

Course Code	Course name	L	T	P	C
CSEG1021	Python Programming	2	0	2	4
Total Units to be Covered: 06		Total Contact Hours: 90			
Prerequisite(s):			Syllabus version: 1.0		

Course Objectives

1. Develop a strong foundation in Python programming language, including syntax, data types, control structures, and functions, enabling students to write efficient and reliable code.
2. Understand and apply object-oriented programming (OOP) principles in Python to design and build modular, reusable, and maintainable software solutions.
3. Gain proficiency in utilizing Python libraries and modules for tasks such as data manipulation, web scraping, data analysis, and visualization, empowering students to work with real-world data effectively.
4. Explore advanced topics in Python, including concurrency, file I/O, exception handling and equipping students with the skills to build robust and scalable applications.

Course Outcomes

On completion of this course, the students will be able to:

- CO1.** Demonstrate proficiency in Python programming by writing code that adheres to Python syntax, utilizes appropriate data types, and implements different control structures effectively.
- CO2.** Apply Python collections, such as lists, tuples, dictionaries, and sets, along with the design and implementation of reusable functions, to solve complex programming problems, demonstrating proficiency in data organization, manipulation, and modular code design.
- CO3.** Implement advanced Python features and techniques, such as modules and packages, file handling, exception handling and regular expression to create robust and reliable applications.
- CO4.** Apply object-oriented programming (OOP) concepts in Python to design and develop various modular software solutions that promote code maintainability and reusability.

CO5. Utilize Python libraries and modules for data manipulation, analysis, and visualization, demonstrating the ability to work with real-world data sets and extract meaningful insights.

CO-PO Mapping

Program Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PS O1	PS O2	PS O3
CO1	-	-	-	-	2	-	-	-	-	-	2	1	-
CO2	-	-	-	-	2	-	-	-	-	-	2	1	-
CO3	-	-	-	-	2	-	-	-	-	-	2	1	-
CO4	-	-	-	-	2	-	-	-	-	-	2	1	-
CO5	-	-	-	-	2	-	-	-	-	-	2	2	-
Average	-	-	-	-	2	-	-	-	-	-	2	1.2	-

1 – Weakly Mapped (Low)

3 – Strongly Mapped (High)

2 – Moderately Mapped (Medium)

“_” means there is no correlation

Syllabus

Unit I: Introduction to Python

5 Lecture Hours

Introduction, Working with Python, Interactive mode and Scripting mode, Dynamic Types, Mutable and immutable data types, Basic Syntax, Comments, String Values, String Methods, The format Method, String Operators, Numeric Data Types, Input & Output functions, Escape sequence characters, Python Tokens (Keyword, identifier, special symbols, literals, constants, operators), Naming Conventions, Operators (Arithmetic, relational, logical, assignment, bitwise, membership, identity), Operators precedence and associativity, Type function and id function, Indentation, Decision Making Statements (if, if else, elif, nested if, match statement), range function, looping structures (while loop, for loop), break, continue, pass statement, else in loops, nested loops.

Unit II: Collections and Functions

5 Lecture Hours

String initialization, String Operators, String functions, indexing, slicing, split() function,

List initialization, List methods, List operations, indexing, slicing, list comprehension, Nesting in lists, tuple initialization, tuple methods, tuple operations, nesting in tuple, List vs Tuple, Set initialization, Set methods, Set operations, Dictionary initialization, Dictionary methods, nesting in Dictionary, Sorting data collections, typecasting collections, Applications of collections, Introduction, Defining user defined function, Parameters, Function Documentation, Keyword and Optional Parameters, default argument, Variable length Arguments, Scope, Passing Collections to a Function, Passing Functions to a Function, Recursion, map, filter, Lambda function, Inner Functions, Passing mutable and immutable datatypes in functions.

Unit III: Module, Packages and Regular Expressions 5 Lecture Hours

Introduction to modules and packages, creating modules and packages, Standard Modules – sys, math, time, os, Need for Regular Expressions, Regular Expression Functions (match, search, sub, findall, finditer), Meta characters, Character Class, Groups.

Unit IV: File and Exception Handling 5 Lecture Hours

File Access Modes, File handling Functions, Writing Data to a File, Reading Data from a File, Additional File Methods, With Statement, Working with Directories, Applications of File Handling, Errors vs Exceptions, The Exception Model, Exception Hierarchy, Exception Handling (try, except, else, finally), Handling Multiple Exceptions, raise, assert.

