



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

A LABORATORY MANUAL
FOR
JAVA PROGRAMMING

(II B.TECH CSE SEMISTER – I)



Prepared By

S.Bosu Babu

B.Mahesh

G.Pranitha

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

Vision:

Our vision is to emerge as a world class Computer Science and Engineering department through excellent teaching and strong research environment that responds swiftly to the challenges of changing computer science technology and addresses technological needs of the stakeholders.

MISSION:

To enable our students to master the fundamental principles of computing and to develop in them the skills needed to solve practical problems using contemporary computer-based technologies and practices to cultivate a community of professionals who will serve the public as resources on state-of-the-art computing science and information technology.

Course Outcomes:

- CO-1: Apply basics of Java programming and analyze oops concepts.
- CO-2: Modularize the application using packages.
- CO-3: Apply multi threading and Exception handling.
- CO-4: Design GUI applications using java AWT and applets.

Program Outcomes: (PO's)

Graduate Attribute1:	Engineering Knowledge
PO-A	An ability to apply the knowledge of basic engineering sciences, humanities, core engineering and computing concept in modeling and designing computer based systems.
Graduate Attribute2:	Problem Analysis
PO-B	An ability to identify, analyze the problems in different domains and define the requirements appropriate to the solution.
Graduate Attribute3:	Design/Development of Solution
PO-C	An ability to design, implement & test a computer based system, component or process that meet functional constraints such as public health and safety, cultural, societal and environmental considerations.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

Graduate Attribute4:	Conduct Investigations of Complex Problems
PO-D	An ability to apply computing knowledge to conduct experiments and solve complex problems, to analyze and interpret the results obtained within specified timeframe and financial constraints consistently.
Graduate Attribute5:	Modern Tool Usage
PO-E	An ability to apply or create modern techniques and tools to solve engineering problems that demonstrate cognition of limitations involved in design choices.
Graduate Attribute6:	The Engineer and Society
PO-F	An ability to apply contextual reason and assess the local and global impact of professional engineering practices on individuals, organizations and society.
Graduate Attribute7:	Environment and Sustainability
PO-G	An ability to assess the impact of engineering practices on societal and environmental sustainability.

Graduate Attribute8:	Ethics
PO-H	Ability to apply professional ethical practices and transform into good responsible citizens with social concern.
Graduate Attribute9:	Individual and Team Work
PO-I	Acquire capacity to understand and solve problems pertaining to various fields of engineering and be able to function effectively as an individual and as a member or leader in a team.
Graduate Attribute10:	Communication
PO-J	An ability to communicate effectively with range of audiences in both oral and written forms through technical papers, seminars, presentations, assignments, project reports etc.
Graduate Attribute11:	Project Management and Finance
PO-K	An ability to apply the knowledge of engineering, management and financial principles to develop and critically assess projects and their outcomes in multidisciplinary areas.
Graduate Attribute12:	Life-long Learning
PO-L	An ability to recognize the need and prepare oneself for lifelong self learning to be abreast with rapidly changing technology.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

Program Specific Outcomes:

1

Programming and software Development skills: Ability to acquire programming efficiency to analyze, design and develop optimal solutions, apply standard practices in software project development to deliver quality software product.

2

Computer Science Specific Skills: Ability to formulate, simulate and use knowledge in various domains like data engineering, image processing and information and network security, artificial intelligence etc., and provide solutions to new ideas and innovations.

S.No	List of Experiments	CO
1	Write a java program which reads your name and other details through command line and print them.	1
2	Write a program to find the longest Substring without Repeating Characters Input: abcabcbb output:3 string: abc Input: pwwkew output:3 string: wke Note: pwke is not a substring , it is a subsequence	2
3	Write a program to find the Valid Parentheses Given a string containing just the characters '(', ')', '{', '}', '[' and ']', determine if the input string is valid. An input string is valid if: 1. Open brackets must be closed by the same type of brackets. 2. Open brackets must be closed in the correct order. Note that an empty string is also considered valid. Input:() Input: ({) } Output: Not valid output: valid	2
4	Letter Combinations of a Phone Number Given a string containing digits from 2-9 inclusive, return all possible letter combinations that the number could represent. A mapping of digit to letters (just like on the telephone buttons) is given below. Note that 1 does not map to any letters. Example: Input: "23" Output: ["ad", "ae", "af", "bd", "be", "bf", "cd", "ce", "cf"].	2



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)
 SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District
 Phone: 08933-225083/84/87 Fax: 226395
 Website: www.anits.edu.in email: principal@anits.edu.in

5	Design a “farm animals” java application with the details of animals like cow, pig, horse. Consider the following details like where they stay, what they eat, the sound they make by using classes and objects.	2
6	An organization is maintaining the data of employee according to cadre of employee with following parameters name, id, designation, salary, promotion status. Apply the constructor overloading to implement it.	3
7	<p>All the banks operating in India are controlled by RBI. (e.g. minimum interest rate, minimum balance allowed, maximum withdrawal limit etc) which all banks must follow. Suppose RBI has set minimum interest rate applicable to a saving bank account to be 4% annually. however, banks are free to use 4% interest rate or to set any rates above it.</p> <p>Write a JAVA program to implement bank functionality in the above scenario and demonstrate the dynamic polymorphism concept. Note: Create few classes namely Customer, Account, RBI (Base Class) and few derived classes (SBI, ICICI, PNB etc). Assume and implement required member variables and functions in each class.</p> <p>Testcase1: Enter the Bank name to find the rate of Interest : RBI RBI rate of interest is : 4%</p>	3
8	<p>Different categories of employees are working in a software company like Regular Employees, Contract Employees and Vendors. And their pay roll is different for regular and contract employees. For the regular employees Basic pay is 25000, HRA is 15000rs and TA is 5000. For the Contract employees Basic pay is 12000 TA is 3000rs and there is no HRA. Find the monthly salary details of Employee. If input is Regular Employee display the Regular employee salary details. If input is Contract based display the Contract salary details.</p> <p>TestCase1: <u>Input</u>: Enter Employee Id: R101</p> <p><u>Output</u>: Salary Details: Basic Pay: 25000 HRA: 15000 T.A: 5000 Total Amount: 45000</p>	4
9	<p>Define a package number and in that define Roman class and implement romanToInteger() and import the method in another class.</p> <p>Input: "LVIII" Output: 58</p> <p>Explanation: L = 50, V= 5, III = 3.</p>	4



