# School of Agriculture, Forestry and Fisheries

# Master of Science in Agriculture

# (Genetics and Plant Breeding)

## (M.Sc. (Ag.) Genetics and Plant Breeding)

Program Code: .....

## CURRICULUM

## ACADEMIC YEAR: 2024-2025

## Program Span: 2025-2027

# JIGYASA UNIVERSITY

**Formerly**
**Himgiri Zee University, Dehradun**
**(Estd. Under Uttaranchal State Act.No.17, 2003.Approved by UGC Under Sec.2(f))**
**Post Office Selaqui, Chakrata Road, Dehradun, Uttarakhand,248011**

## Vision of University

We provide the environment to ignite, nurture, and unleash your potential and talent

## Mission Statement

1. Progressive educational proficiencies that stimulate holistic development.
2. Enhancing experiential learning through endorsing an inclusive mindset.
3. Advancing research, nurturing innovations, and catalyzing entrepreneurship.
4. Cultivation of leadership qualities with a strong sense of values and ethics.

## Vision of SAFF

To become centre of advanced studies in the field of Agriculture, Forestry & Fisheries Education and Research to cater local, national and global needs.

## Mission Statements of SAFF

- To provide quality education and research opportunities in the field of Agriculture and Allied Sciences.
- To engage in extension outreach activities for meeting the farmers and industry needs.
- To inculcate the scientific aptitude through modern techniques and technologies.

# About the Program

## A. Introduction:

The National Education Policy (NEP) 2020 envisions transforming India's higher education system through holistic, multidisciplinary, and research-driven learning that aligns with the Sustainable Development Goal 4 (SDG-4) – Quality Education. In keeping with this vision, the M.Sc. (Ag.) Genetics and Plant Breeding program at the School of Agriculture, Forestry and Fisheries (SAFF), Jigyasa University (Formerly Himgiri Zee University) Dehradun, has been designed to provide advanced academic, technical, and research-oriented training in the field of crop science and sustainable agriculture. The program emphasizes innovation, scientific inquiry, and practical application, integrating traditional agricultural wisdom with modern technological advancements.

The M.Sc. (Ag.) Genetics and Plant Breeding is a two-year full-time postgraduate degree program structured ensuring flexibility, academic rigor, and relevance to industry and research needs. The curriculum builds upon the strong foundation of the B.Sc. (Hons.) Agriculture program, advancing knowledge in areas such as crop physiology, soil-water-plant relationships, nutrient management, sustainable cropping systems, and modern agronomic practices. It also emphasizes climate-resilient agriculture, precision farming, resource conservation technologies, and integrated farming systems to promote productivity and sustainability.

Students gain comprehensive exposure through advanced laboratory experiments, field research, seminars, and dissertation work. The program nurtures analytical thinking, problem-solving, and scientific writing skills, encouraging students to undertake independent and collaborative research. It aims to prepare graduates for careers in agricultural research, teaching, agribusiness consultancy, policy formulation, and entrepreneurship.

Through its focus on innovation, sustainability, and practical research, the M.Sc. (Ag.) Genetics and Plant Breeding program at SAFF, Jigyasa University (Formerly Himgiri Zee University), truly embodies the vision of NEP 2020. It fosters experiential and interdisciplinary learning, equipping postgraduates to contribute effectively to national food security, environmental stewardship, and the future of sustainable agriculture.

## B. National Higher Education Qualifications Framework (NHEQF) levels:

| NHEQF Level | NHEQF Level | NHEQF Level | NHEQF Level | NHEQF Level |
|---|---|---|---|---|
| **Level 5** | **Undergraduate Certificate** | Completion of 1st year of UG program | **~40 credits** | Foundational knowledge and skills; eligible for vertical mobility |
| **Level 6** | **Undergraduate Diploma** | Completion of 2 years of UG program | **~80 credits** | Broader subject understanding; vocational and academic skills |
| **Level 7** | **Bachelor's Degree** *(3 years)* | 10+2 (Senior Secondary) | **~120 credits** | Core disciplinary knowledge and cognitive skills |
| **Level 7.5** | **Bachelor's Degree with Honours** *(4 years)* | Based on strong academic performance | **~160 credits** | Advanced disciplinary depth; research exposure (Capstone) |
| **Level 8** | **Bachelor's Degree with Research** *(4 years)* | 75%+ in previous semesters; research orientation | **~160 credits + Research Project** | Research, innovation, and preparedness for PG or direct PhD |

## C. Academic Bank of Credits (ABC):

In alignment with the National Education Policy (NEP) 2020, the Academic Bank of Credits (ABC) facilitates a flexible curriculum framework. It promotes interdisciplinary/multidisciplinary academic mobility among students across various Higher Educational Institutions (HEIs) through an appropriate credit transfer system. Accordingly, the School of Agriculture, Forestry and Fisheries under Jigyasa University, Dehradun, has developed a comprehensive four-year undergraduate program.