Unit V: Class and Objects in Python 4 Lecture Hours

OOP Concepts, Classes in Python, Creating Classes and Objects, methods in classes, Constructor, Special Methods in classes, Class Variables and Object Variables, Public and Private data members, Built-in Class Attributes, Garbage Collection, Abstract class, Inheritance, types of inheritance, Polymorphism (Function overriding, operator overloading).

Unit VI: Data Analysis and Visualization 6 Lecture Hours

Numpy – Overview, numpy Ndarray, Datatypes, Array creation, List vs Array, numpy attributes, numpy operations, Numpy Broadcasting, Numpy Functions (String, mathematical, statistical, sorting and searching), Numpy Special functions (reshape()),

`sum(), random(), zeros(), ones(), mean(), dot(), std(), empty(), arange(), numpy.linspace()`

Pandas – Overview, Pandas Data Structures: Series and Data Frame, Operations on a Series (head, tail, vector operations), Data Frame operations(create, display, iteration, select column, add column, delete column), Binary operations in a Data Frame (add, sub, mul, div), Matching and broadcasting operations, Handling Missing data and filling values, Data Aggregation, Comparisons, Boolean reductions, comparing Series, Combining Data Frames, Importing/Exporting Data between CSV files and Data Frames.

Matplotlib- Introduction, Matplotlib Pyplot, Plotting, markers, Line, Labels, Grid, Customizing plots, Creating Different Types of Plots (Line Graph, Bar chart, Histograms, Scatter Plot, Pie Chart), Creating and working with Subplots.

Total lecture Hours 30

References*

Textbooks

1. M. C. Brown, Python: the complete reference. New York; London: Osborne/Mcgraw-Hill, 2001.
2. P. Barry, Head First Python: a brain-friendly guide. Beijing: O'reilly, 2016.

Reference books

1. L. Ramalho, Fluent Python. Beijing; Boston Und Drei Andere: O'reilly, -03-18, 2016.

Web Resources

Journals

MOOCs, online courses

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme

Components	Quiz/Assignment/ etc. (Continuation Evaluation)	MID Sem	End Sem	Total
Weightage (%)	50	20	30	100

Python Programming Lab

List of Experiments

Experiment 1: Python Installation and starting with python

1. Install Python and understand difference between scripting and interactive modes in IDLE.
2. Write Python programs to print strings in the given manner:
 - a) Hello Everyone !!!
 - b) Hello
World
 - c) Hello
World
 - d) ' Rohit' s date of birth is 12\05\1999'
3. Declare a string variable called x and assign it the value "Hello".
Print out the value of x
4. Take different data types and print values using print function.
5. Take two variables, a and b. Assign your first name and last name. Print your Name after adding your First name and Last name together.
6. Declare three variables, consisting of your first name, your last name and Nickname. Write a program that prints out your first name, then your nickname in parenthesis and then your last name.
Example output: George (woody) Washington.
7. Declare and assign values to suitable variables and print in the following way:
NAME: NIKUNJ BANSAL
SAP ID: 500069944
DATE OF BIRTH: 13 Oct 1999
ADDRESS: UPES
Bidholi Campus
Pincode: 248007
Programme: AI & ML
Semester: 2

Experiment 2: Use of input statements, operators

1. Declare these variables (x, y and z) as integers. Assign a value of 9 to x. Assign a value of 7 to y, perform addition, multiplication, division and subtraction on these two variables and print out the result.
2. Write a Program where the radius is taken as input to compute the area of a circle.
3. Write a Python program to solve $(x+y)^*(x+y)$
4. Test data: x = 4, y = 3
5. Expected output: 49
6. Write a program to compute the length of the hypotenuse (c) of a right triangle using Pythagoras theorem.
7. Write a program to find simple interests.
8. Write a program to find area of triangle when length of sides are given.
9. Write a program to convert given seconds into hours, minutes and remaining seconds.
10. Write a program to swap two numbers without taking additional variable.
11. Write a program to find sum of first n natural numbers.
12. Write a program to print truth table for bitwise operators (&, |, and ^ operators)
13. Write a program to find left shift and right shift values of a given number.
14. Using membership operator find whether a given number is in sequence (10,20,56,78,89)
15. Using membership operator find whether a given character is in a string.

