CBCS SCHEME

USN | | | | | | | | | |

15ME81

Eighth Semester B.E. Degree Examination, November 2020
Operations Research

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions irrespective of modules.
2. Use of SQC table (area under normal curve only) is permitted.

Module-1

1 a. What are the phases of solving an O.R. problem? **(02 Marks)**

b. ABC company owns a paint factory that produces both exterior and interior paints. The basic raw materials A and B are used to manufacture the paints. The maximum availability of A is 6 tonne/day and that of B is 8 tonne/day. The requirements of raw material per tonne of interior and exterior paints are given below:

Raw material	Exterior paint	Interior paint
A	1	2
B	2	1

The survey shows that maximum demand for interior paint is limited to 2 tonne/day. The price/tone is Rs. 3000 for exterior and Rs. 2000 for interior paint. How much interior and exterior paint the company should produce to maximize the gross income. Formulate and solve graphically. **(07 Marks)**

c. Solve the following LPP by graphical method:

$Z_{max} = 3x_1 + 4x_2$

Subject to constraints, $5x_1 + 4x_2 \leq 200$

$3x_1 + 5x_2 \leq 150$

$5x_1 + 4x_2 \geq 100$

$8x_1 + 4x_2 \geq 80$, $x_1, x_2 \geq 0$ **(07 Marks)**

2 a. Discuss applications of O.R. techniques. **(02 Marks)**

b. A company wishes to plan its advertising strategy for a new product. Two magazines are under consideration, one is a weekly and one is a monthly. The weekly has 2000 potential customers whereas the monthly has 3000 in one page of advertising. The cost of advertising per page in the weekly and monthly is Rs. 400 and Rs. 600 respectively. The company has a budget of Rs. 6000 per month for the advertisement. There is an important requirement that the total reach for the income group under Rs. 20,000 per annum should not exceed 4000 potential customers. The reach of the weekly and the monthly for this income group is 400 and 200 potential customers per page of advertisement. How many pages should be brought in two magazines to maximize reach? **(07 Marks)**

c. Solve the following LPP graphically:

Maximize, $Z = 300x_1 + 400x_2$

Subject to constraints,

$5x_1 + 4x_2 \geq 200$

$3x_1 + 5x_2 \geq 150$

$5x_1 + 4x_2 \geq 100$

$8x_1 + 4x_2 \geq 80$ and $x_1, x_2 \geq 0$ **(07 Marks)**

Module-2

3 Solve the following LPP by Big-M method :

Max $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subject to constraints, $x_1 + 2x_2 + 3x_3 = 15$

$2x_1 + x_2 + 5x_3 = 20$

$x_1 + 2x_2 + x_3 + x_4 = 10$

$x_1, x_2, x_3, x_4 \geq 0$ **(16 Marks)**

4 Solve the given problem using Big-M method:

Maximize $Z = -2x_1 - x_2$

Subject to constraints, $3x_1 + x_2 = 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \leq 4$

$x_1, x_2 \geq 0$ **(16 Marks)**

Module-3

5 a. Products are to be transported from factories A, B and C to destinations D_1, D_2, D_3 and D_4. The factory capacities are 1000, 700 and 900. The destination requirements are 900, 800, 500 and 400. The unit transportation costs from various factories to destinations are given in the table. The units return from factories are Rs. 8, 7 and 9 respectively. Decide an optimum transportation schedule.

	D1	D2	D3	D4
A	2	2	2	4
B	3	5	3	2
C	4	3	2	1

(08 Marks)

b. A company has 5 tasks and 5 persons to perform. Determine the optimum 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

(08 Marks)

6 a. A product is produced by four factories A, B, C and D. The unit production costs in them are Rs. 2, 3, 1 and 5 respectively. The production capacities are 50, 70, 30 and 50 respectively. These factories supply the product to four stores. The demand of which is 25, 35, 105 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given in the table below:

Factory \ Stores	1	2	3	4
A	2	4	6	11
B	10	8	7	5
C	13	3	9	12
D	4	6	8	3

Determine the optimum transportation schedule so that the cost is minimum. **(08 Marks)**

b. A travelling salesman has to visit 5 cities. The distance between the cities is given in the matrix. Determine optimum route to reduce the distance travelled.

	1	2	3	4	5
1	∞	0	15	15	0
2	0	∞	9	14	1
3	0	1	∞	12	2
4	4	0	14	∞	5
5	2	0	17	19	∞

(08 Marks)

Module-4

7 a. Explain the following :
(i) Crashing of networks
(ii) Free float
(iii) Difference between PERT and CPM **(04 Marks)**

b. Find the ES, EF, LS, LF, TS and FS times for the following project using critical path algorithm.

Activity	1 – 2	1 – 3	1 – 4	2 – 5	3 – 5	4 – 6	5 – 6
Duration	8	4	6	10	6	8	4

(06 Marks)

c. In a hair dress saloon with one barber, the customer arrived follows Poisson distribution at an average rate of one in every 45 minutes. The service time is exponentially distributed with a mean of 30 minutes. Find :
(i) Average number of customer in the saloon
(ii) Average waiting time of customer before service
(iii) Average idle time of barber. **(06 Marks)**

8 a. What are the characteristics of waiting lines? **(02 Marks)**

b. The following table lists the jobs of network along with 3 time estimates:
(i) Draw the network
(ii) Calculate length and variance of critical path
(iii) What is the probability that jobs on the critical path are completed by the due date of 41 days?
(iv) What is the probability that jobs on the next most critical path will be completed by the above due date?
(v) What is the probability that the project is completed 2 days earlier than the expected date? **(08 Marks)**

Job	1 – 2	1 – 6	2 – 3	2 – 4	3 – 5	4 – 5	6 – 7	5 – 8	7 – 8
t_0	3	2	6	2	5	3	3	1	4
t_m	6	5	12	5	11	6	9	4	19
t_p	15	14	30	8	17	15	27	7	28

c. At what average rate must a clerk at super market work in order to ensure a probability of 0.9 that the customer will not have to wait longer than 12 minutes? It is assumed that there is only one counter to which customer arrive in a Poisson fashion at an average rate of 15/hr. The length of service by the clerk has an exponential distribution. **(06 Marks)**

Module-5

9 a. Define : (i) Pure Strategy (ii) Mixed Strategy (iii) Saddle point. **(02 Marks)**

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

		Player					
		B_1	B_2	B_3	B_4	B_5	B_6
Player	A_1	4	2	0	2	1	1
	A_2	4	3	1	3	2	2
	A_3	4	3	7	-5	1	2
	A_4	4	3	4	-1	2	2
	A_5	4	3	3	-2	2	2

(08 Marks)

c. Determine the total elapsed time for completion of 8 jobs, each job processed in the order CAB. Processing times are in minutes.

		Jobs							
		1	2	3	4	5	6	7	8
Machines	A	4	6	7	4	5	3	6	2
	B	8	10	7	8	11	8	9	13
	C	5	6	2	3	4	9	15	11

(06 Marks)

10 a. Define :

(i) Idle time (ii) Optimal sequence (iii) SPT rule **(02 Marks)**

b. Solve the following game by graphical method:

Player B

$$\text{Player A} \begin{bmatrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \\ 4 & 1 \end{bmatrix}$$

(07 Marks)

c. Using graphical method to minimize the time required to process two jobs on five machines, find the total elapsed time to complete both the jobs.

Job1	Sequence	A	B	C	D	E
	time (hrs)	7	9	5	13	5
Job2	Sequence	C	A	D	E	B
	time (hrs)	11	9	7	5	13

(07 Marks)

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