As a prerequisite, students/learners are required to register on the Academic Bank of Credits (ABC) portal. The credits earned during the study will be digitally stored in the ABC account. Learners must complete their program as per the guidelines of the UGC's ABC policy. Please note that the validity of earned credits is limited to seven years (or as per the latest advisory from the competent authority).

Additionally, each credit earned may only be used once and cannot be reused for multiple programs or purposes.

## D. Curriculum Framework:

### I. Major Core Courses (MCC):

Major Courses (MCC) in the M.Sc. (Ag.) Genetics and Plant Breeding program encompass a comprehensive range of subjects designed to provide students with a strong foundation in core agricultural sciences and allied disciplines. These courses are structured to develop students' analytical abilities, scientific understanding, problem-solving skills, and leadership potential in the field of agriculture. The curriculum integrates key areas such as Genetics, Cytogenetics and plant breeding to produce competent and well-rounded agricultural professionals capable of contributing to sustainable agricultural development.

The MCC includes courses such as Principles of Genetics, Principles of Cytogenetic, Principles of Plant Breeding, Statistical Methods and Experimental Designs, which provide insights into breeding practices, soil fertility management, climatic influences on crops, and the economics of breeding. Courses like Cell biology and Molecular Genetics, Biotechnology for crop Improvement, Principles of quantitative Genetics and Heterosis Breeding for enhanced productivity and equip students with practical knowledge of sustainable cultivation techniques, resource utilization, and crop management strategies.

Furthermore, advanced courses such as Breeding for Quality Traits, Maintenance Breeding, Concepts of Variety Release and Seed Production, Breeding for Biotic and Abiotic Stress Resistance and Mutagenesis and Mutation Breeding enable students to apply scientific research to practical farming for effective technology transfer and rural development. It fosters innovation, self-employment, and sustainable livelihoods. Overall, the Major Core Courses combine theoretical learning with field experience and research, preparing students to excel in government, agribusiness, research, and entrepreneurial sectors, and to contribute to sustainable agricultural advancement.

### II. Multidisciplinary Courses (MDC)

In line with the National Education Policy (NEP) 2020, the M.Sc. (Ag.) Genetics and Plant Breeding program at the School of Agriculture, Forestry and Fisheries (SAFF), Himgiri Zee University, Dehradun includes Multidisciplinary Courses (MDC) to promote holistic and cross-disciplinary learning. These courses broaden students' perspectives beyond agronomy, linking agriculture with research ethics, technology, environment, and rural development. The MDCs—Disaster Management, Intellectual Property and Its Management in Agriculture, Library and Information Services and Agricultural Research, Research Ethics and Rural Development Programmes equip students with essential knowledge of sustainable development, innovation, and responsible research. Together, they strengthen analytical, ethical, and leadership skills, preparing students to contribute effectively to modern, sustainable, and inclusive agricultural growth.

## III. Skill Enhancement Courses (SEC)

Aligned with the vision of the National Education Policy (NEP) 2020, the M.Sc. (Ag.) Genetics and Plant Breeding program includes Skill Enhancement Courses (SECs) designed to strengthen students' research aptitude, technical proficiency, and professional competence. These courses emphasize advanced practical learning, scientific experimentation, and data interpretation to prepare students for research and industry-oriented careers. The curriculum focuses on enhancing analytical and laboratory skills through hands-on exposure to modern instruments, experimental protocols, and statistical tools used in agronomic research.

Course like Basic Concepts in Laboratory Techniques provides students with essential knowledge of laboratory procedures, safety protocols, precision in experimental work, and the use of analytical instruments, ensuring accuracy and reliability in agricultural research and data analysis.

## IV. Value Added Course (VAC):

In line with the National Education Policy (NEP) 2020, the Value-Added Course (VAC) aims to promote holistic and multidisciplinary learning. It helps students develop essential 21st-century skills such as critical thinking, digital literacy, communication, and leadership. These courses encourage experiential learning and innovation, enabling students to apply classroom knowledge in practical, community, and industry contexts.

