2	3	4	5	6
T1	12	24	30	45	32	42
T2	25	34	16	40	26	31
T3	37	51	26	33	19	28
T4	31	33	36	56	29	45
T5	37	34	26	27	15	43
T6	21	45	19	53	22	40

11) Solve following assignment problem Hungarian Method.

Operator	a	b	c	d	e	f
A	19	27	53	12	17	27
B	43	68	77	58	62	44
C	45	28	81	47	49	53
D	71	41	22	59	29	38
E	36	11	57	22	25	18
F	13	46	43	39	27	28

12) Solve following assignment problem to minimize the cost.

	A	B	C	D
P	8	5	8	2
Q	9	3	6	9
R	4	10	7	4
S	3	5	6	1

13) Solve following assignment problem to maximize the cost.

Operator	1	2	3	4	5
A	10	12	18	15	9
B	12	10	20	18	10
C	8	9	15	10	8
D	9	8	24	12	12
E	10	15	18	12	10

14) To determine the order in which books should be processed in order to minimize the total time required to turn out all the books.

Book	1	2	3	4	5	6
Printing Time(Hrs)	30	120	50	20	90	110
Binding Time(Hrs)	80	100	90	60	30	10

15) To determine the order in which jobs should be processed in order to minimize the total time required to turn out all the jobs.

Job	Time for Turning(minutes)	Time for Threading(minutes)
1	3	8
2	12	10
3	5	9
4	2	6
5	9	3
6	11	1

16) To determine the sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machines A & B.

Job	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Machine A	3	12	15	6	10	11	9
Machine B	8	10	10	6	12	1	3

17) To determine the order in which jobs should be processed in order to minimize the total time required to turn out all the jobs. Also find the idle times for the three operations.

Job	**Time for Turning(minutes)**	**Time for Threading(minutes)**	**Time for Kurling(minutes)**
1	3	8	13
2	12	6	14
3	5	4	9
4	2	6	12
5	9	3	8
6	11	1	13

18) To determine the optimum sequence of these jobs that will minimize the total elapsed time T. Also find idle time for three machines and waiting time for the jobs.

Job	**A**	**B**	**C**
1	3	4	7
2	8	5	9
3	7	1	5
4	5	2	6
5	4	3	10

19) To determine the order in which books should be processed in order to minimize the total time required to turn out all the jobs.

Job	**1**	**2**	**3**	**4**	**5**
Machine A	5	1	9	3	10
Machine B	2	6	7	8	4

20) To determine the optimum sequence of these jobs that will minimize the total elapsed time T. Also find idle time for three machines and waiting time for the jobs.

Job	**A**	**B**	**C**
1	8	5	4
2	10	6	9

3	6	2	8
4	7	3	6
5	11	4	5

21) To determine the sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machines A & B & C.

Job	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Machine A	12	6	5	3	5	7	6
Machine B	7	8	9	8	7	8	3
Machine c	3	4	11	5	2	8	4

22) To determine the order in which books should be processed in order to minimize the total time required to turn out all the jobs.

Job	**1**	**2**	**3**	**4**	**5**
Machine A	5	1	9	3	10
Machine B	2	6	7	8	4

23) To determine the order in which books should be processed in order to minimize the total time required to turn out all the books.

Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Cutting Time	5	7	3	4	6	7	12
Sewing Time	2	6	7	5	9	5	8

24) To determine the order in which books should be processed in order to minimize the total time required to turn out all the jobs.

Job	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Machine M1	5	4	22	16	15	11	9	4
Machine M2	6	10	12	8	20	7	2	21

25) To determine the sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machines A & B & C.

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

Unit-IV

PERT and CPM

.

1) Write difference between PERT Network & CPM Network.
2) Write a note on 'activity and critical activity'.
3) Write a short note on 'Fulkerson's rule' for numbering the events in the network.
4) A research project consists of eleven activities Identified by their beginning (i) and ending nodes (j) as under. Three time estimates have also been specified against each activity.

Activity (i-j)	Estimated Duration (weeks)		
	Optimistic time(a)	Most likely time(m)	Pessimistic time (b)
1-2	6	7	8
1-3	4	5	12
1-4	2	10	12
2-5	3	7	11
3-6	10	20	48
3-7	6	9	18
4-6	3	3	9
5-8	3	3	9
6-9	8	18	40
7-8	2	6	10
8-9	2	5	14

(a) Calculate expected time of each activity.
(b) Construct the network diagram for the above project
(c) Enter the expected time of the activities computed under (a) into the network.

5) Draw a network for the following project and number the events according to Fulkerson's rule:
A is the start event and K is the end event .
A precedes event B.
J is the successesor event to F.
C and D are the successesor events of B.
D is the preceding event to G.
E and F occur after event C.
E precedes event F.
C restraints the occurrence of G and G precedes H.
H precedes J and K succeeds J.
F restraints the occurrence of H .

6) Draw a network for the simple project of erection of steel works for a shed . The various activities of project are as under: using Fulkerson's rule:

Activity	Description	Preceded by
A	Erect site workshop	-
B	Fence site	-
C	Bend reinforcement	A

D	Dig foundation	B
E	Fabricate steel work	A
F	Install concrete pillars	B
G	Place reinforcement	C,D
H	Concrete foundation	G,F
I	Erect steel work	E
J	Paint steel	H,I
K	Give finishing touch	J

7) Tasks A, B, C, H, I constitute a project. The precedence relationships are A < D; A<E, B < F; D < F,C < G, C < H; F < I, G < I
Draw a network to represent the project and find the minimum time of completion of the project when time, in days, of each task is as follows:

Tasks	A	B	C	D	E	F	G	H	I
Time	8	10	8	10	16	17	18	14	9

Also identify the critical path.

8) The utility data for a network are given below. Determine the total, free, and independent floats and identify the critical path.

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	2	8	10	6	3	3	7	5	2	8

9) A Project has the following time schedule :

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

Construct network diagram, Find the critical path, Find the Earliest Starting and Finishing time and Latest Starting and Finishing time, Total floats for each activity

10) A Project has the following time schedule :

Activity	**Predecessor**	**Optimistic Time (t_o)**	**Most Likely Time (t_m)**	**Pessimistic Time (t_p)**
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

Construct PERT network diagram, Find the expected duration & variance of each activity, Find the critical path & expected project completion time

11) A Project has the following time schedule :

Activity	Optimistic Time (t_o)	Most Likely Time (t_m)	Pessimistic Time (t_p)
1-2	1	5	1.5
2-3	1	3	2
2-4	1	5	3
3-5	3	5	4
4-5	2	4	3
4-6	3	7	5
5-7	4	6	5
6-7	6	8	7
7-8	2	6	4
7-9	5	8	6
8-10	1	3	2
9-10	3	7	5

Construct PERT network diagram, Find the expected duration & variance of each activity, Find the critical path & expected project completion time. Also find the project duration at 95% probability.

12) What is critical path analysis? What are the areas where these techniques can be applied?
13) What is the significance of three times estimates used in PERT?