OPTIMIZATION TECHNIQUESLABORATORY

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB15	Core	-	-	2	1	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 24				Total Classes: 24		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic concepts of Python programming.
II. Apply Python programming skills in solving matrix operations.
III. Apply Python concepts in solving linear programming problems.
IV. Apply optimization techniques through TORA.
V. Evaluate optimization problems using Lingo/ Excel solver.

COURSE OUTCOMES (COs):

CO 1: Understand the basic principles and concepts of Python
CO 2: Explore the applicability of programming skills in Python.
CO 3: Summarize various optimization techniques likeLPP models.
CO 4: Analyze the transportation, inventory and assignment problems.
CO 5: Explain the concepts of sequencing, game theory and dynamic programming.

COURSE LEARNING OUTCOMES (CLOs):

The students should enable to:

1. Evaluate the determinant and inverse of a matrix.
2. Perform matrix operations using python programming skills.
3. Understand the programming skills of python.
4. Analyze the parameter optimization using TORA.
5. Evaluate matrix operations like subtraction, addition and inverse of a matrix
6. Understand the programming skills of python to solve matrix operations.
7. Understand the concept of linear programming problem models.
8. Apply the concepts of transportation problems.
9. Understand the applications of assignment problems.
10. Apply the TORA concept in solving game theory.
11. Determine the solution of a dynamic programming problem using TORA/EXCEL SOLVER.
12. Understand the applicability of TORA in queuing problems.
13. Evaluate the decision variables through TORA/EXCEL SOLVER.
14. Apply the concepts of scheduling problems.
15. Understand the applications of optimization techniques.

LIST OF EXPERIMENTS

Week-l	**MATRIX OPERATIONS**

Write a Python program to find out whengiven an array of size **N**,the task is to partition the given array into two subsets such that the average of all the elements in both subsets is equal. If no such partition exists print -1. Otherwise, print the partitions. If multiple solutions exist, print the solution where the length of the first subset is minimum. If there is still a tie then print the partitions where the first subset is lexicographically smallest.

Week-2	**MATRIX OPERATIONS**

Write a Python program to find out when given an array of positive elements, you have to flip the sign of some of its elements such that the resultant sum of the elements of array should be minimum non-negative (as close to zero as possible). Return the minimum no. of elements whose sign needs to be flipped such that the resultant sum is minimum non-negative. Note that the sum of all the array elements will not exceed 10^4.

Week-3	**MINIMUM COST PATH**

Write a Python program to find out when given a two dimensional grid, each cell of which contains integer cost which represents a cost to traverse through that cell. The task is to find the maximum cost path from the bottom-left corner to the top-right corner.

Week-4	**FINDING MAXIMUM IN AN INTEGER ARRAY**

Write a Python program to find out when given an array of non-negative integers **arr[]**, the task is to find a pair **(n, r)** such that ${}^{n}\mathbf{P}_{r}$ is maximum possible and $\mathbf{r} \leq \mathbf{n}$.

Week-5	**ARRAY SORTING**

Write a Python program to find out when given an array **arr[]** of **N** integers, the task is to sort the array in non-decreasing order by performing the minimum number of operations. In a single operation, an element of the array can either be incremented or decremented by **1**. Print the minimum number of operations required.

Week-6	**LINEAR PROGRAMMING PROBLEM**

A store sells men's and women's tennis shoes. It makes a profit of $1 per pair of men's shoes and $1.20 per pair of women's shoes. It takes two minutes of a salesperson's time and two minutes of a cashier's time to sell a pair of men's shoes. It takes three minutes of a salesperson's time and one minute of a cashier's time per pair of women's shoes. The store is open eight hours per day, during which time there are two salespersons and one cashier on duty. How many pairs of shoes of each type should the store sell in order to maximize profit each day?

Week-7	**QUEUING PROBLEM**

A super market has two girls ringing up sales at the counters. If the service time for each customer is exponential with mean 4 minutes, and if people arrive 3 in a poison fashion at the 10/hour.

a. What is the probability of having to wait for the service.
b. What is the expected percentage of idle time for each girl?
c. Find the average length and average number of units in the system.

Week-8 SEQUENCING PROBLEM

We have five jobs each of which must go through two machines in the order BA, processing times are given in the table below

Job No.	1	2	3	4	5
Machine A	10	2	18	6	20
Machine B	4	12	14	16	8

Determine a sequence for the five jobs that will minimize the total elapsed time. Also compute idle times for each of the machine

Week-9 GAME THEORY

Using the dominance property obtain the optimal strategy for both the players and determine the value of game. The payoff matrix for player A is given

		Player-B				
		I	II	III	IV	V
Player-A	I	2	4	3	8	4
	II	5	6	8	7	8
	III	6	7	9	8	7
	IV	4	2	8	4	3

Week-10 ASSIGNMENT PROBLEM

A Company has three plants at locations A,B and C which supply to warehouses located at D,E,F,G and H. monthly plant capacities are 800,500 and 900 respectively. Monthly warehouse requirements are 400, 500,400 and 800 units respectively. Unit transportation cost in rupees is given below.

		Ware houses				
		D	E	F	G	H
Plant	A	5	8	6	6	3
	B	4	7	7	6	5
	C	8	4	6	6	4

Determine an optimum distribution for the company in order to minimize the total transportation cost.

Week-11 DYNAMIC PROGRAMMING PROBLEM

Given an array **arr[]** of **N** integers, the task is to sort the array in non-decreasing order by performing the minimum number of operations. In a single operation, an element of the array can either be incremented or decremented by **1**. Print the minimum number of operations required.

Week-12 INVENTORY PROBLEM

A dealer supplies you the following information with regards to an product that he deals in annual demand =10,000 units, ordering cost Rs.10/order, Price Rs.20/unit. Inventory carrying cost is 20% of the value of inventory per year. The dealer is considering the possibility of allowing some back orders to occurs. He has estimated that the annual cost of back orderingwill be 25% of the value of inventory.

a. What should be the optimum no of units he should buy in 1lot?
b. What qty of the product should be allowed to be backordered
c. What would be the max qty of inventory at any time of year
d.
Would you recommend to allow backordering? If so what would be the annual cost saving by adopting the policy of backordering.

Week-13	EXAMINATIONS
Examinations	
Text Books:	
1. Kalavathy.S, “Operations Research using C Programmes”, vikas publishing house Pvt Ltd., New Delhi, 3rd Edition,2010. 2. Hamdy A. Taha, “Operations ResearchAn Introduction”, Pearson,10thEdition, 2017.	
Reference Books:	
1. Eric Matthes,"Python crash course", 2nd Edition. 2. Paul Barry,” Head- First Python”, 2nd Edition	
Web References :	
1. www.tutorialspoint.com/How-to-Multiply-Two-Matrices-using-Python 2. https://www.programiz.com/python-programming/examples/multiply-matrix	