

Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NCHC595	Research Methodology	3	0	0	3
Course Objective						
<ul style="list-style-type: none"> The objective of this course is to make the research scholars understand the purpose of scientific research through critical examination of its essential characteristics viz. language. Methodology of research including literature review of identifying research gaps, experimental and theoretical approach to research. Collection of data and the statistical analysis, ethics in research, authenticity and check for plagiarism, communication skills, team work, etc. 						
Learning Outcomes						
<ul style="list-style-type: none"> After the completion of the course, the research scholar should be able to understand the purpose and the process of scientific research. Critical analysis of literature, formulation of the research problem, method of conducting research, data gathering and analysis Effective communication, and research ethics. He will also realize the importance of team- work and inter-disciplinary research. 						

Unit No.	Description of Lectures	Lecture Hours	Learning Outcomes
1.	Introduction: Nature and purpose of education and research and conjoined values, styles and process of research, motivational anecdotes about research (historical perspective) and role of serendipity in research.	6	Understanding of the basics of research.
2.	Formation of Research Problem: Literature search-sources, methods of critical review, critical and creative thinking, problem identification and definition-research questions and hypotheses, writing the research proposal.	6	Ability to select good research articles and find research problems.

3.	Execution of Research Work: Experimental and theoretical research skills, data collection, Chemical Engineering software to conduct computer simulations and related work. Instrumental analysis techniques- brief overview. Laboratory hygiene and safety, safety data sheets, and preventive steps for fire and explosion	6	Ability to effectively conduct experiments/simulations and collect data.
4.	Data Analysis: Error analysis- confidence interval estimation, basic statistical methods- statistical inferences using testing of hypothesis, analysis of variance, 2^k factorial design-blocking and confounding, Regression modeling, response surface methodology	10	Understanding of hypothesis testing.
5.	Communication of Scientific Research: Art of writing research papers, reports and thesis, Latex software Introduction, writing and communicating research papers, revisions and rebuttals, oral presentation skills, metrics of research performance	10	Ability to effectively communicate research results.
6.	General topics related to Research Work: The process of peer-review, research ethics, plagiarism, unfair means, professional conduct of research scholars and supervisors, time and stress management, working in a group with harmony- gender issues, ethnic and religious biases, interpersonal skills, constitutional and statutory requirements	4	Knowledge of relevant topics related to research.
Total		42	

Textbooks:

1. Deb, D., Dey, R., Balas, V.E. (2019), Engineering research methodology: A practical insight for researchers, Springer.
2. Phillips, E. M., and D. S. Pugh (2005), How to get a PhD: A handbooks for students and their supervisors, 4th ed., Open University Press (McGraw-Hill Education).
3. Dowdy, S., S. Weardon, and D. Chilko (2004), Statistics for research, 3rd ed., John Wiley & Sons.
4. Montgomery, D.C. (2012), Design and analysis of experiments, 8th ed., John Wiley & Sons.
5. Kumar, D. (2017), Research Methods for Successful PhD, River Publishers, Denmark

Reference Book:

1. Dunleavy, P., (2003), Authoring a PhD: How to plan, draft, write and finish a doctoral thesis or dissertation, Palgrave Macmillan.
2. Gustavi, B. (2008), How to write and illustrate scientific papers, 2nd ed., Cambridge University Press.
3. Paradis, J.G., and M.L, Zimmerman (2002). The MIT guide to science and engineering communication, 2nd ed., The MIT Press.