learned. Instructor may also set one assignment or mini-project that is suitable to respective branch **beyond the scope of syllabus.**

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments ( at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 3 from group E. )

**Group A and B assignments should be implemented in Python without using built-in methods for major functionality of assignment. Use List data structure of Python as array. Group C, D and E assignments should be implemented in C++ language.**

**Operating System recommended:**- 64-bit Open source Linux or its derivative

**Programming tools recommended**: - Open Source Python, Programming tool like Jupyter Notebook, Pycharm, Spyder, G++/GCC.

## Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

## Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

## Suggested List of Laboratory Experiments/Assignments

| Sr. No. | Group A |
|---|---|
| 1 | In second year computer engineering class, group A student's play cricket, group B students play badminton and group C students play football.<br>Write a Python program using functions to compute following: -<br>a) List of students who play both cricket and badminton<br>b) List of students who play either cricket or badminton but not both<br>c) Number of students who play neither cricket nor badminton<br>d) Number of students who play cricket and football but not badminton.<br>(Note- While realizing the group, duplicate entries should be avoided, Do not use SET built-in functions) |
| 2 | Write a Python program to store marks scored in subject "Fundamental of Data Structure" by N students in the class. Write functions to compute following:<br>a) The average score of class<br>b) Highest score and lowest score of class<br>c) Count of students who were absent for the test<br>d) Display mark with highest frequency |
| 3 | Write a **Python** program for department library which has N books, write functions for following:<br>a) Delete the duplicate entries<br>b) Display books in ascending order based on cost of books<br>c) Count number of books with cost more than 500.<br>d) Copy books in a new list which has cost less than 500. |
| 4 | Write a **Python** program that computes the net amount of a bank account based a transaction log from console input. The transaction log format is shown as following: D 100 W 200 (Withdrawal is not allowed if balance is going negative. Write functions for withdraw and deposit) D means deposit while W means withdrawal.<br>Suppose the following input is supplied to the program:<br>D 300, D 300 , W 200, D 100 Then, the output should be: 500 |

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|---|---|
| 5 | Write a Python program to compute following operations on String:<br>a) To display word with the longest length<br>b) To determines the frequency of occurrence of particular character in the string<br>c) To check whether given string is palindrome or not<br>d) To display index of first appearance of the substring<br>e) To count the occurrences of each word in a given string |
| 6 | It is decided that weekly greetings are to be furnished to wish the students having their birthdays in that week. The consolidated sorted list with desired categorical information is to be provided to the authority. Write a **Python** program to store students PRNs with date and month of birth. Let List_A and List_B be the two list for two SE Computer divisions. Lists are sorted on date and month. Merge these two lists into third list "List_SE_Comp_DOB" resulting in sorted information about Date of Birth of SE Computer students |
| 7 | Write a **Python** Program for magic square. A magic square is an n * n matrix of the integers 1 to n2 such that the sum of each row, column, and diagonal is the same. The figure given below is an example of magic square for case n=5. In this example, the common sum is 65.<br>15 8 1 24 17<br>16 14 7 5 23<br>22 20 13 6 4<br>3 21 19 12 10<br>9 2 25 18 11 |
| 8 | Write a **Python** program that determines the location of a saddle point of matrix if one exists. An m x n matrix is said to have a saddle point if some entry a[i][j] is the smallest value in row i and the largest value in j. |
| 9 | Write a **Python** program to compute following computation on matrix:<br>a) Addition of two matrices B) Subtraction of two matrices<br>c) Multiplication of two matrices d) Transpose of a matrix |
| 10 | Write a **Python** program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices |
| | **Group B** |
| 11 | a) Write a **Python** program to store roll numbers of student in array who attended training program in random order. Write function for searching whether particular student attended training program or not, using Linear search and Sentinel search.<br>b) Write a **Python** program to store roll numbers of student array who attended training program in sorted order. Write function for searching whether particular student attended training program or not, using Binary search and Fibonacci search |
| 12 | a) Write a **Python** program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using binary search (recursive and non-recursive). Insert friend if not present in phonebook<br>b) Write a **Python** program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using Fibonacci search. Insert friend if not present in phonebook. |
| 13 | Write a **Python** program to maintain club members, sort on roll numbers in ascending order. Write function "Ternary_Search" to search whether particular student is member of club or not. Ternary search is modified binary search that divides array into 3 halves instead of two. |
| 14 | Write a **Python** program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using<br>a) Selection Sort<br>b) Bubble sort and display top five scores. |