Course like Social Engineering (non-credit) course is designed to enhance students' awareness of human-based security threats and the psychological manipulation techniques used by attackers. The course focuses on understanding how trust, curiosity, and social behaviour can be exploited to compromise individuals or organizations. It promotes ethical awareness, digital responsibility, and the development of preventive strategies against manipulation and fraud in both online and offline environments.

## V. Research Project (REP):

In accordance with the vision of the National Education Policy (NEP) 2020, the Research Project (REP) in the M.Sc. (Ag.) Genetics and Plant Breeding program is designed to promote advanced research aptitude, innovation, and critical thinking among postgraduate students. Conducted under the guidance of faculty supervisors, the project involves independent research on specialized topics such as crop management, soil fertility, water use efficiency, or sustainable farming systems. Students are required to carry out field experiments, data analysis, and prepare a dissertation based on their findings. They are encouraged to present their research in seminars and publish papers in reputed journals. This component strengthens their scientific and analytical capabilities, preparing them for doctoral studies, academic roles, and research-oriented careers in agriculture.

**Constitution of Courses in (M.Sc. (Ag.) Genetics and Plant Breeding)**

**Matrix**

| Course Category Name | Course Category Code | Number of Courses | Total Course Credits |
|---|---|---|---|
| Core Course | COR | 14 | 38 |
| Skill Enhancement Courses | SEC | 1 | Q/ NQ |
| Multi- Disciplinary Course | MDC | 5 | Q/ NQ |
| Research Project | REP | 1 | Q/ NQ |
| Value Added Course | VAC | 3 | Q/ NQ |
| TOTAL | | 24 | 38 |

**E. PEO's - Program Educational Objectives (M.Sc. (Ag.) Genetics and Plant Breeding)**

**PEO1.**To impart knowledge on the fundamental aspects of genetics and breeding of crop plants.

**PEO2.**To develop skills in crop improvement through different conventional and modern methods.

**PEO3.**To encourage the importance of conservation of genetic resources for developing suitable crop varieties for the climate resilient agriculture

**PEO4.**To empower the students to plan and design plant breeding proposal for research

**PEO5.**To develop the students a learning environment for enabling them for higher research projects.

**F. PO's - Program Outcomes (M.Sc. (Ag.) Genetics and Plant Breeding)**

| PO | Outcome | BT Level |
|---|---|---|
| **PO1** | **Memorize** the terms related to genetics and plant breeding. | **L1** |
| **PO2** | **Understand** the different objectives of plant breeding. | **L2** |
| **PO3** | **Distinguish** between the methods of reproduction in different crop species. | **L3** |
| **PO4** | **Enhance** the skills in applying the laws of genetics in crop improvement. | **L3** |
| **PO5** | **Assess** the seed production techniques and their certification. | **L4** |
| **PO6** | **Examine** the knowledge of breeding for biotic and abiotic stresses in crop plants. | **L4** |
| **PO7** | **Recommend** the modern tools and techniques in plant breeding. | **L5** |
| **PO8** | **Select** the methods of release of crops varieties for food sustainability. | **L5** |
| **PO9** | **Plan and Design** the experiments related to crop improvement. | **L6** |

## G. Pedagogy, Teaching & Learning:

The M.Sc. (Ag.) Genetics and Plant Breeding program at the School of Agriculture, Forestry and Fisheries (SAFF), Himgiri Zee University, Dehradun follows an advanced, research-oriented, and experiential learning approach aligned with the National Education Policy (NEP) 2020. The pedagogy integrates classroom teaching with laboratory experiments, field research, data analysis, seminars, and project-based learning to promote critical thinking, innovation, and practical competence.

### I. Experiential and Research-Based Learning:

The program emphasizes hands-on and research-driven learning through field trials, case studies, group discussions, workshops, and dissertation work. Students engage in experimental design, data interpretation, and presentation of research findings, fostering scientific inquiry and analytical skills essential for advanced agricultural research and development.

### II. Industry and Research Exposure:

Students gain exposure to agribusiness firms, research institutes, and government organizations through field visits, internships, and collaborative projects. Expert lectures, seminars, and conferences provide insight into current trends and technologies in agronomy, enhancing professional and entrepreneurial readiness.

