CBCS SCHEME

USN | | | | | | | | | | 15MA71

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Operations Research

Time: 3 hrs. Max. Marks: 80

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Use of Normal distribution table is permitted.

Module-1

1 a. Define operations research. Explain briefly different phases of operations research study. **(06 Marks)**

b. Discuss the scope of operations research in management. **(04 Marks)**

c. ABC foods company is developing a diet supplement. The specification of this diet have been established by medical experts. These specifications along with the calorie, protein, and vitamin content of three basic foods are given in the table below :

Nutritional elements	Basic foods			Specifications
	No. 1	No.2	No.3	
Calories	350	250	200	≤ 300
Proteins	250	300	150	≥ 200
Vitamin A	100	150	75	≥ 100
Vitamin C	75	125	150	≥ 100
Cost/serving Rs	1.50	2.00	1.20	

Formulate the problem as Linear Programming model to minimize the cost. **(06 Marks)**

OR

2 a. Briefly explain the historical development of operations research. **(04 Marks)**

b. What is your conclusions with regard to the following Linear Programming Problems after solving them graphically.

i) Max $z = 5x_1 + 4x_2$
subjected to $x_1 - 2x_2 \leq 1$
$x_1 + 2x_2 \geq 3$
$x_1, x_2 \geq 0$

ii) Max $Z = 3x_1 + 2x_2$
subject to $-2x_1 + 3x_2 \leq 9$
$3x_1 - 2x_2 \leq -20$
$x_1, x \geq 0.$ **(06 Marks)**

c. The manager of oil refinery has to decide upon the optimal mix of two possible blending processes of which the inputs and outputs per production run are as follows :

Process	Input		Output	
	Crude A	Crude B	Gas X	Gas Y
1	5	3	5	8
2	4	5	4	4

The max amount available of crude A and B are 200 units and 150 units respectively. Market requirements show at least 100 units of Gas X and 80 units of Gas Y must be produced. The profits per production run from Process 1 and Process 2 are Rs. 3.00 and Rs.4.00 respectively. Formulate the problem as Linear Programming Problem and solve graphically to determine maximum profit. **(05 Marks)**

Module-2

3 a. Express the following Linear Programming Problem in standard form.
Min $Z = 2x - x_2 + x_3$
Subject to $2x_1 + 3x_2 + 4x_3 \geq -4$
$3x_1 + 5x_2 + 2x_3 \geq 7$
$x_1, x_2 \geq 0$ and x_3 is unrestricted in sign. **(04 Marks)**

b. Solve the following Linear Programming Problem using Big-M method.
Max $Z = 2x_1 + 3x_2 + 4x_3$
Subject to $3x_1 + x_2 + 4x_3 \leq 600$
$2x_1 + 4x_2 + 2x_3 \geq 480$
$2x_1 + 3x_2 + 3x_3 = 540$
$x_1, x_2, x_3 \geq 0$. **(10 Marks)**

c. Explain the concept of degeneracy in Simplex method. **(02 Marks)**

OR

4 a. Write a note on duality in Linear Programming Problem. **(03 Marks)**

b. Write the dual of the following Linear Programming Problem
Min $Z = 2x_1 + 3x_2 + 4x_3$
Subjected to $2x_1 + 3x_2 + 5x_3 \geq 2$
$3x_1 + x_2 + 7x_3 = 3$
$x_1 + 4x_2 + 6x_3 \leq 5$
$x_1, x_2 \geq 0$ and x_3 is unrestricted. **(05 Marks)**

c. Solve by the dual Simplex method.
Min $Z = 2x_1 + 2x_2 + 4x_3$
Subjected to $2x_1 + 3x_2 + 5x_3 \geq 2$
$3x_1 + x_2 + 7x_3 \leq 3$
$x_1 + 4x_2 + 6x_3 \leq 5$
$x_1, x_2, x_3 \geq 0$. **(08 Marks)**

Module-3

5 a. Define transportation problem. Give the mathematical formulation of transportation problem. **(03 Marks)**

b. What is degeneracy in transportation problem how to resolve degeneracy if it happens in initial stage and at any intermediate stage. **(03 Marks)**

c. A company has 3 factories manufacturing the same product and 5 sale agencies in different parts of the country. Production costs differ from factory to factory and sales price from agency to agency. The shipping cost per unit product from each factory to each agency is known. Given the following data, find the production and distribution schedules most profitable to the company. Obtain initial feasible solution by VAM.