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|---|---|
| 15 | Write a **Python** program to store second year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using<br>a) Insertion sort<br>b) Shell Sort and display top five scores |
| 16 | Write a **Python** program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using quick sort and display top five scores. |
| 17 | Write a **Python** program to store $12^{th}$ class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using bucket sort and display top five scores. |
| 18 | Write **Python** program to store $10^{th}$ class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using radix sort and display top five scores |
| | **Group C** |
| 19 | Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of second, third and final year of department can be granted membership on request. Similarly one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member‘s information using singly linked list. Store student PRN and Name. Write functions to:<br>a) Add and delete the members as well as president or even secretary.<br>b) Compute total number of members of club<br>c) Display members<br>d) Two linked lists exists for two divisions. Concatenate two lists. |
| 20 | The ticket booking system of Cinemax theater has to be implemented using C++ program. There are 10 rows and 7 seats in each row. Doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use array to store pointers (Head pointer) to each row. On demand<br>a) The list of available seats is to be displayed<br>b) The seats are to be booked<br>c) The booking can be cancelled. |
| 21 | Write C++ program for storing appointment schedule for day. Appointments are booked randomly using linked list. Set start and end time and min and max duration for visit slot. Write functions for-<br>A) Display free slots B) Book appointment C) Sort list based on time<br>D) Cancel appointment ( check validity, time bounds, availability)<br>E) Sort list based on time using pointer manipulation |
| 22 | Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C++ program to store two sets using linked list. compute and display-<br>a) Set of students who like both vanilla and butterscotch<br>b) Set of students who like either vanilla or butterscotch or not both<br>c) Number of students who like neither vanilla nor butterscotch |
| 23 | Write C++ program for storing binary number using doubly linked lists. Write functions-<br>a) To compute 1‘s and 2‘s complement<br>b) Add two binary numbers |
| 24 | Write C++ program to realize Set using Generalized Liked List (GLL)<br><br>e.g. A ={ a, b, {c, d,e, {}, {f,g}, h, I, {j,k}, l, m}. Store and print as set notation. |
| | **Group D** |

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|---|---|
| 25 | A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions-<br>a) To print original string followed by reversed string using stack<br>b) To check whether given string is palindrome or not |
| 26 | In any language program mostly syntax error occurs due to unbalancing delimiter such as (),{},[]. Write C++ program using stack to check whether given expression is well parenthesized or not. |
| 27 | Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions:<br>1. Operands and operator, both must be single character.<br>2. Input Postfix expression must be in a desired format.<br>3. Only '+', '-', '*' and '/ ' operators are expected. |
| 28 | A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 square arranged in an 8 by 8 grid. The board normally alternates between black and white square, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with recursive function for generating all possible configurations for 4-queen's problem. |
| | **Group E** |
| 29 | Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue. |
| 30 | Write program to implement a priority queue in C++ using an inorder list to store the items in the queue. Create a class that includes the data items (which should be template) and the priority (which should be int). The inorder list should contain these objects, with operator <= overloaded so that the items with highest priority appear at the start of the list (which will make it relatively easy to retrieve the highest item.) |
| 31 | A double-ended queue (deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ program to simulate deque with functions to add and delete elements from either end of the deque. |
| 32 | Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array. |

@The CO-PO Mapping Matrix

| CO\PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 2 | 1 | - | - | - | - | - | - | - | - |
| CO2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| CO3 | - | 2 | 1 | 1 | - | - | - | - | - | - | - | - |
| CO4 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |

# Savitribai Phule Pune University
## Second Year of Computer Engineering (2019 Course)
## 210247: OOP and Computer Graphics Laboratory

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| Teaching Scheme | Credit Scheme | Examination Scheme and Marks |
|---|---|---|
| Practical: 04 Hours/Week | 02 | Term Work: 25 Marks<br>Practical: 25Marks |

**Companion Course :** 210243: Object Oriented Programming(OOP), 210244: Computer Graphics

**Course Objectives:**

To understand basics of Computer Graphics, apply various methods and techniques for implementing line-circle drawing, projections, animation, shading, illumination and lighting using concepts of Object Oriented Programming.

