

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Essentials of Python	2	0	0	2	Class XII	NA

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce programming concepts using python
- To use python programming to solve problems of different domains

Learning outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to understand the basics of programming language
- After studying this course, students will be able to develop, document and debug modular python programs
- After studying this course, students will be able to apply suitable programming constructs and built in data structures to solve a problem

SYLLABUS

Unit I (12 hours)

Introduction

What can Python do? Why Python? Python Syntax compared to other programming languages, Python Installation.

The print statement, Comments, Python Data Structures & Data Types, String Operations in Python, Simple Input & Output, Simple Output Formatting, Operators in python

Python Program Flow

Indentation, The If statement and its' related statement, An example with if and it's related statement, The while loop, The for loop, The range statement, Break &Continue, Assert, Examples for looping

Functions& Modules

Create your own functions, Functions Parameters, Variable Arguments, Scope of a Function, Function Documentations, Lambda Functions& map, n Exercise with functions, Create a Module, Standard Modules

Unit 2

(16 hours)

Exceptions Handling

Errors, Exception handling with try, handling Multiple Exceptions, Writing your own Exception

File Handling

File handling Modes, Reading Files, Writing& Appending to Files, Handling File Exceptions, The with statement

Classes In Python

New Style Classes, Creating Classes, Instance Methods, Inheritance, Polymorphism, Exception Classes & Custom Exceptions

Generators and iterators

Iterators, Generators, The Functions any and all, With Statement, Data Compression

Unit 3

(16 hours)

Data Structures

List Comprehensions, Nested List Comprehensions, Dictionary Comprehensions. Functions, Default Parameters, Variable Arguments, Specialized Sorts

Collections

namedtuple(), deque, ChainMap, Counter, OrderedDict, defaultdict, UserDict, UserList, UserString

Writing GUIs in Python (Tkinter)

Introduction, Components and Events, An Example GUI, The root Component, Adding a Button, Entry Widgets, Text Widgets, Check buttons

Python SQL Database Access

Introduction, Installation, DB Connection, Creating DB Table, INSERT, READ, UPDATE, DELETE operations, COMMIT & ROLLBACK operation, handling Errors

Network Programming

Introduction, A Daytime Server, Clients and Servers, The Client Program, The Server Program

Date and Time

Sleep, Program execution time, more methods on date/time

Unit 4

(16 hours)

Filter, Map, Reduce, Decorators, Frozen set, Collections

Regular Expression

Split, Working with special characters, date, emails, Quantifiers, Match and find all, character sequence and substitute, Search method

Threads ESSENTIAL

Class and threads, Multi-threading, Synchronization, Treads Life cycle, use cases

Accessing API ESSENTIAL

Introduction, Facebook Messenger, Openweather

DJANGO

Django Overview, Django Installation, Creating a Project, Usage of Project in depth Discussion, Creating an Application, Understanding Folder Structure, Creating a Hello World Page, Database and Views, Static Files and Forms, API and Security

Essential/recommended readings

- "Starting Out with Python plus My Programming Lab with Pearson eText -- Access Card Package (3rd Edition) Tony Gaddis ISBN-13: 978-0133862256".
- Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition).
- Head-First Python: A Brain-Friendly Guide (2nd Edition) by Paul Barry.
- Learn Python the Hard Way: 3rd Edition by Zed A. Shaw.
- Python Programming: An Introduction to Computer Science (3rd Edition) by John M. Zelle.
- Python Cookbook: Recipes for Mastering Python 3 (3rd Edition) by Brian Jones and David Beazley
- <https://docs.djangoproject.com/>
- Introduction to Programming using Python by Y. Daniel Liang. Publisher Pearson
- Taneja, S., Kumar, N. Python Programming- A modular Approach, Pearson Education India, 2018.
- Balaguruswamy E., Introduction to Computing and Problem Solving using Python, 2 nd edition, McGraw Hill Education, 2018

Examination scheme and mode:

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

Programming using Python

Credit distribution, Eligibility and Prerequisites of the Course

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		Lecture	Tutorial	Practical / Practice		
Programming using Python	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide exposure to basic problem-solving techniques with computers
- To develop logical thinking abilities and to propose novel solutions for real-world problems through programming language constructs.
- To deepen the empirical knowledge on applying programming in business domains.