Production cost /unit (Rs)	Max capacity (units)	Factory (i)
18	140	1
20	190	2
16	115	3

Table.Q5(c)(i)

Factory(i)	1	2	2	6	10	5
	2	10	8	9	4	7
	3	5	6	4	3	8
Agency (j)		1	2	3	4	5
Demand		74	94	69	39	119
Sales price		35	37	36	39	34

Table.Q5(c)(ii)

(10 Marks)

OR

6 a. A company has 5 jobs to be done. The following matrix shows the return in rupees on assigning these jobs to five machines. Assign the jobs to the machines so as to maximize the total expected profit.

Machine	Jobs				
	A	B	C	D	E
I	5	11	10	12	4
II	2	4	6	3	5
III	3	12	5	14	6
IV	6	14	4	11	7
V	7	9	8	12	5

(08 Marks)

b. Solve the travelling – sales man problem given by the following data :

$C_{12} = 20$, $C_{13} = 4$, $C_{14} = 10$, $C_{23} = 5$, $C_{34} = 6$, $C_{25} = 10$, $C_{35} = 6$, $C_{45} = 20$

Where $C_{ij} = C_{ji}$, and there is no route between cities i and j if the value for C_{ij} is not shown **(08 Marks)**

Module-4

7 a. Differentiate between CPM and PERT network techniques. **(04 Marks)**

b. Explain about crashing of project networks. **(04 Marks)**

c. Consider following table showing the list of jobs of a network with their time estimates.

Activity	Optimistic t_0	Most likely t_m	Pessimistic t_p
1 – 2	1	2	9
2 – 3	1	4	7
2 – 4	2	4	12
3 – 4	0	0	0
3 – 5	2	3	4
3 – 7	6	8	16
4 – 5	4	6	8
4 – 6	3	5	7
5 – 6	$\frac{1}{2}$	1	$\frac{3}{2}$
5 – 7	5	7	15
6 – 7	3	5	13

i) Draw the network diagram
ii) Determine the expected time and variance for each activity
iii) Determine the critical path
iv) What is the probability of completing the project in 25 days
Show the solution in tabular form. **(08 Marks)**

OR

8 a. Explain the different operating characteristics of a queuing system. **(06 Marks)**

b. Discuss Kendale and Lee's notation for representing queuing model. **(02 Marks)**

c. A self service store employs one cashier at its counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service time, find :

i) Average number of customers in the system
ii) Average number of customers in the queue
iii) Average time a customer spends in the system
iv) Average time a customer waits before being served. **(08 Marks)**

Module-5

9 a. Two competitors A and B are competing for the same product. Their different strategies are given in the following payoff matrix.

Company A \ Company B	I	II	III	IV
I	3	2	4	0
II	3	4	2	4
III	4	2	4	0
IV	0	4	0	8

Use dominance principle to find the optimal strategies. What is the valve of the game? Explain every step of applying dominance principle clearly. **(08 Marks)**

b. What is J ohnsons rule used in sequencing problem? **(02 Marks)**

c. Find the sequence that minimizes the total elapsed time required to complete the following tasks each job is to be processed in the order ACB.

Job→ / m/c ↓	I	II	III	IV	V	VI	VII
A	12	6	5	11	5	7	6
B	7	8	9	4	7	8	3
C	3	4	1	5	2	3	4

(06 Marks)

OR

10 a. Solve the following game by graphical method.

Player A \ Player B	y_1	y_2	y_3	y_4
x_1	19	6	7	5
x_2	7	3	14	6
x_3	12	8	18	4
x_4	8	7	13	–1

Determine the optimal strategies and valve of the game. **(08 Marks)**

b. Two major parts P_1 and P_2 for a product require processing through six machine centers. The technological sequence of the parts on six machine and manufacturing times on each machine are given below :

Part P1	M/c sequence	C	A	E	F	D	B
	Time (Hrs)	2	3	4	5	6	1
Part P2	M/c sequence	B	A	E	F	C	D
	Time (Hrs)	3	2	5	3	2	3

Determine the optimal sequence to compute the jobs and also find the total elapsed time. **(08 Marks)**

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