### III. Library and E-Learning Access:

Postgraduate students have full access to the University's well-equipped library and digital databases for academic and research needs. E-learning resources available through the University's ERP system support continuous and self-paced learning, enabling students to deepen their subject expertise and stay updated with emerging advancements in agriculture.

## Annexure II

# H. Program Structure

### Master of Science in Agriculture (Genetics and Plant Breeding)

### (M.Sc. (Ag.) Genetics and Plant Breeding)

| S. No. | Course Code | Course Name | Category | Numbers of Hours/Week | | | C |
|---|---|---|---|---|---|---|---|
| | | | Core / Elective / Others | L | T | P | |
| **SEMESTER I** | | | | | | | |
| 1 | AGB C601 | Principles of Genetics | COR | 2 | 0 | 2 | 3 |
| 2 | AGB C602 | Principles of Cytogenetic | COR | 2 | 0 | 2 | 3 |
| 3 | AGB C603 | Principles of Plant Breeding | COR | 2 | 0 | 2 | 3 |
| 4 | AGB C604 | Statistical Methods | COR | 2 | 0 | 2 | 3 |
| 5 | AGB C 605 | Experimental Designs | COR | 2 | 0 | 2 | 3 |
| 6 | - | Multi-Disciplinary Course-I | MDC | - | - | - | Q/ NQ |
| 7 | - | Value Added Course-I | VAC | - | - | - | Q/ NQ |
| **Total** | | | | **10** | **0** | **10** | **15** |
| **Total contact hours 20** | | | | | | | |
| **SEMESTER II** | | | | | | | |
| 1 | AGB C606 | Cell biology and Molecular Genetics | COR | 2 | 0 | 2 | 3 |
| 2 | AGB C607 | Biotechnology for crop Improvement | COR | 2 | 0 | 2 | 3 |
| 3 | AGB C608 | Principles of quantitative Genetics | COR | 2 | 0 | 2 | 3 |
| 4 | AGB C609 | Heterosis Breeding | COR | 2 | 0 | 2 | 3 |
| 5 | - | Multi-Disciplinary Course-II | MDC | - | - | - | Q/ NQ |
| 6 | - | Multi-Disciplinary Course-III | MDC | - | - | - | Q/ NQ |
| 7 | - | Multi-Disciplinary Course-IV | MDC | - | - | - | Q/ NQ |
| 8 | - | Value Added Course-II | VAC | - | - | - | Q/ NQ |
| **Total** | | | | **08** | **0** | **08** | **12** |
| **Total contact hours 16** | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Cumulative Total** | | | | **18** | **0** | **18** | **27** |
| **SEMESTER III** | | | | | | | |
| 1 | AGB C701 | Breeding for Quality Traits | COR | 1 | 0 | 2 | 2 |
| 2 | AGB C702 | Maintenance Breeding, Concepts of Variety Release and Seed Production | COR | 1 | 0 | 2 | 2 |
| 3 | AGB C703 | Breeding for Biotic and Abiotic Stress Resistance | COR | 2 | 0 | 2 | 3 |
| 4 | AGB C704 | Mutagenesis and Mutation Breeding | COR | 2 | 0 | 2 | 3 |
| 5 | - | Multi-Disciplinary Course-V | MDC | - | - | - | Q/ NQ |
| 6 | - | Skill Enhancement Course-I | SEC | - | - | - | Q/ NQ |
| 7 | - | Value Added Course-III | VAC | - | - | - | Q/ NQ |
| 8 | AGB C707 | Master's Seminar | COR | 0 | 0 | 2 | 1 |
| **Total** | | | | **06** | **0** | **10** | **11** |
| **Total contact hours 16** | | | | | | | |
| **Cumulative Total** | | | | **24** | **0** | **28** | **38** |
| **SEMESTER IV** | | | | | | | |
| 1 | - | Research Project-I | REP | 0 | 0 | 20 | Q/NQ |
| **Total** | | | | **0** | **0** | **20** | **Q/NQ** |
| **Total contact hours 20** | | | | | | | |
| **Grand Total** | | | | **24** | **0** | **48** | **38** |