Learning outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to interpret the basic representation of the data structures and sequential programming
- After studying this course, students will be able to gain knowledge of, and ability to use control framework terminologies.
- After studying this course, students will be able to work out using the core data structures as lists, dictionaries, tuples, and sets.
- After studying this course, students will be able to choose appropriate programming paradigms, interrupt and handle data using files to propose solutions through reusable modules
- After studying this course, students will be able to propose possible error-handling constructs for unanticipated states/inputs.
- After studying this course, students will be able to implements exemplary applications on real-world problems.

Syllabus

Unit-1: Introduction

(8 hours)

Relationship between computers and programs, Basic principles of computers, File systems, Using the Python interpreter, Introduction to binary computation, Input / Output

Unit-2: Data types and control structures

(8 hours)

Operators (unary, arithmetic, etc.), Data types, variables, expressions, and statements, Assignment statements, Strings and string operations, Control Structures: loops and decision

Unit-3: Modularization and Classes

(8 hours)

Standard modules, Packages, Defining Classes, Defining functions, Functions and arguments (signature)

Unit-4: Data structures and Object-oriented design

(8 hours)

Data Structures (array, List, Dictionary), Error processing, Exception Raising and Handling Programming types, Object Oriented Programming, Object Oriented Design, Inheritance and Polymorphism

Practical Exercises

(28 hours)

- Running instructions in Interactive interpreter and a Python Script
- Write a program to purposefully raise Indentation Error and Correct it
- Write a program to compute distance between two points taking input from the user. (Pythagorean Theorem)
- Write a program add.py that takes 2 numbers as command line arguments and prints its sum.
- Write a Program for checking whether the given number is an even number or not.
- Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, 1/10
- Write a program using a for loop that loops over a sequence. What is the sequence?
- Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.
- Find the sum of all the primes below two million. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89,
- By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.
- Write a program to count the numbers of characters in the string and store them in a dictionary data structure.

- Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure.
- Write a program combining lists that combines these lists into a dictionary.
- Write a program to count the frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?
- Write a program to print each line of a file in reverse order.
- Write a program to compute the number of characters, words and lines in a file.
- Write a function ball collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding. Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius. If (distance between two balls centers) \leq (sum of their radii) then (they are colliding)
- Find mean, median, mode for the given set of numbers in a list.
- Write a function nearly equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.
- Write a function dups to find all duplicates in the list.

Essential/recommended readings

- "Starting Out with Python plus My Programming Lab with Pearson eText --Access Card Package (3rd Edition) Tony Gaddis ISBN-13: 978-0133862256".
- Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition).
- Head-First Python: A Brain-Friendly Guide (2nd Edition) by Paul Barry.
- Learn Python the Hard Way: 3rd Edition by Zed A. Shaw.
- Python Programming: An Introduction to Computer Science (3rd Edition) by John M. Zelle.
- Python Cookbook: Recipes for Mastering Python 3 (3rd Edition) by Brian Jones and David Beazley.

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Statistics with 'R'

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		Lecture	Tutorial	Practical/ Practice		
Statistics with R	2	0	0	2	Class XII	Basic course in Statistics

Learning Objectives

The Learning Objectives of this course are as follows:

- To enable students to handle data in the R software thereby helping them to understand meaningful statistical analysis performed on the data.
- To enable students to extract data, and perform basic statistical operations entailing data analysis such as – data cleaning, data visualisation, data summarisation, and regression amongst others.

Learning outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to extract and Read data into R, manipulate, and analyse it
- After studying this course, students will be able Tto debug, organize, and comment R code
- After studying this course, students will be able to understand the R environment for downloading, installing, and using packages
- After studying this course, students will be able to do basic programming to write own functions
- After studying this course, students will be able to use loops
- After studying this course, students will be able to create standard and customized graphics
- After studying this course, students will be able to perform basic statistical operations and regression.

