

Seat No. : _____

DC-134

December-2017

**4th Year M.Sc. (CA & IT) Integrated
Operations Research**

Time : 2 Hours]

[Max. Marks : 100

Instruction : Graph paper and statistical table will be provided on request.

1. Answer any **two** :

2 × 10 = 20

- (a) A chemical company produces two products A and B that are sold as raw materials to companies manufacturing bath soap and laundry detergents. The company's management has specified that the combined product for product A and B must total at least 350 litres. Also a major customer's order for 125 litres of product A also must be satisfied. Product A requires 2 hours of processing time per litre while product B requires 1-hour of processing time per litre. For coming month 600 hours of processing time are available. The company's objective is to satisfy these requirements at a minimum total production cost. Product costs are ₹ 2 per litre for product A and ₹ 3 per litre of product B.

Formulate it as an LPP and solve it by graphical method.

- (b) Solve the following :

$$\text{Max } z = 45x_1 + 30x_2$$

Subject to :

$$5x_1 + 3x_2 \leq 80$$

$$4x_1 + 6x_2 \leq 100$$

$$x_1, x_2 \geq 0$$

(c) (i) Define : Basic variable, infeasible solution, slack variable, multiple optimal solution, unboundedness.

(ii) Convert the following primal to dual :

$$\text{Max } z = 4x_1 + 5x_2 + x_3$$

Subject to

$$x_1 - x_2 + x_3 \leq 10$$

$$5x_1 + 4x_2 + x_3 \geq 20$$

$$x_1, x_2 \geq 0, x_3 \text{ is unrestricted in sign.}$$

2. Answer any **two** :

2 × 10 = 20

(a) A company has three plants and four warehouses. The supply and demand in units and the corresponding transportation costs are given below :

Warehouse → Plant ↓	W1	W2	W3	W4	Supply
A	6	11	5	6	100
B	7	9	8	3	250
C	5	3	6	8	200
Demand	250	100	150	50	

Formulate it as a linear programming problem for optimum allocation.

(b) A company has four factories situated at different locations in the country and four sales agencies located at four different regions. The cost of production (₹ per unit), transportation cost (₹ per unit), selling price at sales agencies (₹ per unit) and monthly factory capacities and requirements are given below :

Sales Agencies → Factory ↓	S1	S2	S3	S4	Supply	Production Cost
A	7	5	6	4	10	10
B	3	5	4	2	15	15
C	4	6	4	5	20	16
D	8	7	6	5	15	15
Requirement :	8	12	18	22		
Selling Price :	23	22	25	21		

Find the optimal allocation.

- (c) Following table is taken from the solution procedure of a transportation problem, involving minimization of cost :

Stockists → Factory ↓	X	Y	Z	Capacity
A	(31) 4	(25) 8	8	56
B	(31) 16	24	(31) 16	62
C	8	(77) 16	24	77
Demand	62	102	31	<div style="border-top: 1px solid black; border-left: 1px solid black; padding: 2px;"> 195 </div>

- (i) Show that given solution is not optimal.
- (ii) Find an optimal solution.
- (iii) Does the optimal solution have multiple optimal solution ? Give reason. If yes, find the alternate optimal solution.

3. Answer any **two** :

2 × 10 = 20

- (a) Four new machines M_1 , M_2 , M_3 and M_4 are to be installed. There are five places A, B, C, D and E. Cost of installation of the machines at different places are given below. Find the optimal assignment schedule :

Place → Machine ↓	A	B	C	D	E
M_1	6	5	8	4	9
M_2	12	14	14	16	18
M_3	6	5	5	3	7
M_4	10	9	8	11	8

- (b) A trip from Surendranagar to Dwarka Takes six hours by bus. A typical time table of bus services by a company is given below. The cost of providing this service by the company depends upon the time spent by the bus crew away from their base location. There is a constraint that every crew should be provided at least four hours of rest before commencing the return trip. The crew can be based either in Surendranagar or Dwarka. Suggest an optimal solution.

Surendranagar to Dwarka			Dwarka to Surendranagar		
Departure from Surendranagar	Bus Number	Arrival at Dwarka	Departure from Dwarka	Bus Number	Arrival at Surendranagar
06:00	a	12:00	05:30	1	11:30
07:30	b	13:30	09:00	2	15:00
11:30	c	17:30	15:00	3	21:00
19:00	d	01:00	18:30	4	00:30
00:30	e	06:30	00:00	5	06:00

- (i) Define : Unbalanced assignment problem and constrained assignment problem.
- (ii) Following table gives the time required (in hours) for assigning a job to an operator. Formulate it as an LPP.

Operator →	O ₁	O ₂	O ₃	O ₄
Job ↓				
J ₁	a ₁	a ₂	a ₃	a ₄
J ₂	b ₁	b ₂	b ₃	b ₄
J ₃	c ₁	c ₂	c ₃	c ₄
J ₄	d ₁	d ₂	d ₃	d ₄

4. Answer any **two** :

2 × 10 = 20

(a) A project schedule has the following characteristics :

Activity :	1 – 2	1 – 3	2 – 4	3 – 4	3 – 5	4 – 9	5 – 6	5 – 7	6 – 8	7 – 8	8 – 10	9 – 10
Time (days) :	4	1	1	1	6	5	4	8	1	2	5	7

- Construct the network diagram.
- Find the critical path and total project duration.

(b) Activities involved in a project with their duration and immediate predecessors are given below :

Activity	Preceding Activities	Duration (Days)
a	—	2
b	—	3
c	—	3
d	c	1
e	d	6
f	b	1
g	c, d	5
h	c, d	8
i	c, d	5
j	a	4
k	d, i	1
l	h, k	1
m	e, l	10
n	g, m	8

- Identify and remove redundant immediate predecessor (if any).
- Develop an arrow diagram.

- (c) The person in-charge of planning and co-ordinating a training program listed the following information :

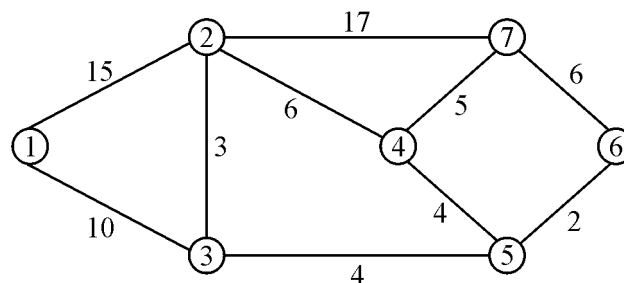
Activity	Immediate	Time (weeks)		
	Predecessor	Optimistic	Most likely	Pessimistic
A	—	1.5	2.0	2.5
B	A	2.0	2.5	6.0
C	—	1.0	2.0	3.0
D	C	1.5	2.0	2.5
E	B, D	0.5	1.0	1.5
F	E	1.0	2.0	3.0
G	B, D	3.0	3.5	7.0
H	G	3.0	4.0	5.0
I	F, H	1.5	2.0	2.5

- (i) Draw the project network.
- (ii) What are the critical activities and what is the expected project completion time ?

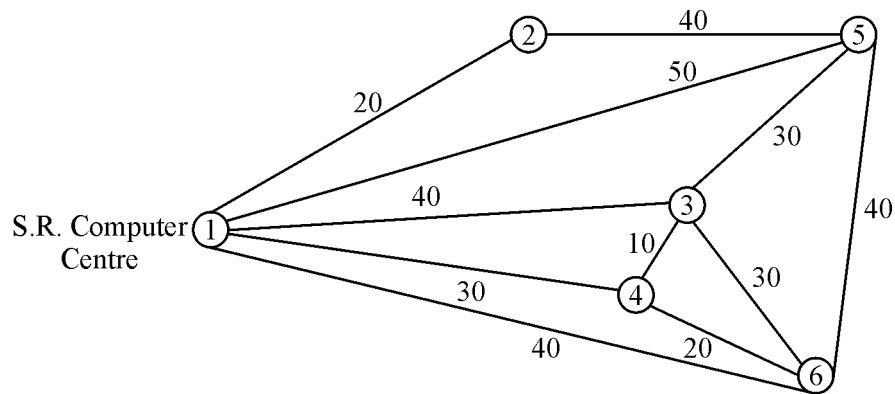
5. Answer any **two** :

2 × 10 = 20

- (a) Find the shortest path from 1 to 7, using Dijkstra's algorithm :

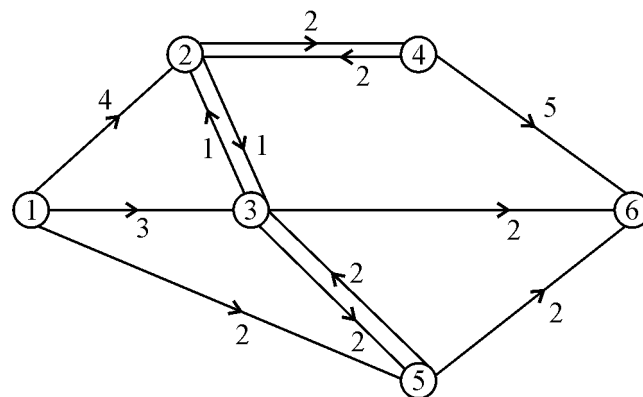


- (b) The S.R. Computer Centre would like to have special computer communications lines installed to connect five satellite users to a new central computer. The installation is an expensive operation, so the management wants the communication lines to be as short as possible. Communication lines can be directly connected to computer centre and user or user can tap into the system by linking them with users already connected to the system. Following networks provides the possible connections along with their distances :



Find the best solution of the problem.

- (c) For the following highway network system determine the maximal flow in vehicle per hours from 1 to 6 :



Unit of flow is in hundred vehicles.

