CBCS SCHEME

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18MR751

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
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 Normal Distribution table is permitted.

Module-1

1 a. Define Operations Research. Explain the phases of OR study. **(06 Marks)**

b. A manufacturer of a line of patent medicines is preparing a production plan on medicines A and B. There are sufficient ingredients available to make 20,000 bottles of A and 40,000 bottles of B, but there are only 45,000 bottles into which either of the medicines can be put. Furthermore it takes 3 hours to prepare enough materials to fill 1,000 bottles of A, it takes 1 hour to prepare enough material to prepare 1,000 bottles of B, and there are 66 hours available for this operation. The profit is Rs.8 per bottle for A and Rs.7 per bottle of B.
(i) Formulate this problem as linear programming problem.
(ii) How should the manufacturer schedule the production in order to maximize his profit? **(14 Marks)**

OR

2 a. Define optimum solution, feasible zone, redundant constraint. **(06 Marks)**

b. Feasible zone ABCDEA, identified by a set of constraints of a LPP having 2 decision variables x, y has A = (1, 0); B = (1, 2); C = (2, 3); D = (4, 1); E = (2, 0). If a new constraint $x \leq 2y$ is added, identify the new feasible zone (show on graph). State redundant constraints. Find maximum and minimum value of $z = 3x + 5y$ for new feasible zone. **(14 Marks)**

Module-2

3 a. Define with examples :
(i) Slack variable, (ii) Surplus variable, (iii) Artificial variable **(06 Marks)**

b. Solve the following LPP by BIG M method.

Max $Z = 3x_1 - x_2$

Subject to $2x_1 + x_2 \leq 2$

$x_1 + 3x_2 \geq 3$

$x_2 \leq 4$

$x_1 , x_2 \geq 0$

(i) Find optimum solution by simplex.
(ii) Write the dual of the given LPP. **(14 Marks)**

OR

4 a. Explain how do you resolve degeneracy in simplex method. **(04 Marks)**

b. Write the dual of the following LPP, solve the dual and read the solution of the primal:

Maximize $Z = 5x_1 - 2x_2 + 3x_3$

Subject to $2x_1 + 2x_2 - x_3 \geq 2$

$3x_1 - 4x_2 \leq 3$

$x_2 + 3x_3 \leq 5$

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

Module-3

5 a. Differentiate between assignment problem and transportation problem. **(04 Marks)**

b. A company has 3 factories manufacturing the same product and 5 sales agencies in different parts of the counter. Production costs differ from factory to factory and the sales prices 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:

Factory (i)	Production cost/unit (Rs.)	Max. Capacity (Units)
1	18	140
2	20	190
3	16	115

Factory (i)	1	2	2	6	10	5	Shipping Cost (Rs.)
	2	10	8	9	4	7	
	3	5	6	4	3	8	
Agency (j)		A	B	C	D	E	
Demand		74	94	69	39	119	
Sales Price (Rs.)		35	37	36	39	34	

(16 Marks)

OR

6 a. A manufacturer of complex electronic equipment has just received a sizable contract and has plans to subcontract part of the job. He has solicited bids for 6 subcontractors from 3 firms. Each job is sufficiently large and any firm can take only one job. The table below shows the bids as well as cost estimates (in Lakhs of Rs.) for doing the job internally. Not more than three jobs can be performed internally.

Firm \ Job	1	2	3	4	5	6
1	44	67	41	53	48	64
2	46	69	40	45	45	68
3	43	73	37	51	44	62
Internal	50	65	35	50	46	63

Find the assignment that will result in minimum total cost. **(12 Marks)**

b. A self service store employs one cashier at its counter. Nine customers arrive on an average every five minutes, while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for the 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-4

7 a. There are eight jobs, each of which is to be processed in the order CAB. Find the sequence that minimizes the total elapsed time. Find total elapsed time and idle time of each machine.

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

The entries give the time in hours on the machines. **(12 Marks)**

b. Use graphical method to minimize the time required to process the following jobs on the machines. For each machine specify the job which should be done first. Also calculate the total elapsed time to complete both the jobs.

Job 1	Sequence	A	B	C	D	E
	Time (hr)	6	8	4	12	4
Job 2	Sequence	B	C	A	D	E
	Time (hr)	10	8	6	4	12

(08 Marks)

OR

8 a. Solve the following game by using the principle of dominance.

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

(10 Marks)

b. Solve the following game by the graphical method.

		Player B			
		Y_1	Y_2	Y_3	Y_4
Player A	X_1	19	6	7	5
	X_2	7	3	14	6
	X_3	12	8	18	4
	X_4	8	7	13	-1

(10 Marks)

Module-5

9 a. Explain Fulkerson's rule for numbering of nodes in a project network. **(04 Marks)**

b. The utility data for a network is as given below. Determine the critical path, duration of project in weeks. Also find the total free and independent floats.

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	2	8	10	6	3	3	7	5	2	8

(16 Marks)

OR

10 a. Define network, event, dummy activity. **(04 Marks)**

b. The time estimates (in weeks) for the activities of a PERT network are given below.

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
t_0	1	1	2	1	2	2	3
t_m	1	4	2	1	5	5	6
t_p	7	7	8	1	14	8	15

(i) Determine the expected project length.

(ii) What is the probability that the project will be completed at least 4 weeks earlier than expected?

(iii) If the project due date is 19 weeks, what is the probability that due date will not be met?

(iv) What should be the scheduled completion time for the probability of completion to be 90% **(16 Marks)**

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