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

10	<p>Write the below text in the file called sample.txt and then find the frequency count of the patterns 'pe', and 'pi'</p> <p>Peter Piper picked a peck of pickled peppers A peck of pickled peppers Peter Piper picked If Peter Piper picked a peck of pickled peppers Where's the peck of pickled peppers Peter Piper picked?</p> <p>Expected Output: 'pe' – no of occurrences - 20 'pi' – no of occurrences – 12</p>	4
11	<p>Input a mobile number and check the number is valid mobile number or not.</p> <ul style="list-style-type: none">• If the given Number Exceeds length of 10 raise Invalid Mobile Number-ArrayIndexOutOfBoundsException Exception• If the given Number less than the length of 10 raise Invalid Mobile Number – LengthNotSufficientException• If the given Number contain any character other than digit raise Invalid Mobile Number –NumberFormatException <p>Sample Input Expected Output – 1</p> <p>9885089465 Valid number</p> <p>98567890121 Invalid ArrayIndexOutOfBoundsException</p> <p>88664433 Invalid LengthNotSufficientException</p> <p>98ab@123 Invalid NumberFormatException</p>	CO4
12	<p>Implement a Reservation system which allows the persons to book seats. Define reserve method initially with 100 seats. Now create one or more person threads to book seats. At any time it should allow only one person thread to access the reserve method.</p> <p>Expected Output:</p> <p>Person-1 entered. Available seats: 10 Requested seats: 5 Seat Available. Reserve now :-) 5 seats reserved. Person-1 leaving. Person-3 leaving.</p>	CO4
13	<p>Design a mini application using the java components.</p>	CO4



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

List Of Industry Relevant Skills:

- Spring Framework to create server-side code
- Hibernate to work with databases
- Relational databases like MySQL and non-relational databases (NoSQL, MongoDB)
- RESTful and JSON for providing and receiving data
- GitHub
- Design Patterns in Java

Guidelines To Teachers

- Faculty must verify the observations and records before assign the system.
- Faculty must verify Students Id cards before enter into Lab
- Faculty must take the attendance starting and ending of the lab time period.

Instructions To Students:

- Students should use computer related components smoothly
- Students should not carry other items into lab.
- Students must wear the dress code and ID cards.

Guidelines To Lab Programmers:

- Lab Programmers must verify All the Systems whether they are working properly or not.
- Lab Programmers must verify All the other equipment's (devices like ACs).



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

Lab Rubrics

Key Performance Criteria(KPC) (25 pts)	4-Very Good	3-Good	2-Fair	1-Need to improve
Problem Statement (2)	Detail understanding of the problem (2)	Understanding of the problem (2)	Basic understanding of the problem (1)	Partial understanding of the problem (1)
Experimental Procedure/ algorithm/ flow chart/ analysis (4)	The procedure is explained and well designed the problem with appropriate analysis (4)	The procedure is explained and designed the problem with analysis (3)	Missing some experimental procedure with partial analysis (2)	Missing major experimental details and analysis (1)
Implementation (4)	Implement Optimal solution with appropriate results for all the inputs	Implement solution with correct results for most of the inputs	implement solution with the correct answers for some inputs and results wrong answers for some cases	Implement Solution does not produce the appropriate results for the given inputs
Test Case verification (3)	Produces correct output for all possible test cases(3)	Produces correct output for most of the test cases (2)	Produces correct output for some of the test cases (2)	Produces Wrong output for most of the test cases (1)
Viva voice / oral presentation(5)	In depth knowledge on the concept and answered all the questions(5)	Good knowledge on the concept and answered all the questions(4)	Basic knowledge on the concept and answered some of the questions(3)	With basic knowledge on the concept and answered few questions(2)
Presentation of record / documentation(4)	Presented the content effectively and Submitted on time (4)	Presented the content and Submitted on time (3)	Presented the incomplete content and Submitted . (2)	Presented the wrong content and submitted in delay.(1)
Code of conduct (courtesy, safety, behavioral aspects, ethics etc.)(3)	While conducting the procedure, the student is in proper dress code, always respectful of others and leaves the area clean.(3)	While conducting the procedure, the student is in proper dress code, many times respectful of others and leaves the area clean only	While conducting the procedure, the student is in partial dress code, sometimes respectful of others and leaves the area clean only	While conducting the procedure, the student is not in proper dress code , not respectful of othersand leaves the area messy even



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

		after being reminded.(2)	after being reminded.(2)	after being reminded.(1)
--	--	--------------------------	--------------------------	--------------------------

PRACTICAL 1:

1. Practical significance :

- An **argument** passed when a Java program is run is called a **command line argument**.
- The **arguments** can be used as input. So, it provides a convenient way to check out the behavior of the program on various values.
- We can pass any number of **arguments** from the **command prompt** or nearly anywhere a Java program is executed.

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students can able to test applications by passing the parameters (text,images) through online and can generate reports.

4. Prerequisites:

Students should have knowledge on functions and parameters and return values.
Students should have knowledge on Arrays and their properties.

5.Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.



- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

A command-line argument is an information that directly follows the program's name on the command line when it is executed. To access the command-line arguments inside a Java program is quite easy. They are stored as strings in the String array passed to main().

8. Test cases:

```
C:\WINDOWS\system32\cmd.exe
C:\workspace>java Demo apple orange

C:\WINDOWS\system32\cmd.exe
C:\workspace>java Demo apple orange
Argument one = apple
Argument two = orange
```

9. Sample Code :

```
class A
{
    public static void main(String args[])
    {
        for(int i=0;i<args.length;i++)
            System.out.println(args[i]);
    }
}
```

Output:

```
compile by > javac CommandLineExample.java
run by > java CommandLineExample sonoo
```

Output: Your first argument is: sonoo

10. Practical Related Question

- Which method is given parameter via command line arguments?
- Which data types is used to store command line arguments?
- How many arguments can be passed to main()?



- Can command line arguments be converted into int automatically if required?

11. Exercise Questions :

- What Are Command Line Arguments?
- Java Command Line Arguments Example
 - Factorial Of A Number

PRACTICAL 2:

Write a program to find the longest Substring without Repeating Characters

1. Practical significance :

Strings are very special in Java, the content within the string cannot be changed or overridden after creation. Strings support many other functionalities, and programmers can use them according to their project requirement.

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students can able to compare duplicate names in given list.
Arranging data in ascending and descending order.
Search the data from bulk of data.

4. Prerequisites:

Students should have knowledge on Data types of C
Students should have knowledge on String Functions in C

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

We can consider all substrings one by one and check for each substring whether it contains all unique characters or not. There will be $n*(n+1)/2$ substrings. Whether a substring contains all unique characters or not can be checked in linear time by scanning it from left to right and keeping a map of visited characters.

8. Test cases:

Input: abcabcb output:3 string: abc

Input: pwwkew output:3 string: wke

9. Sample Code :

```
import java.util.LinkedHashMap;
public class MainClass
{
    static void longestSubstring(String inputString)
    {
        char[] charArray = inputString.toCharArray();
        String longestSubstring = null;
        int longestSubStringLength = 0;
        LinkedHashMap<Character, Integer> charPosMap = new LinkedHashMap<Character, Integer>();
        for (int i = 0; i < charArray.length; i++)
        {
            char ch = charArray[i];
            if(!charPosMap.containsKey(ch))
            {
                charPosMap.put(ch, i);
            }
            else
            {
                i = charPosMap.get(ch);
                charPosMap.clear();
            }
            if(charPosMap.size() > longestSubStringLength)
            {
                longestSubStringLength = charPosMap.size();
                longestSubstring = charPosMap.keySet().toString();
            }
        }
    }
}
```



```
}  
}  
System.out.println("Input String : "+inputString);  
System.out.println("The longest substring : "+longestSubstring);  
System.out.println("The longest Substring Length : "+longestSubstringLength);  
}  
public static void main(String[] args)  
{  
    longestSubstring("javaconceptoftheday");  
    longestSubstring("thelongestsubstring"); } }
```

Output:

Input: abcabcbb output:3 string: abc
Input: pwwkew output:3 string: wke

10. Practical Related Question

- How to find duplicate characters in a string?
- How to count occurrences of each character in a string?
- How to find first repeated and non-repeated character in a string?

11. Exercise Questions :

- What is String in Java? ...
- What are different ways to create String Object?
- Write a method to check if input String is Palindrome?
- Write a method that will remove given character from the String?
- How can we make String upper case or lower case?
- What is String subSequence method?
- How to compare two Strings in java program?



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

PRACTICAL 3:

Write a program to find the Valid Parentheses

1. Practical significance :

The knowledge behind the valid Parentheses program is used to compare duplicate and similar characters in given list.

An expression can be divided into different tokens. Evaluation of String tokens

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students can able to evaluate expressions in compiler design concept.

Students can able to evaluate mail validations

4. Prerequisites:

Students should have knowledge on stacks and queues

Students should have knowledge on String Functions and array functions in C

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Algorithm:

- Declare a character [stack](#) S.
- Now traverse the expression string exp.
 1. If the current character is a starting bracket ('(' or '{' or '[') then push it to stack.
 2. If the current character is a closing bracket (') or '}' or ']') then pop from stack and if the popped character is the matching starting bracket then fine else brackets are not balanced.
- After complete traversal, if there is some starting bracket left in stack then "not balanced"

8. Test cases:

Input: ({) } Output: Not valid

Input: { () } Output: valid

9. Sample Code :

```
import java.util.*;

public class BalancedBrackets {
    static boolean areBracketsBalanced(String expr)
    {
        Deque<Character> stack
            = new ArrayDeque<Character>();
        for (int i = 0; i < expr.length(); i++)
        {
            char x = expr.charAt(i);

            if (x == '(' || x == '[' || x == '{')
            {
                stack.push(x);
                continue;
            }
            if (stack.isEmpty())
                return false;
            char check;
```



```
switch (x) {
case ' ':
    check = stack.pop();
    if (check == '{' || check == '[')
        return false;
    break;

case '}':
    check = stack.pop();
    if (check == '(' || check == '[')
        return false;
    break;

case ']':
    check = stack.pop();
    if (check == '(' || check == '{')
        return false;
    break;
}
}
return (stack.isEmpty());
}
public static void main(String[] args)
{
    String expr = "({})";

    // Function call
    if (areBracketsBalanced(expr))
        System.out.println("Balanced ");
    else
        System.out.println("Not Balanced ");
}
}
```

Output:

Input: ({) } Output: Not valid

Input: { () } Output: valid

10. Practical Related Question

Check for balanced parentheses in an expression | $O(1)$ space | $O(N^2)$ time complexity

Minimum number of bracket reversals needed to make an expression balanced

11. Exercise Questions :

- What is Stack? ...
- What is Queue?
- What is Time complexity?