**Course Outcomes:**

On completion of the course, learner will be able to–

- **CO1:** U**nderstand** and **apply** the concepts like inheritance, polymorphism, exception handling and generic structures for implementing reusable programming codes.
- **CO2: Analyze** the concept of file and **apply** it while storing and retrieving the data from secondary storages.
- **CO3: Analyze** and **apply** computer graphics algorithms for line-circle drawing, scan conversion and filling with the help of object oriented programming concepts.
- **CO4: Understand** the concept of windowing and clipping and **apply** various algorithms to fill and clip polygons.
- **CO5: Apply** logic to implement, curves, fractals, animation and gaming programs.

## Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

## Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

## Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

## Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of student's academics.

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## Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC, OPENGL.

## Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

## Part I : Object Oriented Programming

### Suggested List of Laboratory Experiments/Assignments

**(All assignments are compulsory)**

| Sr. No. | Group A |
|---|---|
| 1. | Implement a class Complex which represents the Complex Number data type. Implement the following<br>1. Constructor (including a default constructor which creates the complex number 0+0i).<br>2. Overload operator+ to add two complex numbers.<br>3. Overload operator* to multiply two complex numbers.<br>4. Overload operators << and >> to print and read Complex Numbers. |
| 2. | Develop a program in C++ to create a database of student's information system containing the following information: Name, Roll number, Class, Division, Date of Birth, Blood group, Contact address, Telephone number, Driving license no. and other. Construct the database with suitable member functions. Make use of constructor, default constructor, copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete as well as exception handling. |
| 3. | Imagine a publishing company which does marketing for book and audio cassette versions. Create a class publication that stores the title (a string) and price (type float) of publications. From this class derive two classes: book which adds a page count (type int) and tape which adds a playing time in minutes (type float).<br>Write a program that instantiates the book and tape class, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values. |
| | **Group B** |
| 4. | Write a C++ program that creates an output file, writes information to it, closes the file, open it again as an input file and read the information from the file. |
| 5. | Write a function template for selection sort that inputs, sorts and outputs an integer array and a float array. |
| | **Group C** |
| 6. | Write C++ program using STL for sorting and searching user defined records such as personal records (Name, DOB, Telephone number etc) using vector container.<br>**OR**<br>Write C++ program using STL for sorting and searching user defined records such as Item records (Item code, name, cost, quantity etc) using vector container. |

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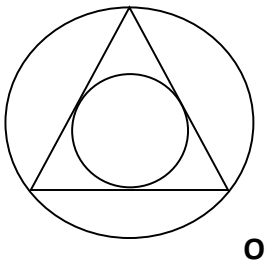
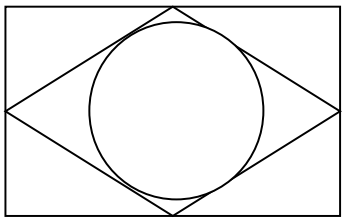
| 7. | Write a program in C++ to use map associative container. The keys will be the names of states and the values will be the populations of the states. When the program runs, the user is prompted to type the name of a state. The program then looks in the map, using the state name as an index and returns the population of the state. |

## Part II : Computer Graphics

### Suggested List of Laboratory Experiments/Assignments

**(All assignments are compulsory)**

| Sr. No. | Group A |
|---|---|
| 1. | Write C++ program to draw a concave polygon and fill it with desired color using scan fill algorithm. Apply the concept of inheritance. |
| 2. | Write C++ program to implement Cohen Southerland line clipping algorithm. |
| 3. | a) Write C++ program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm. Apply the concept of encapsulation.<br>  <br>**OR**<br>b) Write C++ program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm. Apply the concept of encapsulation.<br>  |
| | **Group B** |
| 4. | a) Write C++ program to draw 2-D object and perform following basic transformations, Scaling b) Translation c) Rotation. Apply the concept of operator overloading.<br>**OR**<br>b) Write C++ program to implement translation, rotation and scaling transformations on equilateral triangle and rhombus. Apply the concept of operator overloading. |
| 5. | a) Write C++ program to generate snowflake using concept of fractals.<br>**OR**<br>b) Write C++ program to generate Hilbert curve using concept of fractals.<br>**OR**<br>c) Write C++ program to generate fractal patterns by using Koch curves. |
| | **Group C** |
| 6. | a) Design and simulate any data structure like stack or queue visualization using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL.<br>**OR**<br>b) Write C++ program to draw 3-D cube and perform following transformations on it using OpenGL i) Scaling ii) Translation iii) Rotation about an axis (X/Y/Z).<br>**OR**<br>c) Write OpenGL program to draw Sun Rise and Sunset. |

