

MATH-235 Mathematical Computing

Credit Hours: 2-1

Prerequisite: None

Course Objectives: The objective of this course is to give practical introduction of the two most broadly utilized numerical computing softwares: MATLAB and Python. The main goal of this course is to make students to learn these softwares so that they are way better prepared for future research areas. This course is planned for the students of Mathematics but students of other disciplines can also opt this subject.

Core Contents: Vectors and matrices, Script and function files, Loops, Array operations, Plotting, Programming and debugging of code

Detailed Course Contents: MATLAB: Introduction to the basic environment, MATLAB Desktop, syntax, variables, strings,

Vectors, Matrices, Basic program writing in MATLAB, Loops (for, while, if loops), Functions, Array operations, solving systems of linear equations, Two and three dimensional plots in MATLAB.

Python: Introduction to basic environment, Core objects, Variables, Input and Output, Programming in Python (for, while loops), Functions and user-defined functions, Plotting.

Course Outcomes: On successful completion of this course, students will be able to:

use these softwares in applications

plot, modify and present graphs to analyze data

program different mathematical methods

use the built-in functions efficiently

use a number of techniques that are useful for future courses like Numerical Analysis and Machine Learning

Textbooks:

1. Gilat, Amos (AG). MATLAB: An introduction with Applications. John Wiley & Sons, 2014.
2. Pine, David J (DP). Introduction to Python for Science and Engineering. CRC Press, 2018.

Reference Books:

1. Chapman, Stephen J. MATLAB Programming for Engineers. Nelson Education, 2015.
2. Schneider, David I. An Introduction to Programming using Python. Pearson, 2016.

Weekly Breakdown		
Week	Section	Topics

1	(AG) 1.1-1.6 , 1.6.1, 1.7, 1.8, 1.8.2 , 1.8.3	Starting MATLAB, MATLAB Windows, Working in the Command Window, Arithmetic Operations with Scalars, Order of Precedence, Using MATLAB as a Calculator, Display Formats, Elementary Math Built-in Functions, Defining Scalar Variables, The Assignment Operator, Useful Commands for Managing Variables, Script Files, Creating and Saving a Script File, Running (Executing) a Script File
2	2.1- 2.2.1 2.4- 2.5.2	Creating a One-dimensional Array (vector), Creating a Two-dimensional Array (matrix), The zeros, ones and eye commands, The Transpose Operator, Array Addressing, Vector, Matrix
3	2.6-2.10	Using a Colon: In Addressing Arrays, Adding Elements to Existing Variables, Deleting Elements, Built-in Functions for Handling Arrays, Strings and Strings as Variables
4	3.1-3.7	Addition and Subtraction, Array Multiplication, Array Division, Element by Element Operations, Using Arrays in MATLAB Built-in Math Functions, Built-in Functions for Analyzing Arrays, Generation of Random Numbers
5	4.1- 4.5.1	The MATLAB Workspace and the Workspace Window, Input to a Script File, Output Commands, the disp command, the fprintf command, The save and load commands, the save Command, the load command, Importing and Exporting Data, Commands for Importing and Exporting Data
6	5.1-5.6, 5.8-5.11	The plot command, Plot of Given Data, Plot of a Function, The fplot Command, Plotting Multiple Graphs in the Same Plot, Using the plot Command, Using the hold on and hold off commands, Using the line Command, Formatting a Plot, Formatting a Plot Using Commands, Plots with Logarithmic Axes, Plots with Error Bars, Histograms, Polar Plots, Putting Multiple Plots on the Same Page, Multiple Figure Windows
7	6.1-6.6	Relational and Logical Operators, Conditional Statements, The if-end Structure, The if-else-end Structure, The if-elseif-else-end Structure, The Switch-case Statement, Loops, for-end Loops, while-end Loops, Nested Loops and Nested Conditional Statements, The break and continue Commands
8	7.1-7.5	Creating a Function File, Structure of a Function File, Function Definition Line, Input and Output Arguments, The H1 Line and Help Text Lines, Function Body, Local and Global Variables, Saving a Function File, Using a User-Defined Function
9	Mid Semester Exam	
10	7.6-7.11	Examples of Simple User-Defined Functions, Comparison between Script Files and Function Files, Anonymous Functions, Function Functions, Using Function Handles for Passing a Function into a Function Function, Using a Function Name for Passing a Function into a Function Function, Subfunctions, Nested Functions
11	10.1-0.4	Line Plots, Mesh and Surface Plots, Plots with Special Graphics, The view Command
12		Introduction to Python for Science and Engineering, Interacting with Python, The Spyder Window, The IPython Pane, Interactive Python as a Calculator, Binary Arithmetic Operations

	(DP) 1.1, 2.1, 2.3, 2.4, 2.5 -2.8	in Python, Types of Numbers, Important Note on Integer Division in Python, Names and the Assignment Operator, Legal and Recommended Variable Names, Reserved Words in Python, Script Files and Programs, First Scripting Example: The Editor Pane, Python Modules, Python Modules and Functions: A First Look, Some NumPy Functions, Scripting Example 2, Different Ways of Importing Modules
13	3.1-3.3, 3.5	Strings, Lists, Slicing Lists, The range Function: Sequence of Numbers, Tuples, Multidimensional Lists and Tuples, Numpy Arrays, Creating Arrays (1-d), Mathematical Operations with Arrays, Slicing and Addressing Arrays, Fancy Indexing: Boolean Masks, Multidimensional Arrays and Matrices, Difference between Lists and Arrays, Objects,
14	5.1-5.3	Conditionals, If, elif and else Statements, Logical Operators, Loops, for Loops, while Loops, Loops and Array Operations, List Comprehensions
15	6.1-6.7,	An Interactive Session with PyPlot, Basic Plotting, Specifying Line and Symbol Types and Colors, Error Bars, Setting Plotting Limits and Excluding Data, Subplots, Semi-log Plots, Log-log Plots, More Advanced Graphical Output, Plots with Multiple Axes
16	6.8 - 6.9	Mathematics and Greek Symbols, The Structure of matplotlib: OOP and All That Contour and Vector Field Plots, Making a 2D Grid of Points, Contour Plots, Streamline Plots, Three Dimensional Plots
17	7.1-7.4	User Defined Functions, Looping over Arrays in User-Defined Functions, Fast Array Processing for User Defined Functions, Functions with More than one Input or Output, Positional and Keyword Arguments, Variable Number of Arguments, Passing Function Names and Parameters as Arguments, Variable and Arrays Created Entirely within a Function, Passing Lists and Arrays to Functions: Mutable and Immutable Objects, Anonymous Functions: lambda Expressions, NumPy Object Attributes: Methods and Instance Variables
18	End Semester Exam	