SYLLABUS

Unit 1: Data Extraction and Spread Sheet Exploration

(12 hours)

Extraction of economics and financial data from Prowessiq, RBI, IMF, World bank or an equivalent financial/economic database. The students should be able to save and export the data to 'R-environment' for further analysis.

Unit 2: Basics of R-language

(28 hours)

Overview of the R language: Installing R and R Studio : Using R studio, Scripts, Text editors for R, Graphical User Interfaces (GUIs) for R, Creating and storing R workspaces, installing packages and libraries, Mathematical operations.

Data Types in R – Numeric, Integer, Character, Logical, Complex and missing data. Data Structures in R

- Vectors – Creation, Arithmetic operations of Vectors, Vector Sub setting, Sorting and Sequencing functions.
- Matrix and Arrays – Creation, Arithmetic Operations of matrix, Sub setting, Use of Drop Function.
- Factors – Converting a vector into factor, assigning levels and labels, ordered Factor.
- List – Creating a list, accessing elements from a list, adding a new element and eliminating an existing element from the list, converting list to vectors.
- Data Frames – Creation of Data Frame, adding new columns, rows and removing columns, accessing column using the \$ sign, importing a data set (important file formats such as csv, txt and spreadsheet), aggregate function and subsetting of dataframes, tapply function, manipulation using dplyr package (select, filter, arrange, mutate and group by function, pipe operator).

Programming Fundamentals: Logical operators, conditional statements (if, else, else if statements in R), While loops, For loops, repeat loops.

Creating functions in R.

Reading data in R (file formats such as csv, txt, and xlsx), Writing data to external files (file formats such as csv, txt, and xlsx), writing a table to a file, print function.

Unit 3: Basic Statistics and Regression

(20 hours)

Summarizing and exploring data: Descriptive statistics (mean, median, mode, variance, skewness, five-point summary), dealing with missing data in R, Data cleaning (dplyr package, tidyr package and pipe operator), Exploratory Data Analysis; data visualization using inbuilt functions and ggplot2 package (pie chart, bar chart, line chart, histogram, box plot, scatter plot, Normal QQ plot).

Regression analysis using R: Regression vs Correlation, Simple and multiple regression, Ordinary least square, Assumptions of classical normal linear regression model (CNLRM), corrplot package, car package, lmtest package, scatter plot (using plot function and ggplot2 package) to understand the relationship between variables, lm, abline, predict, resid function, interpreting ‘summary table’ of the regression model, normality of residuals (qqnorm and qqPlot functions), multicollinearity (correlation matrix, corrplot and vif function), autocorrelation (acf plot and Durbin Watson test), heteroscedasticity (graphically, bptest, ncvtTest), impact on estimates and inferences in case of violations of assumptions of CNLRM, methods to take care of violations.

Time series data, components of a time series data, additive and multiplicative time series model, ts function, diff function, plot of a time series data, time series data with linear trend; regression analysis using ‘lm’ function, stationarity in time series (concept only).

Essential/recommended readings

- Gardener, M. (2018), *Beginning R: The Statistical Programming Language*, Wiley & Sons.
- Sekhar, S.R.M., et al. (2017), *Programming with R*, Cengage Learning India.
- Wickham, H., et al. (2017), *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*, O'Reilly'.
- Field, A., Miles, J and Field (2012), Z. *Discovering Statistics using R (Indian Reprint 2022)*, SAGE
- SimpleR - Using R for Introductory Statistics: John Verzani.
- The R Guide.
- Analysis of Epidemiological Data Using R and Epicalc: Virasakdi Chongsuvivatwong.

- Statistics Using R with Biological Examples: Kim Seefeld and Ernst Linder.
- An Introduction to R: Software for Statistical Modeling & Computing: Petra Kuhnert and Bill Venables.
- Gujarati, D.N. et al (2018), *Basic Econometrics*, McGraw Hill India, 5th Ed.
- CRAN website: <https://cran.r-project.org/>
- <https://prowessiq.cmie.com>,
- <https://data.worldbank.org/indicator>,
- [https://rstudio.com/products/rstudio/download/\(Rstudio\)](https://rstudio.com/products/rstudio/download/(Rstudio))
- <http://r-statistics.co>

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