



RESEARCH METHODOLOGY

AUTUMN SEMESTER, 2021

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LECTURE 1

29-09-2021

PURPOSE OF THE COURSE

- To meet UGC requirements
- To give basic training in writing and presentation
- To bring awareness of various ethical issues
- To discuss some techniques of analyzing results
- Social relevance, motivation, demotivation ...

(50% techniques, 40% ethics and other issues, 10% general advice)

SYLLABUS (SNBNCBS)

By both of us

PHY 501 RESEARCH METHODOLOGY: 4-0-0-4

1. Define Research and Methodology; Types of research methods available; Describe Experiments, Theory and Computation/ Simulation in general terms; Spell out explicitly (with a few examples) the connection among them.
2. Define Library Research, Field Research and Laboratory Research; Explain Sample Survey, Sample Collection and/or Preparation, Data Analyses, Hypothesis, Modeling, Interpretation, and Conclusion.

By P. K. Mukhopadhyay

3. Error in Data Analyses and Ways to Report Error; Statistical Analyses of Collected Data; Importance of Error Analyses in Experimental/Numerical Study. Validity, Reliability and Reproducibility of Measured/Acquired Data.
4. Accuracy and Precision in Measurements/ Predictions. Selectivity and Specificity of a Method Developed; Generalization and External Validity; Internal Validity and Inter-relationship between measurements and the underlying theory/hypothesis.

By Amitabha Lahiri

5. Formulation of a Research Problem: Motivation, Induction, Hypothesis, Deduction, Observation and Conclusion
6. Scientific Reporting of Data/Observation/Prediction; Difference between Magazine or Newspaper Reporting, and Science Journal Reporting; Expression Skill Development and Nurturing.
7. Plagiarism – Self and External. Ethics, Attitude, Discipline and Holistic Approach to Research; Implication of Research Tenure on Personality Development. Importance of Focus, Challenge and Self-belief in Research.

By both of us

8. Research and Society – Coupling and Necessary Aloofness. Relevance to “Old fashion” Indian Philosophy of High Thinking. Basic Scientific Research, Translational Research, Technology Development and Elements of Commerce.

By P. K. Mukhopadhyay

9. Specific Experimental, Theoretical and Simulation Techniques for Decoding the Systems Around; Interconnection Between Theory and Experiments. Computer Languages Necessary for Machining a Scientific Problem, and Relevant Data Collection; Examples of a few commercially available software; Popular Numerical Techniques and Libraries (For example, MATLAB).

WHAT THIS COURSE IS NOT

- Many things, including techniques, are taught by supervisors
- That will not change
- This course is **NOT** a substitute for your PhD guide
- This is an overview and preparation for research
- It should reduce some burden on the supervisor

GRADING

- Assignments – writing
- Presentation – preparation and delivery
- Final Exam
- Probably other things (error analysis, plots, etc.)

WHAT IS RESEARCH?

m-w.com (Merriam-Webster):

research (noun)

1 : careful or diligent search

2 : studious inquiry or examination

especially : investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws

3 : the collecting of information about a particular subject

WHAT IS RESEARCH?

Wikipedia defines research as

- systematic work to create new knowledge or devise new applications of knowledge

Also as

- creative and systematic work undertaken to increase the stock of knowledge

We will define research as

- A process of collecting and analysing information to answer a question to increase our understanding of an issue.

WHAT IS METHODOLOGY?

Merriam-Webster online (m-w.com):

methodology (noun)

1 : a body of methods, rules, and postulates employed by a discipline : a particular procedure or set of procedures

2 : the analysis of the principles or procedures of inquiry in a particular field

We will usually take the meaning in 1.

METHODOLOGY

Wikipedia gives several alternative definitions:

- the analysis of ... the methods, rules, and postulates employed by a discipline
- the systematic study of methods ... applied within a discipline
- the study or description of methods

Another useful definition is

general research strategy that outlines the way in which research is to be undertaken (*An Introduction to the Philosophy of Methodology*, K. Howell, 2013)

METHODOLOGY

Ask yourself whether you are describing how you will collect your data (method), or if it's the broader strategy for your research approach (methodology). With one methodology, you can apply several different methods to support or reject the research hypothesis.

-- *Method vs. Methodology, Understanding the Difference*, K. Brookshier, (article on medium.com)