Stack A **stack** is a linear **data structure** in which elements can be inserted and deleted only from one side of the list, called the top. ...

The **queue data structure** follows the FIFO (First In First Out) principle, i.e. the element inserted at first in the list, is the first element to be removed from the list

PRACTICAL 4:

Write a program for Letter Combinations of a Phone Number

1. Practical significance :

The leading **letters** of a central office name **were used** as the leading components of the **telephone number** representation, so that each **telephone number** in an area was unique. These **letters were** mapped to digits, which was indicated visibly on a dial **telephone**.

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students can able to evaluate expressions in Number validation.

Students can able to evaluate identifying names from number formats

4. Prerequisites:

Students should have knowledge on stacks and queues

Students should have knowledge on recursion

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.

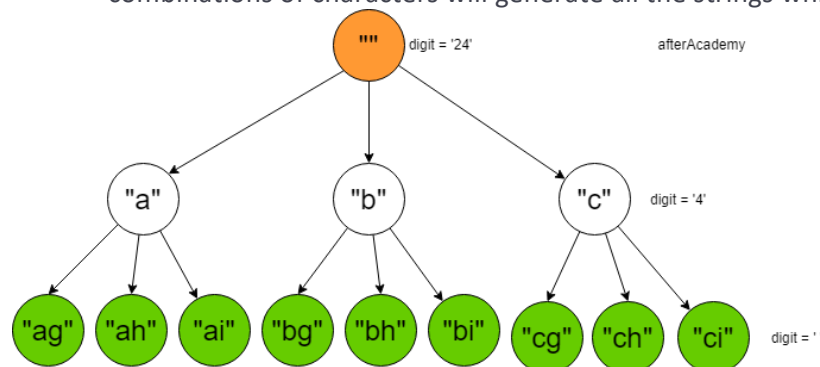
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Algorithm:

The problem statement explains that we have to generate all the possible combinations of characters that can be obtained from the respective digit of the phone's keypad. Looking over the given example,

- 2 can generate "a" or "b" or "c"
- 4 can generate "g" or "h" or "i"
- We can take one character from each of the digits to form a string. All such possible combinations of characters will generate all the strings which will be our required answer.



8. Test cases:

Input: "24"

Output: ["ag","ah","ai","bg","bh","bi","cg","ch","ci"]

9. Sample Code :

// Java implementation of the approach

```
import java.io.*;
import java.util.*;
```

```
class GFG {
    // Function to return a vector that contains
    // all the generated letter combinations
    static ArrayList<String>
    letterCombinationsUtil(int[] number, int n,
                           String[] table)
    {
        // To store the generated letter combinations
        ArrayList<String> list = new ArrayList<>();
```



```
Queue<String> q = new LinkedList<>();
q.add("");

while (!q.isEmpty()) {
    String s = q.remove();

    // If complete word is generated
    // push it in the list
    if (s.length() == n)
        list.add(s);
    else {
        String val = table[number[s.length()]];
        for (int i = 0; i < val.length(); i++)
        {
            q.add(s + val.charAt(i));
        }
    }
}
return list;
}

// Function that creates the mapping and
// calls letterCombinationsUtil
static void letterCombinations(int[] number, int n)
{
    // table[i] stores all characters that
    // corresponds to ith digit in phone
    String[] table
        = { "0", "1", "abc", "def", "ghi",
            "jkl", "mno", "pqrs", "tuv", "wxyz" };

    ArrayList<String> list
        = letterCombinationsUtil(number, n, table);

    // Print the contents of the list
    for (int i = 0; i < list.size(); i++) {
        System.out.print(list.get(i) + " ");
    }
}

// Driver code
public static void main(String args[])
{
    int[] number = { 2, 3 };
    int n = number.length;

    // Function call
    letterCombinations(number, n);
}
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

}

Output:

Input: "24"

Output: ["ag","ah","ai","bg","bh","bi","cg","ch","ci"]

10. Practical Related Question

- Sudoku Solver
- Knight on a chessboard
- Rat in a maze problem
- Graph colouring problem
- Subset sum
- Generate Parentheses

11. Exercise Questions :

- What is Stack? ...
- What is Queue?
- What is Recursion?



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

PRACTICAL 5:

Design a “farm animals” java application with the details of animals like cow, pig, horse. Consider the following details like where they stay, what they eat, the sound they make by using classes and objects.

1. Practical significance :

. The knowledge behind the design of application is to how to look any application in terms of object and functionalities. Any application can be designed using this perspective in an efficient way.

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students can able to create classes and objects.

Students can able to implement the functionalities required.

4. Prerequisites:

Students should have knowledge on functions .

Students should have knowledge on pointers.

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15” 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Algorithm:

1. Create Animals class with methods like insert.
2. Create the objects of cow, pig, horse.
3. Access the details of an animals.

8. Test cases:

Input:

Input initialized in the program.

9. Sample Code :

```
// Java implementation of the approach
```

```
import java.io.*;
```

```
import java.util.*;
```

```
class Animals {
```

```
    String place, food, sound;
```

```
    void insert(String p, String f, String s) {
```

```
        place = p;
```

```
        food = f;
```

```
        sound = s;
```

```
    }
```

```
    void display() {
```

```
        System.out.println(" stays in a "+place+" lives by eating "+food+" and makes a sound "+sound);
```

```
    }
```



}

```
public class AnimalsExp5 {  
    public static void main(String[] args) {  
        Animals cow = new Animals();  
        cow.insert("shed", "grass", "moo");  
        System.out.print("Cow");  
        cow.display();  
  
        Animals pig = new Animals();  
        pig.insert("pigsty", "biological materials", "grunt");  
        System.out.print("Pig");  
        pig.display();  
  
        Animals horse = new Animals();  
        horse.insert("stable", "grass", "neigh");  
        System.out.print("Horse");  
        horse.display();  
    }  
}
```

Output: Cow stays in a shed lives by eating grass and makes a sound moo.

10. Practical Related Question

- How to write an application by dividing into modules.
- How to implement the functionalities using methods concept.

11. Exercise Questions:

Create a class named 'Student' with String variable 'name' and integer variable 'rollo'. Assign the value of rollno as 2 and that of name as "john"; by creating an object of the class Student.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

PRACTICAL 6:

An organization is maintaining the data of employee according to cadre of employee with following parameters name, id, designation, salary, promotion status. Apply the constructor overloading to implement it.

1. Practical significance :

This experiment will give the knowledge of how to initialize the variables and how to overload a constructor based on the initialization parameters

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students will be able to create classes and objects.

Students will be able to implement the constructor overloading .

4. Prerequisites:

Students should have knowledge on classes .

Students should have knowledge on object creation.

5.Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:



- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Algorithm:

1. Create Employee class with methods like display.
2. Create the constructors with different parameters.
3. Create objects and pass the parameters and implement constructor overloading.

8. Test cases:

Input:

Input initialized in the program.

9. Sample Code :

```
// Java implementation of the approach
```

```
public class Employee {  
  
    String name;  
  
    int id;  
  
    String designation;  
  
    double salary;  
  
    String promotionStatus;  
  
    Employee()  
    {  
        name = "Aditya";  
        id = 1111;
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
designation = "Manager";
```

```
salary = 200000;
```

```
promotionStatus = "no";
```

```
}
```

```
Employee(String n, int i, String des, double sal, String ps)
```

```
{
```

```
    name = n;
```

```
    id = i;
```

```
    designation = des;
```

```
    salary = sal;
```

```
    promotionStatus = yes;
```

```
}
```

```
Employee(String n, int i, String des, double sal)
```

```
{
```

```
    name = n;
```

```
    id = i;
```

```
    designation = des;
```

```
    salary = sal;
```

```
    promotionStatus = "yes";
```

```
}
```

```
Employee(String name, int id, String designation)
```

```
{
```

```
    this.name = name;
```

```
    this.id = id;
```

```
    this.designation = designation;
```

```
    salary = 100000;
```

```
    promotionStatus = "yes";
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
}
```

```
void display()
```

```
{
```

```
    System.out.println(name+" "+id+" "+designation+" "+salary+" "+promotionStatus);
```

```
}
```

```
public static void main(String[] args) {
```

```
    Employee e1 = new Employee();
```

```
    Employee e2 = new Employee("Arjun", 2222, "Accountant", 50000, "no");
```

```
    Employee e3 = new Employee("Arthreya", 3333, "Receptionist", 30000,  
"yes");
```

```
    Employee e4 = new Employee("Ashwin", 4444, "Supervisor", 40000);
```

```
    Employee e5 = new Employee("Alice", 5555, "Assistant Manager");
```

```
    e1.display();
```

```
    e2.display();
```

```
    e3.display();
```

```
    e4.display();
```

```
    e5.display();
```

```
}
```

```
}
```

10. Practical Related Question

How do you implement a constructor with different parameters.

11. Exercise Questions :

- What is constructor?
- Types of constructors
- Differences between constructors and methods



PRACTICAL 7

All the banks operating in India are controlled by RBI. (e.g. minimum interest rate, minimum balance allowed, maximum withdrawal limit etc) which all banks must follow. Suppose RBI has set minimum interest rate applicable to a saving bank account to be 4% annually. however, banks are free to use 4% interest rate or to set any rates above it.

Write a JAVA program to implement bank functionality in the above scenario and demonstrate the dynamic polymorphism concept. Note: Create few classes namely Customer, Account, RBI (Base Class) and few derived classes (SBI, ICICI, PNB etc). Assume and implement required member variables and functions in each class.

Testcase1:

Enter the Bank name to find the rate of Interest : RBI

RBI rate of interest is : 4%

1. Practical significance :

This experiment will give the knowledge of how to implement the dynamic polymorphism and implement the classes using methods and variables.

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students will be able to create classes and objects.

Students will be able to implement the dynamic polymorphism .

4. Prerequisites:

Students should have knowledge on classes .

Students should have knowledge on inheritance.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Algorithm:

1. Create 5 classes SBI, PNB, RBI, ICICI.
2. Inherit the classes from RBI.
3. Implement the dynamic polymorphism using the objects..

8. Test cases:

Input:

Input initialized in the program.

9. Sample Code :

```
// Java implementation of the approach
import java.util.Scanner;

class RBI {

    int getRateOfInterest() {

        return 4;
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
}  
  
}  
  
class SBI extends RBI{  
    int getRateOfInterest() {  
        return 7;  
    }  
}  
  
class ICICI extends RBI {  
    int getRateOfInterest() {  
        return 8;  
    }  
}  
  
class PNB extends RBI {  
    int getRateOfInterest() {  
        return 9;  
    }  
}  
  
public class bankInterest {  
    public static void main(String[] args) {  
        Scanner sc = new Scanner(System.in);  
        System.out.print("enter the bank name to find the rate of interest: ");  
        String bank = sc.nextLine();  
        System.out.print(bank+" rate of interest:");  
        sc.close();  
        RBI r = new RBI();  
        SBI s = new SBI();  
        ICICI i = new ICICI();  
        PNB p = new PNB();  
  
        switch(bank) {
```



```
case "SBI":
    System.out.println(s.getRateOfInterest()+"%");
    break;
case "ICICI":
    System.out.println(i.getRateOfInterest()+"%");
    break;
case "PNB":
    System.out.println(p.getRateOfInterest()+"%");
    break;
case "RBI":
    System.out.println(r.getRateOfInterest()+"%");
    break;
default:
    System.out.println(" invalid option");
}
}
```

10. Practical Related Question

How do you implement a polymorphism dynamically?

11. Exercise Questions :

- What is polymorphism?
- Types of polymorphism.
- Examples of polymorphism.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

PRACTICAL 8:

1. Practical significance :

- Preventing naming conflicts. For example there can be two classes with name Employee in two packages, college.staff.cse.Employee and college.staff.ee.Employee
- Making searching/locating and usage of classes, interfaces, enumerations and annotations easier
- Providing controlled access: protected and default have package level access control. A protected member is accessible by classes in the same package and its subclasses. A default member (without any access specifier) is accessible by classes in the same package only.

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students will be able to create classes and objects.

Students will be able to implement the inheritance and polymorphism concepts

4. Prerequisites:

Students should have knowledge on class and user defined package concepts.

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Taking the input from user . Here two types of employee are there. One is Regular and another one is Contract based. Salaries will be different. Based on that user input data for example employee id the salary details will be displayed.

8. Test cases:

Output1:

Enter Employee Id: R101

Salary Details:

Basic Pay: 25000 HRA: 15000 T.A: 5000 Total Amount: 45000

Output2:

Enter Employee Id: C101

Salary Details:

Basic pay: 12000 HRA: 0 TA: 3000 Total Amount: 15000

9. Sample Code :

```
import java.util.Scanner;

interface salary
{
    void display();
}

class Regular implements salary
{
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
int amount = 25000+15000+5000;

public void display() {

    System.out.println("Basic pay: 25000  HRA: 15000  TA: 5000  Total Amount: "+
amount);
}

}

class Contract implements salary
{

    int amount = 12000+3000;

    public void display() {

        System.out.println("Basic pay: 12000  HRA: 0  TA: 3000  Total Amount: "+ amount);
    }

}

public class SalaryEmployee {
    public static void main(String args[]) {
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter employee ID: ");
        String id = sc.nextLine();
        sc.close();
        System.out.println("Salary Details:");
        if(id.charAt(0) == 'R')
        {
            salary s = new Regular();
            s.display();
        }
        else
        {
            salary s = new Contract();
            s.display();
        }
    }

}
```

Output:

Enter Employee Id: R101

Salary Details:

Basic Pay: 25000 HRA: 15000 T.A: 5000 Total Amount: 45000



10. Practical Related Question

- What are Java Packages? What's the significance of packages?
- Does Importing a package imports its sub-packages as well in Java?

11. Exercise Questions :

- Create a user defined package with one class and import into another java program.

PRACTICAL 9:

1. Practical significance :

A number in Roman Numerals is a string of these symbols written in descending order(e.g. M's first, followed by D's, etc.). However, in a few specific cases, to avoid four characters being repeated in succession(such as IIII or XXXX), subtractive notation is often used as follows:

I placed before V or X indicates one less, so four is IV (one less than 5) and 9 is IX (one less than 10). X placed before L or C indicates ten less, so forty is XL (10 less than 50) and 90 is XC (ten less than a hundred).

C placed before D or M indicates a hundred less, so four hundred is CD (a hundred less than five hundred) and nine hundred is CM (a hundred less than a thousand).

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Roman numerals are based on the following symbols.

SYMBOL	VALUE
I	1
IV	4
V	5
IX	9
X	10
XL	40
L	50
XC	90
C	100
CD	400
D	500
CM	900
M	1000

4. Prerequisites:

Students should have knowledge on class and user defined package concepts.



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

1. Split the Roman numeral string into Roman Symbols (character).
2. Convert each symbol of Roman Numerals into the value it represents.
3. Take symbol one by one from starting from index 0:
 1. If current value of symbol is greater than or equal to the value of next symbol, then add this value to the running total.
 2. else subtract this value by adding the value of next symbol to the running total.

8. Test cases:

Input: "LVIII" **Output:** 58

Input: "XXX" **Output:** 30

9. Sample Code :

```
import number.Roman;

import java.util.Scanner;

public class labExp9 {

    public static void main(String[] args) {
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
Roman roman = new Roman();

Scanner sc = new Scanner(System.in);

System.out.println("Enter the roman number: ");

String str = sc.nextLine();

sc.close();

roman.romanToInteger(str);

}

}

package number;

import java.util.*;

public class Roman {

    public int romanToInteger(String str) {

        if(str == null || str.length() == 0) {

            return 0;

        }

        HashMap<Character,Integer> lm = new HashMap<Character,Integer>();

        lm.put('I', 1);

        lm.put('V', 5);

        lm.put('X', 10);

        lm.put('L', 50);

        lm.put('C', 100);

        lm.put('D', 500);

        lm.put('M', 1000);

        int result = 0;
```



```
int i;
for(i=0; i<str.length()-1; i++) {
    if(lm.get(str.charAt(i)) >= lm.get(str.charAt(i+1)))
        result = result + lm.get(str.charAt(i));
    else
        result = result - lm.get(str.charAt(i));
}

result = result + lm.get(str.charAt(str.length()-1));
System.out.println(result);

