CBCS SCHEME

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15ME81

Eighth Semester B.E. Degree Examination, Feb./Mar. 2022
Operations Research

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Operations Research and explain its methodology. **(06 Marks)**

b. A company is planning to determine its product mix out three different products: P_1, P_2, P_3. The monthly sale of the product P_1 is limited to a maximum of 500 units. For every two units of P_2 produced, there will be one unit of by product which can be sold at the rate of Rs.20/unit. The highest monthly demand for this by product is 200 units. The contributions/unit of the product P_1, P_2, P_3 are Rs.50, Rs.70 and Rs.60 respectively. The processing requirement for three products are shown in table below:

Process	Hours/unit			Available hours
	P_1	P_2	P_3	
I	3	5	2	1000
II	4	-	3	700
III	4	3	3	1300

Formulate a linear programming model of this problem to find the optimum product mix such that the total contribution is maximized. **(10 Marks)**

OR

2 a. A plant makes 2 types of automobile parts ie, part A and part B. It buys castings that are machined, bored and polished. The data is given in the following table:

Capacity	Part A	Part B
Machining	25/hr	40/hr
Boring	28/hr	35/hr
Polishing	35/hr	25/hr

Casting for part A Rs.20 each and for part B cost Rs.30/item. They are sold for Rs.50 and Rs.60 respectively. The running costs of the machine are Rs.200, Rs.150 and Rs.175/hr. Assuming that any combination of part A and part B can be sold, formulate as LPP. **(08 Marks)**

b. Solve the following LPP graphically:

Maximize $Z = -x_1 + 2x_2$

Subject to constraints $-x_1 + 3x_2 \le 10$

$3x_1 + 8x_2 \le 24$

$10x_1 + 7x_2 \le 35$

$x_1, x_2 \ge 0$ **(08 Marks)**

Module-2

3 a. Solve the given problem by simplex method.

Maximize $Z = x_1 + x_2$

Subject to constraints $2x_1 + 5x_2 \le 18$

$6x_1 + 5x_2 \le 30$

$x_1, x_2 \ge 0$ **(08 Marks)**

b. Solve the given LPP by Big M method.
Maximize $Z = 3x_1 - x_2$
Subject to constraints $2x_1 + x_2 \geq 2$; $x_1 + 3x_2 \leq 3$
$8x_2 \leq 4$; $x_1, x_2 \geq 0$ **(08 Marks)**

OR

4 a. Solve the following LPP:
Maximize $Z = x_1 + 2x_2 + 3x_3$
Subject to constraints $x_1 + 2x_2 + 3x_3 \leq 10$; $x_1 + x_2 \leq 5$
$x_1 \leq 1$; $x_1, x_2, x_3 \geq 0$
Does this problem have an alternative optimal solution? If yes, find atleast 2 alternative optimal solutions. **(08 Marks)**

b. Solve the following LPP by dual simplex method:
Minimize $Z = 2x_1 + 2x_2 + 4x_3$
Subject to constraints $2x_1 + 3x_2 + 5x_3 \geq 2$
$3x_1 + x_2 + 7x_3 \leq 3$
$x_1 + 4x_2 + 6x_3 \leq 5$
$x_1, x_2, x_3 \geq 0$ **(08 Marks)**

Module-3

5 a. There are 3 parties who supply the following quantity of coal $P_1 = 14$ tonne, $P_2 = 12$ tonne, $P_3 = 5$ tonne. There are 3 consumers who require the coal as follows $C_1 = 6$ tonne, $C_2 = 10$ tonne, $C_3 = 15$ tonne. The cost matrix in Rs./tonne is as follows. Find the schedule of transportation policy which minimizes the cost. **(08 Marks)**

Party/consumers	C_1	C_2	C_3
P_1	6	8	4
P_2	4	9	3
P_3	1	2	6

b. A company has for factories A, B, C, D which supply to warehouses at E, F, G , H and I monthly capacities are 200, 225, 175 and 350 units respectively. Monthly warehouse requirements are 130, 110, 140, 260 and 180 units respectively. The shipping cost/unit in Rs. is as follows:

	E	F	G	H	I
A	14	19	32	9	21
B	15	10	18	7	11
C	26	12	13	18	16
D	11	22	14	14	18

Determine the optimum distribution for this company to minimize the shipping cost. **(08 Marks)**

OR

6 a. Using the following cost matrix, determine:
(i) Optimal job assignment and (ii) the cost of assignments. **(08 Marks)**

Machine \ Job	1	2	3	4	5
A	10	3	3	2	8
B	9	7	8	2	7
C	7	5	6	2	4
D	3	5	8	2	4
E	9	10	9	6	10

b. A machine operator processes 5 types of items on his machine each week, and must choose a sequence for them. The set-up cost per change depends on the item presently on the machine and setup to be made according to the following table:

	To item				
	A	B	C	D	E
A	∞	4	7	3	4
B	4	∞	6	3	4
C	7	6	∞	7	5
D	3	3	7	∞	7
E	4	4	5	7	∞

If the processes each type of item once and only once each week, how should be sequence the items on his machine in order to minimize the total set-up cost? **(08 Marks)**

Module-4

7 a. A project consists of the following activities with their duration in days and the precedence relationship.

Activity	Precedence	Duration (in days)
A	-	5
B	-	5
C	A	4
D	B	8
E	C, D	6
F	B	5
G	E, F	7
H	E, F	7
I	E, F	4
J	G	2
K	H	5
L	I	5
M	K, L	4

(i) Draw the network for the above project.
(ii) Identify the critical path and duration of the project.
(iii) Calculate EST, EFT, LST, LFT, TF, FF and IF for activity. **(12 Marks)**

b. Write difference between PERT and CPM. **(04 Marks)**

OR

8 a. Write a note on customer's behaviour in queueing. **(04 Marks)**

b. Consider a box office ticket window being manned by a single server. Customers arrive to purchase tickets according to Poisson input process with a mean rate of 30/hr. The time required to serve a customer has an exponential distribution with a mean of 90 seconds, determine:
(i) Mean queue length
(ii) Mean waiting time in the system
(iii) The probability of a customer waiting in the queue for more than 10 min
(iv) The fraction of the time for which the server is busy. **(12 Marks)**

Module-5

9 a. Define the following:
(i) Zero and non zero sum games
(ii) Strategy
(iii) Pure strategy
(iv) Mixed strategy **(04 Marks)**

b. Two players A and B play a game in which each has 20P, 25P and 50P coins. Each of them selects a coin without the knowledge of the other player. If the sum of the value of coins is an even number. A coins B's coin and if the sum is odd number B wins A's coin.
   (i) Develop a payoff matrix with respect to player A.
   (ii) Find the optimal strategies for player and value of the game. **(12 Marks)**

OR

10 a. Find the sequence that minimizes the total time required in performing the job on 3 machines in the order CBA.

Job	A	B	C
1	8	3	8
2	7	4	3
3	6	5	7
4	9	2	2
5	10	1	5
6	9	6	1

Also determine the idle time of each machine. **(08 Marks)**

b. Two job are to be processed on 5 machines A, B, C, D and E the technological order for their jobs on the machine and the processing time of each job on each machine in as follows:

Job 1:	A – 2, B – 3, C – 4, D – 6, E – 2 = 17
Job 2:	C – 4, A – 5, D – 3, E – 2, B – 6 = 20

Determine the minimum elapsed time to complete both the jobs. Also determine the optimal sequence of jobs on each machine. **(08 Marks)**

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