Programme	B.Sc. (Hons) Agriculture (Major: Soil Science)	Course Code	SS-307	Credit Hours	2(2-0)
Course Title	**RESEARCH AND EXPERIMENTAL PLANNING**				

Course Introduction

By the end of this course students will be able to:

1. Describe the basics of experiment, experimental research, and its types.
2. Demonstrate the planning and execution of research experiments.
3. Explain data collection, processing and analysis.
4. Demonstrate critical evaluation of data report writing

Learning Outcomes

The learning outcomes of this course can be designed to ensure that students gain comprehensive knowledge and practical skills in research methodologies and experimental design. Here are the suggested learning outcomes:

Learning Outcomes:

1. **Understanding Research Concepts**:
    - Define and distinguish between different types of research (basic, applied, qualitative, quantitative).
    - Understand the significance and objectives of research.
2. **Research Process Proficiency**:
    - Identify and articulate research problems.
    - Conduct a thorough literature review and formulate hypotheses.
3. **Experimental Skills**:
    - Define and explain various types of experiments (laboratory, field, controlled, natural).

- Understand and apply the principles of experimentation, including validity, reliability, and ethical considerations.

4. **Experimental Design Mastery**:
   - Design experiments using different experimental designs (CRD, RCBD, Latin Square, Factorial Design).
   - Select appropriate research parameters for experiments.
5. **Sampling and Data Collection Expertise**:
   - Implement effective sampling techniques for experimental plots.
   - Use various data collection methods (observations, surveys, interviews) and ensure data accuracy.
6. **Data Processing and Analysis Competence**:
   - Organize and tabulate data efficiently.
   - Analyze data using statistical methods and software tools (SPSS, R, Excel).
7. **Results Presentation and Reporting Skills**:
   - Present research findings using visual tools (graphs, charts, tables).
   - Write structured research reports following academic standards.
8. **Professional and Ethical Conduct**:
   - Adhere to ethical guidelines in research and experimentation.
   - Develop skills in editing, proofreading, and preparing for oral presentations.

By the end of the course, students will be able to conduct independent research projects, design and execute experiments, collect and analyze data, and present their findings professionally and ethically.

Course Content (Theory)		Assignments/Readings
Week 1	**Unit 1** 1.1. Introduction to Research 1.1.1. Definition and Types of Research 1.1.2. Basic, Applied, and Developmental Research 1.1.3. Qualitative vs. Quantitative Research	Write a 1000-word essay explaining the differences between basic, applied, and developmental research. Include examples of each type.

Week 2	**Unit 2** 2.1. Research Process 2.1.1. Objectives and Importance of Research 2.1.2. Overview of the Research Process 2.1.3. Identification of Research Problem	
Week 3	**Unit 3** 3.1. Research Process 3.1.1. Literature Review 3.1.2. Formulation of Hypotheses	
Week 4	**Unit 4** 4.1. Experimentation Basics 4.1.1. Definition and Types of Experiments 4.1.2. Laboratory vs. Field Experiments 4.1.3. Controlled vs. Natural Experiments	Choose a research topic of interest. Conduct a literature review and summarize your findings in a 2-3 page report, highlighting key studies and gaps in the literature.
Week 5	**Unit 5** 5.1. Principles of Experimentation 5.1.1. Validity, Reliability, and Replicability in Experiments 5.1.2. Ethical Considerations in Research	
Week 6	**Unit 6** 6.1. Experimental Designs 6.1.1. Introduction to Experimental Designs 6.1.2. Completely Randomized Design (CRD) 6.1.3. Randomized Complete Block Design (RCBD)	Propose an experiment related to your research topic. Define the type of experiment (laboratory, field, controlled, natural) and outline the hypothesis, variables, and expected outcomes.