L – Lecture T- Tutorial P- Practical C-Credits

1L = 1Hr. 1T= 1 Hr. 1P=2 Hr. 1+1C = 1 Hr. of Theory/Tutorial Paper/ week & 2 Hrs. of Practical/ week

| **Skill Enhancement Courses (SEC): List** | | | |
|---|---|---|---|
| AGB N006 | Basic Concepts in Laboratory Techniques | | |
| **Multi- Disciplinary Course: List** | | | |
| AGB N001 | Disaster Management | AGB N005 | Agricultural Research, Research Ethics And Rural Development Programmes |
| AGB N002 | Intellectual Property and Its Management In Agriculture | AGB N004 | Technical Writing And communications skills |
| AGB N003 | Library and Information Services | | |

| Research Project (REP): List | | | |
|---|---|---|---|
| AGB C706 | Master's Research | | |
| **Value Added Course (VAC): List** | | | |
| SE 001 | Social Engineering I | SE 003 | Social Engineering III |
| SE 002 | Social Engineering II | | |

**SEMESTER I**

# COURSE DETAILS

## Course: Principle of Genetics

| | | | | | |
|---|---|---|---|---|---|
| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-I** | | | |
| **Course Name** | Principle of Genetics | L | T | P | C |
| **Course Code** | AGB C601 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To know about the principles of genetics |
| **COb2** | To study the different Mendelian genetics and Population genetics |
| **COb3** | To understand the Chromosomal structure and function in self-pollinated cross-pollinated and vegetative propagated crops |
| **COb4** | To distinguish between the chromosomal aberrations in crop plants |
| **COb5** | To develop skills in solving numeral problems of genetics |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To know about the principles of genetics. | **L1** |
| **CO 2** | To study the different Mendelian genetics and population genetics. | **L2** |
| **CO 3** | To understand the chromosomal structure and function in self-pollinated, cross-pollinated, and vegetatively propagated crops. | **L3** |
| **CO 4** | To distinguish between the chromosomal aberrations in crop plants. | **L4** |

| | | |
|---|---|---|
| **CO 5** | To develop skills in solving numerical problems of genetics. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Beginning of genetics; Cell structure and cell division; Early concepts of inheritance, Mendel's laws; Discussion on Mendel's paper, Chromosomal theory of inheritance. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Multiple alleles, Gene interactions. Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage-detection, estimation; Recombination and genetic mapping in eukaryotes, Somatic cell genetics, Extra chromosomal inheritance. Genetic fine structure analysis, Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters | | |
| **Unit-3** | | **Contact Hours: 05** |
| Population - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium. | | |
| **Unit-4** | | **Contact Hours: 05** |
| Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Genetic code; Protein biosynthesis. Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Molecular chaperones and gene expression. Gene regulation in eukaryotes. RNA editing. | | |
| **Unit-5** | | **Contact Hours: 05** |
| Gene isolation, isolation, synthesis and cloning, genomic and c-DNA libraries, PCR based cloning, positional cloning; Nucleic acid hybridization and immunochemical detection; DNA sequencing; DNA restriction and modification, Anti-sense RNA and ribozymes; Micro-RNAs (mi-RNAs). Genomics and proteomics; Functional and pharmaco genomics; Meta genomics, Methods of studying polymorphism at biochemical and DNA level; Transgenic bacteria and bioethics; Gene silencing; genetics of mitochondria and chloroplasts ,Concepts of Eugenics, Epigenetics, Genetic disorders and Behavioral genetics. | | |
| **Practical** | **Suggested list of Exercises** | |
| 1 | Exercise on ten famous Scientist and their contribution to Genetics | |
| 2 | Exercise on numerical chromosomal aberrations | |

| | |
|---|---|
| 3 | Exercise on Chromosome mapping using three point test cross; |
| 4 | Exercise on the study of mitotic cell Division using Onion |
| 5 | Exercise on Hardy Weinberg Law |
| 6 | Exercise on Mendel's Law of Segregation |
| 7 | Exercise on Mendel's law of Independent Assortment |
| 8 | Exercise on Sex determination and their types |
| 9 | Exercise on Linkage-detection and estimation |
| 10 | Study the Transposable genetic elements and their types |
| 11 | Exercise on mitotic cell division in onion |
| 12 | Exercise on meiotic cell division in onion |

