

Course Code	Course Name	Credits
26PH010	COMPUTATIONAL PHYSICS	04

### Course Objectives

- Introduces Python programming basics, covering data types, arithmetic operations, and control structures.
- Explores string manipulation, control flow, file handling, and function creation, including advanced coding techniques.
- Applies Python to solve mathematical problems using numerical methods, including integration, interpolation, and differential equations.
- Learn the use of essential workshop tools and precision measuring devices, including digital and CNC tools.
- Covers the practical application of tools in machining processes, including lathes, grinding, welding, and CNC programming.

### Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

- Understand the fundamentals of Python programming including data types, operators, control structures, and basic error handling.
- Apply string operations, lists, tuples, functions, and file handling techniques to develop simple Python programs.
- Utilize Python scientific libraries such as NumPy, Matplotlib, and SciPy to perform numerical computations and visualize data.
- Explain the principles and usage of common workshop tools, measuring instruments, and machining devices.
- Demonstrate basic workshop practices including lathe operations, cutting tools, welding, and modern technologies such as CNC machining and 3D printing.

### Unit 1 - Introduction To Python (12 Hrs.)

Introduction to Python – Python shell and IDEs – Data types: integers, floats, complex numbers – Using Python as a calculator – Basic arithmetic and operator precedence – Methods and attributes in Python – Mathematical functions – Variables and naming conventions – Logical and comparison operators – Conditional statements: if, elif, else – Identity and immutability of objects - Python virtual environments and basic error handling.

### Unit 2 – Strings And Functions (12 Hrs.)

Introduction to strings – Indexing and slicing techniques – String methods – Using the print function effectively – Lists and list methods – Introduction to tuples and their uses – Control flow: if, elif, else, while loops – break, pass, and continue – File handling: reading and writing files – Introduction to defining and calling functions – Simple plotting with matplotlib using pylab - comprehensions and lambda functions for more efficient coding.

### Unit 3 - Numerical Methods Using Python (12 Hrs.)

Python packages: Numpy (array operations, basic matrices), Matplotlib (visualization basics), Scipy (physical constants, special functions) – Numerical integration: Simpson's and Trapezoidal methods – Solving ordinary differential equations – Interpolation: Newton forward, Lagrange methods – Root finding techniques (Newton-Raphson method) – Euler's method for differential equations – Introduce the basics of Monte Carlo simulations and solving systems of linear equations using Numpy.

### Unit 4 – Workshop Tools And Devices (12 Hrs.)

Overview of workshop tools: Steel scale, scribes, punches, hammers, callipers, dividers – Measuring devices: Vernier callipers, micrometre, dial indicator, bevel protractor – Marking and cutting tools: hacksaw, chisels, files – Introduction to cutting speeds, feeds, and lubricants – Types of drills and reamers – Overview of different types of drilling machines and their applications - Introduction to modern digital measuring tools and CNC machines.

### Unit 5 - Tools Application (12 Hrs.)

Steel properties and heat treatment processes – Lathe: Types, key components, and basic lathe operations – Accessories used in lathe work – Cutting tools and their proper angles – Overview of grinding techniques and tool post settings – Introduction to rivets, riveting processes, and basic sheet metal work – Locking devices in mechanical systems – Introduction to welding and soldering techniques – Types of grinding wheels and their applications – Basics of CNC lathe programming and 3D printing technologies.

### Reference Books:

1. JaanKiusalaas, Numerical Methods in Engineering with Python 3, Cambridge University Press, 2013. ISBN: 978-1107033856.
2. Amos Gilat, Numerical Methods for Engineers and Scientists: An Introduction with Applications Using Python, Wiley, 2020. ISBN: 978-1119302535.
3. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, Elements of Workshop Technology, Volume 1, 15th edition, Media Promoters and Publishers Pvt. Ltd, 2020.

**Websites and eLearning Sources:**

1. <https://nptel.ac.in/courses/115106118>
2. <https://youtu.be/Gx5qb1uHss4?si=eZrz1JGC00aXdFyg>
3. <https://youtu.be/eZuDwi4OIIA?si=TLtjh-t0MATB5yLZ>

**COs and Bloom's Taxonomy Mapping – 26PH010**

Course Outcomes	On successful completion of this course, students will be able to	BTL
CO1	Recall and explain Python programming fundamentals and basic computational concepts.	K1, K2
CO2	Apply programming techniques to develop Python codes for mathematical and physical problems.	K3
CO3	Analyze numerical methods using Python libraries such as NumPy, SciPy, and Matplotlib.	K4
CO4	Evaluate computational results and workshop practices in solving scientific and engineering problems.	K5
CO5	Develop computational models and implement practical solutions using programming and workshop tools.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

**Relationship Matrix – 26PH010**

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)						Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	2	2	1	1	3	1	2	2	1	1	3	1	1.75
CO2	2	3	2	2	3	1	2	3	3	2	3	2	2.33
CO3	2	3	3	2	3	1	2	3	3	2	3	3	2.50
CO4	2	2	3	2	3	2	2	2	3	2	3	3	2.42
CO5	2	2	3	3	3	3	2	2	3	3	3	3	2.67
<b>Total</b>												2.33	

Mean Score: 3- High, 2- Medium/Moderate, 1-Low