Experiment 3: Conditional Statements

1. Check whether a given number is divisible by 3 and 5 both.
2. Check whether a given number is multiple of five or not.
3. Find the greatest among two numbers. If numbers are equal than print "numbers are equal".
4. Find the greatest among three numbers assuming no two values are same.
5. Check whether the quadratic equation has real roots or imaginary roots.
Display the roots.
6. Find whether a given year is a leap year or not.

7. Write a program which takes any date as input and display next date of the calendar e.g.

I/P: day=20 month=9 year=2005

O/P: day=21 month=9 year 2005

8. Print the grade sheet of a student for the given range of cgpa. Scan marks of five subjects and calculate the percentage.

CGPA=percentage/10

CGPA range:

0 to 3.4 -> F

3.5 to 5.0->C+

5.1 to 6->B

6.1 to 7-> B+

7.1 to 8-> A

8.1 to 9->A+

9.1 to 10-> O (Outstanding)

Sample Gradesheet

Name: Rohit Sharma

Roll Number: R17234512 SAPID: 50005673

Sem: 1 Course: B.Tech. CSE AI&ML

Subject name: Marks

PDS: 70

Python: 80

Chemistry: 90

English: 60

Physics: 50

Percentage: 70%

CGPA:7.0

Grade: A

Experiment 4: Loops

Q1) Find a factorial of given number.

Q2) Find whether the given number is Armstrong number.

- Q3) Print Fibonacci series up to given term.
- Q4) Write a program to find if given number is prime number or not.
- Q5) Check whether given number is palindrome or not.
- Q6) Write a program to print sum of digits.
- Q7) Count and print all numbers divisible by 5 or 7 between 1 to 100.
- Q8) Convert all lower cases to upper case in a string.
- Q9) Print all prime numbers between 1 and 100.
- Q10) Print the table for a given number:
 $5 * 1 = 5$
 $5 * 2 = 10$

Experiment 5: String and Sets

1. Write a program to count and display the number of capital letters in a given string.
2. Count total number of vowels in a given string.
3. Input a sentence and print words in separate lines.
4. WAP to enter a string and a substring. You have to print the number of times that the substring occurs in the given string. String traversal will take place from left to right, not from right to left.

Sample Input

ABCDCDC

CDC

Sample Output

2

5. Given a string containing both upper and lower-case alphabets. Write a Python program to count the number of occurrences of each alphabet (case insensitive) and display the same.

Sample Input

ABaBCbGc

Sample Output

2A

3B

2C

1G

6. Program to count the number of unique words in a given sentence using sets.
7. Create 2 sets s1 and s2 of n fruits each by taking input from user and find:
 - a. Fruits which are in both sets s1 and s2
 - b. Fruits only in s1 but not in s2
 - c. Count of all fruits from s1 and s2
8. Take two sets and apply various set operations on them:
 $S1 = \{\text{Red, yellow, orange, blue}\}$
 $S2 = \{\text{violet, blue, purple}\}$

Experiment 6: Lists, tuples, dictionary

1. Scan n values in range 0-3 and print the number of times each value has occurred.
2. Create a tuple to store n numeric values and find the average of all values.
3. WAP to input a list of scores for N students in a list data type. Find the score of the runner-up and print the output.

Sample Input

N = 5

Scores= 2 3 6 6 5

Sample output

5

Note: Given list is [2, 3, 6, 6, 5]. The maximum score is 6, second maximum is 5. Hence, we print 5 as the runner-up score.

4. Create a dictionary of n persons where key is name and value is city.
 - a. Display all names
 - b. Display all city names
 - c. Display student names and cities of all students.
 - d. Count the number of students in each city.
5. Store details of n movies in a dictionary by taking input from the user. Each movie must store details like name, year, director name, production cost, collection made (earning) & perform the following :-
 - a. print all movie details
 - b. display name of movies released before 2015
 - c. print movies that made a profit.

- d. print movies directed by a particular director.

