



DEPARTMENT OF MATHEMATICS AND COMPUTER & INFORMATION SCIENCE

SYLLABUS

## SCIENTIFIC PROGRAMMING IN PYTHON CS2521

**Prerequisite:** MA 2310: Calculus I

### **COURSE DESCRIPTION:**

This course focuses on the developing the Python coding skills. It discusses the Python fundamentals, anatomy of a program, functions, data structures, dealing with bugs and errors, debugging. Emphasis on scientific applications, data abstraction and object-oriented programming concepts. Students learn the language features of Python with an eye toward scientific and data analysis applications using NumPy, Pandas, Scikit-learn and Matplotlib for visualization.

**COURSE OBJECTIVES:** At the end of this course the students will be able to:

- Understand various data containers and control structures
- Access files, write to files and to and from other data streams
- Understand the object model and OOP concepts
- Use abstract data structures and implement algorithms
- Understand basic concepts in machine learning
- Apply scientific algorithms to various scientific scenarios

### **TEXTBOOK:**

- <https://thepythoncodingbook.com/>
- A Primer on Scientific Programming with Python (Texts in Computational Science and Engineering) 5<sup>th</sup> ed. 2016 Edition by Hans Peter Langtangen.

## **Topics Covered\*:**

- 1. Fundamental Concepts: Python (*Part 1: Chapter 1*)**
  - a. variables | using functions | data type basics | commenting
  - b. Conditions: if statements
  - c. Importing modules
  
- 2. Loops, Lists & More Fundamentals (*Part 1: Chapter 2*)**
  - a. Loops: while, For
  - b. Lists
  - c. Indexing & Slicing
  
- 3. User-defined Functions (*Part 1: Chapter 3*)**
  - a. Defining functions
  - b. Scope
  - c. Parameters & arguments
  - d. Return statement
  
- 4. Data, Data Types & Data Structures (*Part 1: Chapter 4*)**
  - a. data structures | iterable,
  - b. mutable and immutable data types
  - c. string and list methods
  - d. tuples | dictionaries
  - e. reading data from files | writing data to spreadsheets
  
- 5. Dealing with Errors & Bugs (*Part 1: Chapter 5*)**
  - a. Understanding bugs and errors
  - b. Error messages
  - c. Debugging
  
- 6. Object Oriented Programming (*Part 2: Chapter 7*)**
  - a. Classes | attributes |
  - b. data attributes/ instance variables & Methods
  - c. `__init__` and `self`
  
- 7. Quantitative Applications using NumPy (*Part 2: Chapter 8*)**
  
- 8. Analyzing Data using Pandas**
  
- 9. Data Visualization using Matplotlib (*Part 2: Chapter 10*)**
  - a. 2D plots | subplots | images | 3D plots
  
- 10. Introduction to Machine Learning using SciKit-learn**

\* The instructor has the right to update the contents if needed.

## **ACTIVITIES/ASSIGNMENTS/REQUIREMENTS:**

There will be programming assignments, exams, and Quizzes. Students are required to submit their work by the due date.