Week 7	**Unit 7** 7.1. Experimental Designs (Continued) 7.1.2. Latin Square Design 7.1.3. Factorial Design	
Week 8	**Unit 8** 8.1. Research Parameters 8.1.1. Definition and Importance of Research Parameters 8.1.2. Selection of Appropriate Parameters 8.1.3. Sampling Techniques 8.1.4. Sampling from Experimental Plots 8.1.5. Random Sampling 8.1.6. Systematic Sampling	Develop a sampling plan for your experiment. Describe the sampling method (random, systematic) and detail how samples will be collected.
Week 9	**Unit 9** 9.1. Data Collection Methods 9.1.2. Techniques for Data Collection Observations 9.1.3. Surveys and Questionnaires 9.1.4. Interviews	
Week 10	**Unit 10** 10.1. Data Collection Methods 10.1.1. Instruments and Tools for Data Collection 10.1.2. Ensuring Data Accuracy and Precision 10.1.3. Data Processing 10.1.4. Data Tabulation	Collect a small set of sample data related to your experiment. Organize and tabulate this data in a clear and concise manner.

	10.1.5. Creating Tables and Charts 10.1.6. Organizing Data for Analysis	
Week 11	**Unit 11** 11.1. Data Analysis 11.1.2. Statistical Methods for Data Analysis 11.1.3. Descriptive Statistics 11.1.4. Inferential Statistics 11.1.5. Software Tools for Data Analysis 11.1.6. Introduction to SPSS, R, and Excel	
Week 12	**Unit 12** 12.1. Presentation of Results 12.1.1. Visual Representation of Data 12.1.2. Graphs, Charts, and Tables 12.1.3. Writing Research Reports	Create visual representations (graphs, charts, tables) of your data. Prepare a brief presentation (5-10 slides) explaining the visualizations.
Week 13	**Unit 13** 13.1. Report Preparation 13.1.1. Structure of a Research Report	
Week 14	13.1.2. Introduction, Methodology, Results, Discussion, and Conclusion 13.1.3. Citation and Referencing Styles	
Week 15	**Unit 14** 14.1. Finalizing the Report 14.1.2. Editing and Proofreading 14.1.3. Preparing for Oral Presentations	Write a draft of your research report, including the introduction, methodology, results, and discussion sections.

Week 16	**Unit 15** 15.1. Review and Assessment 15.1.1. Review of Key Concepts 15.1.2. Final Assessment and Feedback	

Textbooks and Reading Material

1. Chandra, V. and Hareendran, A., 2017. Research Methodology by Pearson 1st Edition. Pearson Education India.
2. Herzog, M.H., Francis, G. and Clarke, A., 2019. Understanding statistics and experimental design: how to not lie with statistics (p. 142). Springer Nature.
3. Leelerg, E.L., W.H. Leonard and A.C. Clark. 1980 Field plot techniques, National book foundation, Govt. of Pakistan, Islamabad
4. McBurney, D.H., 2001. Research methods. Wadsworth/Thomson Learning, CA, USA.
5. Pannerselvam, R., 2012. Design and analysis of experiments. PHI Learning Pvt. Ltd.

Teaching Learning Strategies

1. Multimedia
2. White Board
3. Group discussion
4. Quiz/Assignments
5. Demonstration/Activity

Assignments: Types and Number with Calendar

1. Write a 1000-word essay explaining the differences between basic, applied, and developmental research. Include examples of each type.
2. Choose a research topic of interest. Conduct a literature review and summarize your findings in a 2-3 page report, highlighting key studies and gaps in the literature.
3. Propose an experiment related to your research topic. Define the type of experiment (laboratory, field, controlled, natural) and outline the hypothesis, variables, and expected outcomes.
4. Develop a sampling plan for your experiment. Describe the sampling method (random, systematic) and detail how samples will be collected.
5. Write a draft of your research report, including the introduction, methodology, results, and discussion sections.
6. Create visual representations (graphs, charts, tables) of your data. Prepare a brief presentation (5-10 slides) explaining the visualizations.

Assessment

Sr. No.	Elements	Weightage	Details

1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.