Experiment 7: J Functions

1. Write a Python function to find the maximum and minimum numbers from a sequence of numbers. (Note: Do not use built-in functions.)
2. Write a Python function that takes a positive integer and returns the sum of the cube of all the positive integers smaller than the specified number.
3. Write a Python function to print 1 to n using recursion. (Note: Do not use loop)
4. Write a recursive function to print Fibonacci series upto n terms.
5. Write a lambda function to find volume of cone.
6. Write a lambda function which gives tuple of max and min from a list.
Sample input: [10, 6, 8, 90, 12, 56]
Sample output: (90,6)
7. Write functions to explain mentioned concepts:
 - a. Keyword argument
 - b. Default argument
 - c. Variable length argument

Experiment 8: File Handling and Exception Handling

1. Add few names, one name in each row, in “name.txt file”.
 - a. Count no of names
 - b. Count all names starting with vowel
 - c. Find longest name
2. Store integers in a file.
 - a. Find the max number
 - b. Find average of all numbers
 - c. Count number of numbers greater than 100
3. Assume a file city.txt with details of 5 cities in given format (cityname population(in lakhs) area(in sq KM)):
Example:

Dehradun 5.78 308.20

Delhi 190 1484

.....

Open file city.txt and read to:

- a. Display details of all cities
- b. Display city names with population more than 10Lakhs
- c. Display sum of areas of all cities
4. Input two values from user where the first line contains N, the number of test cases. The next N lines contain the space separated values of a and b. Perform integer division and print a/b. Handle exception in case of ZeroDivisionError or ValueError.

Sample input

1 0

2 \$

3 1

Sample Output:

Error Code: integer division or modulo by zero

Error Code: invalid literal for int() with base 10: '\$' 3

5. Create multiple suitable exceptions for a file handling program.

Experiment 9: Classes and objects

1. Create a class of student (name, sap id, marks[phy,chem,maths]). Create 3 objects by taking inputs from the user and display details of all students.
2. Add constructor in the above class to initialize student details of n students and implement following methods:
Display() student details
Find Marks_percentage() of each student
Display result() [Note: if marks in each subject >40% than Pass else Fail]
Write a Function to find average of the class.
3. Create programs to implement different types of inheritances.
4. Create a class to implement method Overriding.
5. Create a class for operator overloading which adds two Point Objects where Point has x & y values

e.g. if

P1(x=10,y=20)

P2(x=12,y=15)

P3=P1+P2 => P3(x=22,y=35)

Experiment 10: Data Analysis and Visualization

1. Create numpy array to find sum of all elements in an array.
2. Create numpy array of (3,3) dimension. Now find sum of all rows & columns individually. Also find 2nd maximum element in the array.
3. Perform Matrix multiplication of any 2 n*n matrices.
4. Write a Pandas program to get the powers of an array values element-wise.

Note: First array elements raised to powers from second array

Sample data: {'X':[78,85,96,80,86], 'Y':[84,94,89,83,86],'Z':[86,97,96,72,83]}

Expected Output:

X	Y	Z	
0	78	84	86
1	85	94	97
2	96	89	96
3	80	83	72
4	86	86	83

5. Write a Pandas program to get the first 3 rows of a given DataFrame.

Sample Python dictionary data and list labels:

```
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily',
'Michael', 'Matthew', 'Laura', 'Kevin', 'Jonas'],
'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],
'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],
'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
```

Expected Output:

First three rows of the data frame:

attempts	name	qualify	score	
a	1	Anastasia	yes	12.5
b	3	Dima	no	9.0
c	2	Katherine	yes	16.5

6. Write a Pandas program to find and replace the missing values in a given DataFrame which do not have any valuable information.
7. Create a program to demonstrate different visual forms using Matplotlib.

Total lab hours 60

References*

Textbooks

1. M. C. Brown, Python: the complete reference. New York; London: Osborne/Mcgraw-Hill, 2001.
2. P. Barry, Head First Python: a brain-friendly guide. Beijing: O'reilly, 2016.

Reference books

1. Reema Thareja and S. Prasad, Python Programming. 2022.
2. M. Lutz, Learning Python. Sebastopol, Ca: O'reilly, 2018.

Web Resources

Journals

MOOCs, online courses

Modes of Evaluation: Continuous Assessment

Examination Scheme

Components	Quiz	Performance & Viva	Lab Report	Total
Weightage (%)	30	50	20	100