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| 7. | a) Write a C++ program to control a ball using arrow keys. Apply the concept of polymorphism.<br>**OR**<br>b) Write a C++ program to implement bouncing ball using sine wave form. Apply the concept of polymorphism. **OR**<br>c) Write C++ program to draw man walking in the rain with an umbrella. Apply the concept of polymorphism. **OR**<br>Write a C++ program to implement the game of 8 puzzle. Apply the concept of polymorphism. **OR**<br>d) Write a C++ program to implement the game Tic Tac Toe. Apply the concept of polymorphism. |
| **Mini-Projects/ Case Study** | |
| 8. | Design and implement game / animation clip / Graphics Editor using open source graphics library. Make use of maximum features of Object Oriented Programming. |

**@The CO-PO Mapping Matrix**

| PO/CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | 1 | 2 | 1 | - | - | - | - | - | - | - | - |
| CO2 | - | 1 | 2 | 1 | - | - | - | - | - | - | - | - |
| CO3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - |
| CO4 | 1 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| CO5 | - | 2 | 2 | 1 | - | - | - | - | - | - | - | - |

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# Savitribai Phule Pune University
# Second Year of Computer Engineering (2019 Course)
# 210248: Digital Electronics Laboratory

| Teaching Scheme | Credit Scheme | Examination Scheme and Marks |
|---|---|---|
| Practical: 02 Hours/Week | 01 | Term Work: 25 Marks |

**Companion Course :** 210245: Digital Electronics and Logic Design

**Course Objectives:**

To understand fundamentals and functionality of electronic circuits, design and implement combinational circuits like MUX, comparator, adder/subtractor, design and implement sequential circuits like flip-flop, registers, and counters using different integrated circuits.

**Course Outcomes:**

On completion of the course, learner will be able to–

CO1: **Understand** the working of digital electronic circuits.

CO2: **Apply** the knowledge to appropriate IC as per the design specifications.

CO3: **Design** and **implement** Sequential and Combinational digital circuits as per the specifications.

## Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, data sheets of various ICs.

## Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).

**As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided**.

## Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of student. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

## Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students.

The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Student should perform at least 12 experiments with all experiments from group A and any 5 assignments from group Band one from group C assignments.

## Virtual Laboratory:

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- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/index.html
- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/index.html

| Suggested List of Laboratory Experiments/Assignments | |
|---|---|
| **Sr. No.** | **Group A** |
| 1 | To Realize Full Adder/ Subtractor using a) Basic Gates and b) Universal Gates |
| 2 | Design and implement Code Converters-Binary to Gray and BCD to Excess-3 |
| 3 | Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483). |
| 4 | Realization of Boolean Expression for suitable combination logic using MUX 74151 /74153, DMUX 74154/74138 |
| 5 | To Verify the truth table of two bit comparators using logic gates. |
| 6 | Design and Implement Parity Generator and checker using EX-OR. |
| | **Group B** |
| 7 | Design and Realization: Flip Flop conversion |
| 8 | Design of 2 bit and 3 bit Ripple Counter using MS JK flip-flop. |
| 9 | Design of Synchronous 3 bit Up and Down Counter using MSJK Flip Flop / D Flip Flop |
| 10 | Realization of Mod -N counter using (Decade Counter IC 7490 ) . |
| 11 | Design and implement Sequence generator (for Prime Number/odd and even ) using MS JK flip-flop. |
| 12 | Design and implement Sequence detector using MS JK flip-flop. |
| | **Group C** |
| 13 | Study of Shift Registers ( SISO,SIPO, PISO, PIPO) |
| 14 | Design of ASM chart using MUX controller Method. |

**@The CO-PO Mapping Matrix**

| PO/CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 3 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |