BE10-R3: APPLIED OPERATIONS RESEARCH

NOTE:

> 1. **Answer question 1 and any FOUR from questions 2 to 7.**
> 2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Solve the following LPP by graphical method:

maximize $Z = 3x + 4y$

Subject to $4x + 2y \leq 80$

$2x + 5y \leq 180$

$x, y \geq 0$

b) Write the dual of the following LPP

Minimize $Z = 3x - 2y + 4z$

Subject to

$6x + y + 3z \geq 4$

$7x - 2y - z \leq 10$

$x - 2y + 5z = 3$

$x, y, z \geq 0$

c) There are eight jobs, each of which has to go through the machines A and B in the order AB. Processing time in hours are given as follows:

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

Determine a sequence of these jobs that will minimize the total elapsed time.

d) A publisher has contract with an author to publish a text book. The (simplified) activities associated with the production of the text book are given below. Develop the associated network for the project.

Activity		Predecessor(s)	Duration (weeks)
A	Manuscript proof reading by editor	-	3
B.	Sample pages prepared by typesetter	-	2
C.	Book Cover Design	-	4
D.	Preparation of artwork for book figures	-	3
E.	Author's approval of edited manuscript and sample pages	A, B	2
F.	Book typesetting	E	2
G.	Author checks type set pages	F	2
H.	Author checks artwork	D	1
I.	Production of printing plates	G, H	2
J.	Book production and binding	C, I	4

e) Solve the following two person game whose pay off matrix is as follows:

Player 2

Player 1	9	3	1	8	0
	6	5	4	6	7
	2	4	3	3	8
	5	6	2	2	1

f) A transport corporation has three vehicles W, X, Y to be assigned to three cities A, B, C for tourism. The distance differ from one city to another as under-

	W	X	Y
A	33	40	43
B	45	28	31
C	42	29	36

Assign the vehicles to the cities in such a way that the total distance travelled is minimized.

g) An AC serviceman finds that the time spent on this job has an exponential distribution with mean 20 minutes. He repairs sets in the order in which they come in, and the arrival of sets is approximately Poison with an average rate of 8 per 8 hours a day. What is the serviceman's expected idle time each day?

(7x4)

2.

a) Use MODI method to obtain the optimal solution for the transportation problem given below:

	D_1	D_2	D_3	D_4	Supply
O_1	21	32	52	12	7000
O_2	72	32	42	62	9000
O_3	42	10	72	22	18000
Demand	5000	8000	7000	14000	

b) Use simplex method to solve the following linear programming problem

Minimize $z = 8x_1 + 4x_2$

Subject to $3x_1 + x_2 \geq 27$

$x_1 + x_2 = 21$

$x_1 + 2x_2 \leq 40$

$x_1, x_2 \geq 0.$

(9+9)

3.

a) Find the sequence that minimize the total time required to perform the following jobs on three machines in the order ABC. The processing time (in hours) are given below:

Job	**Machine A**	**Machine B**	**Machine C**
1	4	9	14
2	13	7	15
3	6	5	10
4	3	7	13
5	10	4	9
6	12	2	14

Also determine minimum elapsed time and idle time for each machine.

b) Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of a telephone call is assumed to be distributed exponentially with mean 3 minutes.

i) What is the probability that a person arriving at the booth will have to wait?

ii) What is the average length of the queues that form time to time?

iii) The telephone department will stall a second booth when convinced that an arrival would expect to have to wait at least three minutes for the phone. By how much must the flow of arrivals be increased in order to justify a second booth?

(9+9)

4.

a) Solve the following integer programming problem using the branch and bound method

Maximize $z = 2x + 3y$

Subject to constraints

$$6x + 5y \leq 25$$
$$x + 3y \leq 0$$
$$x, y \geq 0 \text{ and integers}$$

(b) A linear Markovian birth process, initialized at one member, experiences an average hourly birth rate $\lambda = 2$. Determine the probability of having a population larger than 3 after 1 hr.

(10+8)

5.

a) The demand for a product is 25 units per month and the items are withdrawn uniformly. The set up cost each time a production is run is Rs 15. The inventory holding cost is Rs 0.30 per item per month.

i) Determine, how often to make production run, if shortages are not allowed.

ii) Determine, how often to make the production run if shortage cost is Rs 1.50 per item per month.

b) In the inventory of a company, which deals with large heavy metal blocks, four new blocks are to be placed. There are only five empty places in the inventory of the company, namely A, B, C, D and E, where places A and C are relatively small. Hence the place A cannot hold block 3 and place C can not hold block 2.The cost of transferring the blocks into places of inventory is as follows:

Places / Blocks	A	B	C	D	E
1	9	11	15	10	11
2	12	9	-	10	9
3	-	11	14	11	7
4	14	8	12	7	9

Find the optimal inventory placement assignment.

(8+10)

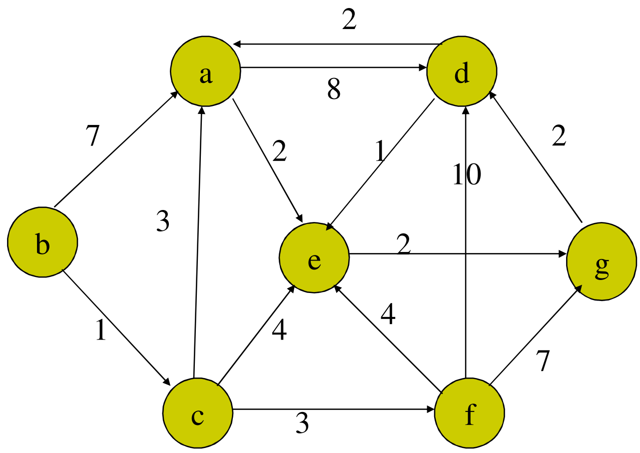
6.

a) A small project is composed of 7 activities whose time estimates are listed in the table below:

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
Optimistic time	1	1	2	1	2	2	3
Most likely time	1	4	2	1	5	5	6
Pessimistic time	7	7	8	1	14	8	15

i) Find the expected duration and variance of each activity
ii) Draw the project network.
iii) What is the expected project length?
iv) Calculate the variance and standard deviation of critical path.

b) Use the Dijkstra's algorithm to find shortest paths from node 'b' to all others in the following network.



(9+9)

7.

a) Solve the following using dynamic programming:

Maximize $z = Y_1 Y_2 Y_3$

Subject to $Y_1 + Y_2 + Y_3 = 5$

$Y_1, Y_2, Y_3 \geq 0.$

b) Use the concept of dominance to solve the following game

		Player B			
		I	II	III	IV
	I	3	2	4	8
Player A	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

(9+9)