

Course Type	Course Code	Name of the Course	L	T	P	Credits
DP	NESC511	Environmental Computational Lab	0	0	3	1.5

Course Objectives

The objective of this course is to introduce students to modern programming languages such as MATLAB, Python, and R for solving environmental problems.

Overall Learning Outcomes

Upon successful completion of this course, students will be able to:

- Upon successful completion of this lab course, the students should be able to write their own MATLAB/R/Python for a variety of environmental modelling problems.

Unit No.	Topics to be covered	Practical Hr (P)	Learning outcomes
I	Basics of environmental modelling using MATLAB.	3	Learn to write the MATLAB code for simple analytical models.
II	Two-dimensional modelling of contaminant transport in groundwater using MATLAB	3	Learn to write the MATLAB code for the numerical solution of the contaminant transport equation.
III	Fitting a curve to discrete data using nonlinear regression in MATLAB.	3	Learn to fit a curve to a given data set for environmental problems
IV	Basics on python and the large geospatial data download and their handling for the analysis.	3	Learn how to download and extract the dataset based on the requirement, using Python
V	Climate change assessment using climate model datasets using Python.	3	Learn about climate models and their implications for the projections, specifically over India.
VI	Plotting the environmental data/climate data using Python libraries.	3	Learn about plotting the datasets which is useful in preparing the reports and manuscripts.
VII	Basics to R programming language, handling of environmental data using R and initial data processing.	3	Familiarization with R programming language and learning to deal with environmental data.
VIII	Causal analysis and development of simulation/prediction models using models like multiple linear regression in R.	3	Learn the utility of R towards the development of different statistical models.
IX	Modelling of stationary and non-stationarity processes in R.	3	Learn the difference between stationary and non-stationarity series and modelling of such datasets in R.
X	Correlation and simple linear regression using Excel/R/Origin/SPSS	3	Learn about relationship between explanatory and predictor variable
XI	Concept of testing hypothesis and significance, parametric tests: z-test and t-test	3	Learn the hypothesis testing for comparison between environmental datasets
XII	Writing a MATLAB/R/Python code for flood routing through a reservoir	3	Learn to write a MATLAB/R/Python code for flood routing with any given inflow hydrograph
XIII	Practice & Review	6	To enhance the knowledge and assess the progress.
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Reference book:

1. Pratap, R. (2010). Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford University Press, Inc.
2. Lubanovic, B. (2014). Introducing Python: Modern Computing in Simple Packages, O'Reilly Media, Inc.
3. Urban, M., and Murach, J. (2016). Murach's Python Programming, Shroff Publishers & Distributors Pvt. Ltd.
4. Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). R for Data Science. " O'Reilly Media, Inc."