System.out.println("Explanation: ");
for(Map.Entry<Character, Integer> entry : lm.entrySet()) {
    char k = entry.getKey();
    int v = entry.getValue();

    for(i=0; i<str.length();i++) {
        if(k == str.charAt(i))
            System.out.print(k + "=" + v + " ");
    }
}
return 0;
}
}
```

Output:

Enter the roman number: LVIII

Out put: 58

10. Practical Related Question



- What are Hashmap? What's the significance of Hashmap?
- Does Importing a package imports its sub-packages as well in Java?

11. Exercise Questions :

Converting Decimal Number lying between 1 to 3999 to Roman Numerals

PRACTICAL 10:

1. Practical significance :

We can copy a file from one location to another using FileInputStream and FileOutputStream classes in Java.

For this we have to import some specific classes of java.io package. So for instance let us include the entire package with statement `import java.io.*;`

The main logic of copying file is to read the file associated to FileInputStream variable and write the read contents into the file associated with FileOutputStream variable.

Methods used in the program

1. **int read();** Reads a byte of data. Present in FileInputStream. Other versions of this method : `int read(byte[] bytearray)` and `int read(byte[] bytearray, int offset, int length)`
2. **void write(int b)** : Writes a byte of data. Present in FileOutputStream. Other versions of this method : `void write(byte[] bytearray)` and `void write(byte[] bytearray, int offset, int length)`

2. Relevant program outcomes:

PO1,PO2,PO3,PO4

3. Competency and Practical Skills:

Students can give source file and using the methods to copy content from source file to destination file.

4. Prerequisites:

Students should have knowledge on class and user File io stream classes.

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
--------------------------------------	---



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

Hardware Requirements
(Recommend)

Monitor : 15" 1024x768 LCD
Ram : 4GB
Harddrive: 512GB

6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

Java provides I/O Streams to read and write data where a Stream represents an input source or an output destination which could be a file, i/o device, other programs, etc.

In general, a Stream will be an input stream or, an output stream.

- InputStream – This is used to read data from a source.
- OutputStream – This is used to write data to a destination.

Based on the data they handle there are two types of streams –

- Byte Streams – These handle data in bytes (8 bits) i.e., the byte stream classes read/write data of 8 bits. Using these you can store characters, videos, audios, images, etc.
- Character Streams – These handle data in 16 bit Unicode. Using these you can read and write text data only.

8. Test cases:

Input: input file **Output:** output file

9. Sample Code :

```
import java.io.File;
import java.io.FileInputStream;
import java.io.FileWriter;
import java.io.IOException;
import java.util.Scanner;
public class CopyContent {
    public static void main(String[] args) throws IOException {
        //Instantiating a file class
        File file = new File("D:\\sampleData.txt");
```




```
//Instantiate an FileInputStream class
FileInputStream inputStream = new FileInputStream(file);
//Instantiating the Scanner class
Scanner sc = new Scanner(inputStream);
//StringBuffer to store the contents
StringBuffer buffer = new StringBuffer();
//Appending each line to the buffer
while(sc.hasNext()) {
    buffer.append(" "+sc.nextLine());
}
System.out.println("Contents of the file: "+buffer);
//Creating a File object to hold the destination file
File dest = new File("D:\\outputFile.txt");
//Instantiating an FileWriter object
FileWriter writer = new FileWriter(dest);
//Writing content to the destination
writer.write(buffer.toString());
writer.flush();
System.out.println("File copied successfully.....");
}
}
```

Output:

File copied successfully.....

10. Practical Related Question

- How to read data from .csv file in Java?
- How to read the data from a file in Java?

11. Exercise Questions:

- ➔ Read a 2d array from a file in java?
- ➔ Read integers from a file using Buffered Reader in Java?



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

PRACTICAL 11:

1. Practical significance:

Exceptions These are the events that occur due to the programmer error or machine error which causes a disturbance in the normal flow of execution of the program.

Handling multiple exceptions: There are two methods to handle multiple exceptions in java.

1. Using a Single try-catch block try statement allows you to define a block of code to be tested for errors, and we can give exception objects to the catch block because this all the exceptions inherited by the Exception class.
2. The second method is to create individual catch blocks for the different exception handler.

2. Relevant program outcomes:

PO1, PO2, PO3, PO4

3. Competency and Practical Skills:

Students can raise `ArrayIndexOutOfBoundsException` then handle the exceptions by using exception handling mechanism.

4. Prerequisites:

Students should have knowledge on Exceptions hierarchy and learn about types of exceptions.

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB



6. Precautions:

- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

To implement this, enter your code to connect to the server (Using traditional if and else conditions). You will check if the server is down. If yes, write the code to connect to the backup server. Such organization of code, using "if" and "else" loop is not effective when your code has multiple java exceptions to handle.

```
class connect{
    if(Server Up){
        // code to connect to server
    }
    else{
        // code to connect to BACKUP server
    }
}
```

8. Test cases:

Input: enter index value 20 **Output:** ArrayindexOutOfBoundsException

9. Sample Code :

```
import java.util.Scanner;

class Utility{

    public static boolean numbercheck(String input) {

        try {

            Long.parseLong(input);

        }

        catch(Exception e) {
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
        return false;
    }
    return true;
}
}

public class labExp11 {
    public static void main(String[] args) {
        try {
            Scanner sc = new Scanner(System.in);
            System.out.println("Enter the mobile number: ");
            String num = sc.nextLine();
            sc.close();

            if(Utility.numbercheck(num) && num.length() == 10)
                System.out.println("Valid number");
            else if(Utility.numbercheck(num) && num.length()>10)
                throw new ArrayIndexOutOfBoundsException();
            else if(Utility.numbercheck(num) && num.length()<10)
                throw new MyException("invalid mobile number- LengthNotSufficient
Exception");
            else
                throw new NumberFormatException();
        }

        catch(ArrayIndexOutOfBoundsException e) {
            System.out.println("invalid mobile number- ArrayIndexOutOfBoundsException");
        }
        catch(NumberFormatException e) {
```



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
        System.out.println("invalid mobile number- NumberFormat Exception");
    }
    catch(Exception e) {
        System.out.println(e);
    }
}
}
@SuppressWarnings("serial")
class MyException extends Exception
{
    MyException(String msg){
        super(msg);
    }
}
```

Output:

Enter the mobile number: 1234567891011
invalid mobile number- ArrayIndexOutOfBoundsException.

