USN ☐☐☐☐☐☐☐☐☐☐   **18ME735**

Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024
Operations Research

Time: 3 hrs.   Max. Marks: 100

Note : 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of SQC table (Area under Normal Curve) is permitted.*

Module-1

1 a. Explain the evolution of OR. List the advantages and disadvantages of OR. **(10 Marks)**

   b. A manufacturer produces three models I, II and III of a certain product using raw materials A and B. The following table gives the data.

Raw Material	Requirement per unit			Availability
	I	II	III	
A	2	3	5	4000
B	4	2	7	6000
Minimum demand	200	200	150	-
Profit / unit	30	20	50	

Formulate this problem as LPP to maximize the profit. **(10 Marks)**

OR

2 a. Explain in detail various phases of OR. **(10 Marks)**

   b. Determine graphically what type of solution is obtained for the following LPP.
Minimize $= Z = 20x + 10y$.
Subjected to constraints : $x + 2y \leq 40$
$$3x + y \geq 30$$
$$4x + 3y \geq 60$$
$$x, y \geq 0.$$
(10 Marks)

Module-2

3 a. Define Slack variable, Surplus variable and Artificial variable. **(06 Marks)**

   b. Solve the following by Simplex method.
Max. $Z = 3x_1 + 2x_2 + 5x_3$
Subject to the constraints : $x_1 + 2x_2 + x_3 \leq 430$
$$3x_1 + 2x_3 \leq 460$$
$$x_1 + 4x_2 \leq 420 \quad \text{and}$$
$$x_1, x_2, x_3 \geq 0.$$
(14 Marks)

OR

4 Solve the following problem by Big – M method.
Max. $Z = x_1 + 2x_2 + 3x_3 - x_4$
Subjected to the constraints : $x_1 + 2x_2 + 3x_3 = 15$
$$2x_1 + x_2 + 5x_3 = 20$$
$$x_1 + 2x_2 + x_3 + x_4 = 10 \quad \text{and}$$
$$x_1, x_2, x_3, x_4 \geq 0.$$
(20 Marks)

Module-3

5 a. How does the problem of Degeneracy arise in transportation problem? Explain how does one overcome it. **(06 Marks)**

b. PQR limited has three production shops supplying a product to five warehouses. The cost of production varies from shop to shop, cost of transportation from shop to shop, cost of transportation from shop to warehouses also varies. Each shop has a specific production capacity. Each warehouse has certain amount of requirement. The cost of transportation are as given below :

Shop	Warehouse					Capacity	Cost of production
	I	II	III	IV	V		
P	6	4	4	7	5	100	14
Q	5	6	7	4	8	125	16
R	3	4	6	3	4	175	15
Requirement	60	80	85	105	70		

Find the optimum quantity to be supplied from each shop to different warehouse at minimum cost. **(14 Marks)**

OR

6 a. A Company has Five persons and Five tasks. Determine the optimal assignment that minimizes the total cost.

Jobs	Machines				
	A	B	C	D	E
P	6	7	5	9	4
Q	7	5	10	9	6
R	5	4	3	6	5
S	8	3	5	6	4
T	4	7	5	6	6

(10 Marks)

b. A machine operator purchases five type of operations on his machine each week, and must choose sequence for them. The set – up cost per change depends on the item presently on machine and the set – up to be made according to the following table given below :

From item	To item				
	A	B	C	D	E
A	∞	3	6	2	3
B	3	∞	5	2	3
C	6	5	∞	6	4
D	2	2	6	∞	6
E	3	3	4	6	∞

If he processes each type of item only once in each week, how should he sequence the items on his machine? Use the method of travelling salesman to find minimum cost. **(10 Marks)**

Module-4

7 a. Compare the two techniques PERT and CPM. **(06 Marks)**

b. The following table lists the jobs of a network with their estimates.

Jobs (i - j)	Duration (days)		
	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

  i)   Draw the Project work.
  ii) Calculate the length and variance of the critical path and
  iii) What is the approximate probability on the critical path will be completed in 41 days?

(14 Marks)

OR

8 a. Briefly explain queing system and its features. (06 Marks)
   b. Arrival rate of telephone call at a telephone booth are according to Poisson distribution, with an average time of 9 minutes between two consecutive arrivals. The length of telephone call is assumed to be exponentially distributed with mean 3 minutes.
   i)   Determine the probability that a person arriving at the booth will have to wait.
   ii) Find the average queue length.
   iii) The telephone company will install a second booth when convinced that an arrival would expect to have to wait at least four minutes for the phone. Find the increase in flow rate of arrivals which will justify a second booth.
   iv) What is the probability that he will have to wait for more than 10 minutes before the phone is free?

(14 Marks)

Module-5

9 a. Use the dominance rule to find the optimum strategies for both the players.

B

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

(10 Marks)

   b. Solve the following game by Graphical method.

B

		I	II	III	IV
A	I	2	2	3	-1
	II	4	3	2	6

(10 Marks)

OR

10 a. The following table contains information regarding four jobs that are waiting to be processed at a work center :

Jobs	Processing time (days)	Due data (days)
A	14	20
B	10	16
C	7	15
D	6	17

Sequence the jobs using :
i)   Shortest Processing Time (SPT).
ii) FCFS.
iii) LCFS.
iv) Processing with due dates.

Assume the list is by order of arrivals. For each of the methods determine the average job flow time, average lateness. **(08 Marks)**

b. We have five jobs each of which must go through the machines A, B and C in the order ABC. Determine a sequence for job that will minimize the total elapsed time and idle time for each machine. **(12 Marks)**

Job Number	Processing time in hours				
	1	2	3	4	5
Machine "A"	5	7	6	9	5
Machine "B"	2	1	4	5	3
Machine "C"	3	7	5	6	7

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