Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NPHC595	RESEARCH METHODOLOGY	3	0	0	3

Course Objective
- To show the scholars roadmaps of research from the beginning to the end and their intricacies.
- To inform and equip the scholars with essential knowledgebase and infrastructures for conducting research before landing up in the field.

Learning Outcomes

After completion of the course a scholar will learn how to plan research objectives and to communicate research findings, about – research procedure, necessary statistical tools, data and information resources, research utilities, good laboratory practices, ethical aspects of research.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
Research Methodology			
1.	**Research objectives:** Types of research, Development of a research question; Science, pseudoscience and rationalism; Physical science and metaphysics; Literature survey, Identification of knowledge gaps and a research problem; Concept of novelty, Formulation and implementation of a research plan; Serendipity, creativity, discovery and innovation.	5	This unit will help the student to understand the concept of a research problem, importance of literature survey, novelty of a research problem. Teach the procedure of formulating a research problem.
2.	**Research process and tools:** Design of experiments, testing and characterization; Measurement - Standardization, calibration and sampling; Primary and secondary data; Computer programming, theory, modelling and simulation; Data acquisition, processing, observation, critical analysis and interpretation; Presentation of data; Reliability and reproducibility.	6	Helps in the understanding why the calibration of an instrument is important, differentiate between the primary and secondary data. Teach the concept of data processing and data analysis, why the repeatability and reproductivity of experimental results are important
3.	**Computer applications and tools:** Software for documentation, graphs, graphics, drawing and presentation.	2	This unit will teach some of the basic knowledge of the computer skill required in the research work.
4.	**Search engines and databases:** Web literature search; International standards, reference data and constants.	2	This unit will help in understanding different scientific search engines require for research work and also idea of the reference data.
5.	**Library system:** Physical cataloguing of books and journals; Online catalogue search; Subscribed books and journals.	2	This unit provide different modes of accessing the scientific journals and book related to the research work.
6.	**Good laboratory practices:** Organization and cleanliness; Maintenance of laboratory records; Biological, chemical, electrical and fire safety; Safe disposal of hazardous materials; Upholding environmental and human concerns in planning and conducting experiments; Government regulations.	3	This unit will provide the pre-requisite knowledge of how to organized the experimental data for easy access, laboratory safety, rule and regulation of scientific research work to be carry out in research laboratory.
7.	**Communicating research results:** Journal paper – types of available publishing services; Research proposal, Report, Thesis; Presentation in Seminar and conference; Journal abbreviations, Bibliography standards; Indices of quality assessment of publications.	3	This unit will provide the knowledge of different types of research journals, the meaning of seminar and conferences, indexing and quality of the journal.
8.	**Research ethics:** Ethics code of American Psychological Association; Collaboration, cooperation and teamwork; Research outcome; Intellectual property right, Copy-right, patent, fundamentals of patent filing; Usage of pirated version of literatures and software; Plagiarism – Case Studies, Web based verification.	5	This unit will teach the concept of research ethics, plagiarism, IPR, patent filing of the scientific research work carry out in the laboratory.
Statistics			
9.	**Statistical techniques:** Mathematical tools for analysis, Statistical data treatment and evaluation; Probability and probability distributions; Sampling and sampling designs, Data analysis,Testing of hypothesis, statistical tests and analysis, Data interpretation, multivariate analysis, Modelbuilding.	6	This unit will provide all the knowledge of the statistical methods required in the data analysis of the research work.
10.	**Uncertainty in measurements:** Null hypothesis; Interval estimation, Statistical significance, Central tendency and dispersion; ErrorAnalysis.	2	This unit will make the students to the idea of hypothesis of research work, error analysis and concept of dispersion in the research data.
11.	**Analytical and numerical techniques:** Mean deviation, Root mean square deviation, Histogram, Skewness, Kurtosis, Moments, Variance, Chi-square, Correlation, Factor analysis, Mean square weighted deviation, Regression, Time series analysis.	4	This unit will provide all the knowledge of the statistical methods required in the data analysis of the research work.
12.	**Statistical and graphical packages:** MS Excel, MATLAB, Microcal Origin / Sigma plot, gnu plot, xmgr – Key Features; Developing algorithms and applications, Tex.	2	This unit will provide knowledge of all necessary software for word processing, plotting, programming software required for presentation of the research work.
	Total	42	

Text Books:
1. Research Methodology: The Aims, Practices and Ethics of Science, P. Pruzan, Springer, 2016
2. Research Methods for Science, M. P. Marder, Cambridge University,2011
3. Fundamentals of Research Methodology and Statistics, Y.K. Singh, New Age,2006

Reference Books:
1. Research Methodology: An Introduction for Science and Engineering Students; Melville and Goddard, Juta,1996
2. Research Methods in Science and Engineering, Scott A. Gold, CRC Press,2016