10. Practical Related Question

How the exceptions are handled in java? OR Explain exception handling mechanism in java?

what are checked and unchecked exceptions in java?

Can we keep the statements after finally block If the control is returning from the finally block itself?

11. Exercise Questions:

- ➔ Create an Exception for OutofMemory
- ➔ Create an exception for ArthimetiException



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

PRACTICAL 12:

1. Practical significance:

Synchronization between threads in Java can be achieved by using Synchronized key word. Synchronized key word allows one thread at a time to access a method, variable or an object such that making other threads to wait until one finishes its work or get terminated.

2. Relevant program outcomes:

PO1, PO2, PO3, PO4

3. Competency and Practical Skills:

There are two ways of using synchronized key word in Java.

1. Synchronized Methods
2. Synchronized Blocks

4. Prerequisites:

Students should have knowledge on Exceptions hierarchy and learn about types of exceptions.

5. Resources Required:

Software Requirements (Recommend)	Operating System : Windows7/Linux/Ubuntu Application Software : Java SE 9 Text Editor : Notepad
Hardware Requirements (Recommend)	Monitor : 15" 1024x768 LCD Ram : 4GB Harddrive: 512GB

6. Precautions:



- Check Whether the computer is getting proper power or not.
- Ensure the keyboard, mouse and monitor are properly working.
- Ensure that there are no power fluctuations while executing the commands.
- Safe working conditions help prevent injury to people and damage to computer equipment.
- A safe work space is clean, organized, and properly lighted. Everyone must understand and follow safety procedures.
- Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities in the home and the workplace.
- Power supplies and CRT monitors contain high voltage.

7. Algorithm/circuit/Diagram/Description:

In the below program we have three classes SeatReservation, Reservation and Person. In SeatReservation at LINE A we have an object for Reservation. At LINE B we are creating three threads and passing the Reservation reference as a parameter and running them by invoking thread's start method which in turn invokes Persons run method. Remember all the threads function on the same Reservation object.

At LINE C in the Person class run method we are invoking reserveSeat method of Reservation. At LINE D we made the reserveSeat method as synchronized meaning only one thread can access it at a time. At LINE E we are making the thread to sleep for 100 milliseconds.

8. Test cases:

Thread-1 entered.
Availableseats : 10 Requestedsetas : 5
Seat Available. Reserve now :
5 seats reserved.
Thread-0 leaving.

Thread-1 entered.
Availableseats : 5 Requestedsetas : 2
Seat Available. Reserve now :
2 seats reserved.
Thread-1 leaving.

Thread-2 entered.
Availableseats : 3 Requestedsetas : 4
Requested seats not available :
Thread-2 leaving.

9. Sample Code :



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

```
class SeatReservation
```

```
{
    public static void main(String[] args)
    {
        Reservation reserve = new Reservation(); // LINE A
        Person thread1 = new Person(reserve, 5); // LINE B
        thread1.start();
        Person thread2 = new Person(reserve, 4);
        thread2.start();
        Person thread3 = new Person(reserve, 2);
        thread3.start();
    }
}
```

```
class Reservation
```

```
{

    static int availableSeats = 10;

    synchronized void reserveSeat(int requestedSeats) // LINE D
    {
        System.out.println(Thread.currentThread().getName() + " entered.");
        System.out.println("Availableseats : " + availableSeats + " Requestedsetas : " + requestedSeats);
        if (availableSeats >= requestedSeats)
        {
            System.out.println("Seat Available. Reserve now :-");
            try
            {
                Thread.sleep(100); // LINE E
            }
            catch (InterruptedException e)
            {
                System.out.println("Thread interrupted");
            }
            System.out.println(requestedSeats + " seats reserved.");
            availableSeats = availableSeats - requestedSeats;
        }
        else
        {
            System.out.println("Requested seats not available :-");
        }
        System.out.println(Thread.currentThread().getName() + " leaving.");
        System.out.println("-----");
    }
}
```




```
class Person extends Thread
{

    Reservation reserve;
    int requestedSeats;

    public Person(Reservation reserve, int requestedSeats)
    {
        this.reserve = reserve;
        this.requestedSeats = requestedSeats;
    }

    @Override
    public void run() // LINE C
    {
        reserve.reserveSeat(requestedSeats);
    }
}
```

Output:

```
Thread-0 entered.
Availableseats : 10 Requestedsetas : 5
Seat Available. Reserve now :-)
5 seats reserved.
Thread-0 leaving.
-----
Thread-2 entered.
Availableseats : 5 Requestedsetas : 2
Seat Available. Reserve now :-)
2 seats reserved.
Thread-2 leaving.
-----
Thread-1 entered.
Availableseats : 3 Requestedsetas : 4
Requested seats not available :-)
Thread-1 leaving.
-----
```

10. Practical Related Question

What is the difference between Process and Thread?
What are the benefits of multi-threaded programming?
What is difference between user Thread and daemon Thread?

11. Exercise Questions:



Anil Neerukonda Institute of Technology & Sciences (Autonomous)

(Affiliated to AU, Approved by AICTE & Accredited by NBA & NAAC with 'A' Grade)

SANGIVALASA-531 162, Bheemunipatnam Mandal, Visakhapatnam District

Phone: 08933-225083/84/87

Fax: 226395

Website: www.anits.edu.in

email: principal@anits.edu.in

- Create one more thread for Person with requested seats 1 and see the output.
- Remove the synchronized key word for the method reserveSeat in Reservation.