Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NESC595	Research Methodology	3	0	0	3

Course Objectives

The course objective is to enable the Ph. D students to frame research objectives and hypothesis, to familiarize with classic multivariate statistics, and to make sure that they understand how actually these analyses are done.

Overall Learning Outcomes

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

- This course will provide the knowledge of research methodology and basic techniques of multivariateanalysis applicable to environmental research.
- The students will be able to understand the analysis of experimental data and their interpretation in environmental research.

Unit No.	Topics to be covered	Contact Hr (L)	Learning outcomes
I	Introduction to Research: Definition of applied science and research- Classification of research – Concepts and hallmarks of a good research – Scope and objectives of research problem- Research Process-Types of Research- Criteria of Good Research- literature survey -Research Hypothesis Development- Research Methods- qualitative research and emerging streams of research.	10	Understanding of the research hypothesis along with scope and objectives formulation.
II	Designing Research: Identification of Research gap – Need of research Design-Experimental-computational- research-methodology-analytical technics- Factors affecting – Measurement of variables – Scales and measurements of Variables-Science direct and Data mining -Plagiarism, Impact factors of journals, Retraction and reproducibility. Thesis and research article writings: Thesis and Research report writing-manuscript preparation for research platform- the role of computer in research-usage of software packages in research- Ethical aspects.	11	Understanding on the overallresearch design along with ethical issues related to research.
III	Data collection, presentation and organization of data – tabular/graphical form. Descriptive statistics – measures of central tendency and measures of dispersion, Skewness, Kurtosis and moments, correlation analysis and regression analysis. Basic elements and tools of statistical analysis: Probability, sampling, measurement and distribution of attributes, distribution – normal, Poisson and binomial; arithmetic, geometric and harmonic means, metrices, simultaneous linear equations.	11	This unit will help to understand the ways of data presentation along with basic descriptive statistics.
IV	Concept of testing hypothesis and significance, parametrictests, z-test, t-test, analysis of variance and non-parametrictests – Chi- square test. Sample size calculation for different study designs, devising conclusion from data analysis. Introduction to environmental system analysis; approaches to development of models; linear simple and multiple regression models, introduction to time series modelling, validation and forecasting.	10	Understanding of the variousstatistical tests and modelling approach.
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Text books:

1. Berthouex, P. M., Brown, L. C., (2002). Statistics for Environmental Engineers, 2nd Edition,Lewis Publishers, CRC Press.
2. Stuart Melville and Wayne Goddard Research Methodology: An Introduction Juta Academic, 2007 ISBN:9780702156601

Reference books:

1. Daniel, W. W., & Cross, C. L. (2018). *Biostatistics: a foundation for analysis in the healthsciences*. Wiley.
2. Tabachnick, B. G., & Fidell, L. S. (2012). Using Multivariate Statistics, 6th Edition. Pearson.
3. S. Melville and W. Goddard Research Methodology: An Introduction for Science & Engineering Students, Juta Academic, ISBN-10: 0702135623.