**M. Sc. Agriculture-I (Semester-I)**
**AS-504: STATISTICAL METHODS**

**L T P** **Duration- 60 hrs**
**3 0 1(1 P=2 Hours)**

**Total Theory:** 75 (External: 55 and Internal: 20)
**Total Practical**: 25 (External: 25 and Internal: 0)
Pass marks: 60%

**Course Objectives:** The objective of this course is to become familiar of drawing the valid conclusions about the population from the sample when nature of the population is known. After completing this course, students will be able to estimate the parameters of the population and perform the testing for them. This course is meant to expose the students to the basic principles of design of experiments.

**Course Learning Outcomes:** Upon completion of this course, students should be able to:

- Understand the need of Sampling in Agriculture and determine if the probability method used to obtain data was a simple random sample or stratified.
- Recognize the situation in which the analysis of variance (ANOVA) is appropriate and able to perform one-way and two-way ANOVA
- Understand the basic design of experiment CRD and RBD.

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**

The question paper will consist of three sections A, B and C. Section-A will have four questions from section-A of the syllabus and section-B will have four questions from section B of the syllabus carrying 11 marks each. Student will have to attempt two questions from each section. Section - C will consist of 11 short answer type questions which will cover the entire syllabus uniformly and will carry 01 mark for each question. All questions of Section-C are compulsory. Time of the exam will be 3 hrs.

**Section-A**

**Distribution:** Basic concepts of Normal Distribution, Definition and Examples of Normal Distribution, Normal Probability Curve(NPC) and Properties of Normal Distribution.

**Sampling**: Introduction, need of sampling in agriculture, how to draw sample from population, Simple random sampling with and without replacement, Stratified random sampling (Introduction only)

**Linear Models:** Concept of fixed effects, random effects and mixed effects models, basic principles of design of experiments (randomization, replication & local control).

**One way analysis of variance (ANOVA)**: Layout, description, complete statistical analysis.

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**Section-B**

**Two way analysis of variance**: One observation per cell (layout, description and statistical analysis).

**Two way analysis of variance**: $m(\geq 2)$observation per cell (layout, description and application only) without analysis.

**Basic Designs:** Completely randomised design (layout, description, statistical analysis),Randomised block design (layout, description, statistical analysis) and their relative merits and demerits.

**Practicals**

1. Draw a random sample from a normal population
2. One way ANOVA
3. Two Way ANOVA (One observation and $m(\geq 2)$ observation per cell)
4. Completely Randomised Design
5. Randomised Block design

**Recommended and Suggested Readings**


1. S. C. Gupta and V. K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Sons Educational Pub. New Delhi, 2018.
2. S. C. Gupta and V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons Educational Pub. New Delhi, 2019.
3. Gun, A. M., Gupta, M. K. and Dasgupta, B.: Fundamentals of Statistics, Vol. I, World Press Pvt. Ltd., 2013.
4. Gun, A. M., Gupta, M. K. and Dasgupta, B.: An outline of Statistical Theory Vol.-II, World Press Pvt. Ltd., 2016.
5. Graybill, F. A.: An Introduction to Linear Statistical Model, Vol.-I, McGraw hill, 1961.


**Teaching Learning Activities:**

**Assignments**: Class assignments focus on strong foundation of conceptual knowledge, better understanding of the subject and development of problem solving and analytical skills.

**Guest lecturer**: Guest lectures are conducted for the overall development of students and for updating knowledge of the papers.

**Quizzes**: Quizzes are organized to build the bridge between theoretical (conceptual knowledge) and practical applications of the learned concepts.

**Group Discussion**: Group discussions are conducted to develop and boost the self confidence, competitive aptitude and enhance the problem solving and analytical skills.

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**M. Sc. Agriculture-I ( Semester-II)**
**AS-510 EXPERIMETAL DESIGNS**

| L | T | P | Duration- 45 hrs |
|---|---|---|---|
| 2 | 0 | 1(1 P = 2 Hours) | |

**Total Theory:** 75 (External: 55 and Internal: 20)
**Total Practical**: 25 (External: 25 and Internal: 0)
Pass marks: 60%

**Course objectives:** Design of experiments provides the statistical tools to get maximum information from least amount of resources. This course is meant to expose the students to the basic principles of design of experiments. The students would also be provided with mathematical background of various basic designs involving one-way and two way elimination of heterogeneity and their characterization properties. This course would also prepare the students in deriving the expressions for analysis of experimental data.
**Course Learning Outcomes:** Upon completion of this course, students should be able to:

- Fix the Agriculture/Industrial field according to different experimental design like LSD, BIBD, PBIBD
- Explore the general theory of factorial and block designs and understand this theory sufficiently to find appropriate designs for specific applications.
- Perform Statistical analysis of all the particular designs that were introduced (including interpretation of e.g. block effects or interaction effects, adapted to the design).
- Understand the concept of confounding**.**

**INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES**
The question paper will consist of three sections A, B and C. Section-A will have four questions from section-A of the syllabus and section-B will have four questions from section-B of the syllabus carrying 11 marks each. Student will have to attempt two questions from each section. Section - C will consist of 11 short answer type

questions which will cover the entire syllabus uniformly and will carry 01 mark for each question. All questions of section-C are compulsory. Time of the exam will be 3 hrs.

**Section-A**

**Basic Designs:** Latin square design (layout, description, statistical analysis) and its merits and demerits.

**Incomplete Block Design (IBD)**: Basic concepts of IBD, terminology, need and importance of IBD

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**BIB Designs:** Definition, parametric relations, BIB Designs related to a given BIBD (without recovery of Inter-block information) (concept and layout only).

**PBIB Design:** Introduction, definition of association schemes and PBIB Designs with m-associate classes, classification of two associate class association schemes into group divisible (GD), triangular and Latin square schemes only. (Only definitions)

**Youden square design**

**Section-B**

**Split Plot Design and strip plot design** (layout, description only) .

**Factorial experiments:** Introduction, main effects and Intercation effects of $2^2$ and $2^3$ factorial experiment with their advantages and disadvantages

**Factorial experiments:** Introduction, main effects and Intercation effects of $3^2$ factorial experiment with advantages and disadvantages

**Confounding:** Confounding in symmetrical factorial experiments ($2^2$ & $2^3$ factorial experiment), concept of partial and complete confounding (Only definitions)

**Practicals**

1. **Examples based on:**
   i) LSD
   ii) BIBD
   iii) PBIBD
   iv) $2^2$ and $2^3$ Factorial Experiments
   v) $3^2$ factorial experiment

**Recommended and Suggested Readings**


1. Aloke, D.: Incomplete Block Designs, Hindustan Book Agency, 2010.
2. S. C. Gupta, V. K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Sons Educational Pub. New Delhi, 2018.
3. Gun, A. M., Gupta, M. K. and Dasgupta, B.: An outline of Statistical Theory Vol.-II, World Press Pvt. Ltd., 2016.
4. Das, M. N. & Giri, N. C.: Design and Analysis of experiment Wiley Eastern, Ed. 2nd, 1987.
5. Graybill, F. A.: An Introduction to Linear Statistical Model, Vol.-I, McGraw hill, 1961.


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6. Raghavarao, D.: Construction & combinatorial problems in Design of Experiments, Wiley, New York, 1988.
7. Kempthorne, O: Design and Analysis of Experiments, Wiley New York, Vol.-2, 2005.

**Teaching Learning Activities:**

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