**Suggestive Readings:**

**Text Books:**

**TI.**Crop Breeding and Biotechnology, Hari Har Ram, Kalyani Publishers, Ludhiana.

**T2.**Plant Breeding, Singh, B.D. Kalyani Publishers. New Delhi /Ludhiana

**Reference Books:**

**R1.**Essentials of Plant Breeding, By Singh, Phundan, Kalyani Publishers Ludhiana/ New Delhi

**R2.**Principles of Plant Breeding, Allard, R.W

**R3.**Genetics. By Prof B.D. Singh (2001). Kalyani publishers, New Delhi.

**R4.**Principles of Genetics Gardner, E. J. &Snustad, D. P. (1991).. John Wiley, New York .

**R5.**Concepts of Genetics Klug, W.S. & Cummings, M. R. (2003).. Peterson Education.

**R6.**Genes IX. Lewin B. (2008). Jones & Bartlett Learning.

**R7.**Genetics. Russell, P. J. (1998). The Benzamin/ Cummings Publ. Co.,USA.

**R8.**Genetics. 4th Ed Snustad D. P. & Simmons M. J. (2006).. John Wiley & Sons, New York.

**R9.**Genetics (III Ed). Strickberger M. W. (2005). Prentice Hall, New Delhi, India.

**R10.**Tamarin, R. H. (1999). Principles of Genetics. McGraw-Hill Publishers.

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER I**

**Course: Principles of Cytogenetics**

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-I** | | | |
|---|---|---|---|---|---|
| **Course Name** | Principle of Cytogenetics | L | T | P | C |
| **Course Code** | AGB C602 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Make the students Recall the structure and functions of prokaryotic and eukaryotic cell and its organelles |
| **COb2** | Enable students to understand the types of cell division in prokaryotes and eukaryotes |
| **COb3** | Analyse the chromosome structure and functions and variations thereof. |
| **COb4** | Enable students to know the significance of polyploidy in crop improvement |
| **COb5** | Evaluate fertilization barriers in crop plants and propose advanced techniques for crop improvement. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| **CO** | **Outcome** | **BT Level** |
|---|---|---|

| | | |
|---|---|---|
| **CO 1** | To Define the important terms and concepts related to types of cells and its history along with major achievements in cytogenetics | **L1** |
| **CO 2** | To Classify the different types of chromosomes and their structure and functions. | **L2** |
| **CO 3** | To Apply the knowledge of polyploidy in crop breeding | **L3** |
| **CO 4** | To analyze the structural and numerical variations in chromosomes in crop breeding. | **L4** |
| **CO 5** | To Plan future strategies and technologies to overcome fertilization barriers in crop plants. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Architecture of chromosome in prokaryotes and eukaryotes; Chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; Artificial chromosome construction and its uses; Special types of chromosomes. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Chromosomal theory of inheritance – Cell Cycle and cell division – mitosis and meiosis; Differences, significance and deviations – Synapsis, structure and function of synaptonemal complex and spindle apparatus, anaphase movement of chromosomes and crossing over- mechanisms and theories of crossing over- recombination models, cytological basis, Introduction to techniques for karyotyping; Chromosome banding and painting - in situ hybridization and various applications | | |
| **Unit-3** | | **Contact Hours: 05** |
| Structural and Numerical variations of chromosomes and their implications - Symbols and terminologies for chromosome numbers - euploidy - haploids, diploids and polyploidy; Utilization of aneuploids in gene location - Variation in chromosome behavior - somatic segregation and chimeras – endo-mitosis and somatic reduction; Evolutionary significance of chromosomal aberrations - balanced lethal and chromosome complexes. | | |
| **Unit-4** | | **Contact Hours: 05** |
| Inter-varietal chromosome substitutions; Polyploidy and role of polyploids in crop breeding; Evolutionary advantages of auto-polyploids vs allopolyploids –- Role of aneuploids in basic and applied aspects of crop breeding, their maintenance and utilization in gene mapping and | | |

| | | |
|---|---|---|
| gene blocks transfer – Alien addition and substitution lines – creation and utilization; Apomixis - Evolutionary and genetic problems in crops with apomixes. Reversion of auto-polyploids to diploids; Genome mapping in polyploids - Interspecific hybridization and allopolyploids; Synthesis of new crops (wheat, triticale and brassica) – Hybrids between species with same chromosome number, alien translocations - Hybrids between species with different chromosome number; Gene transfer using amphidiploids - Bridge species. | | |
| **Unit-5** | | **Contact Hours: 05** |
| Fertilization barriers in crop plants at pre-and post-fertilization levels- In vitro techniques to overcome the fertilization barriers in crops; Chromosome manipulations in wide hybridization ; case studies – Production and use of haploids, dihaploids and doubled haploids in genetics and breeding. | | |

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Study of different types of microscopes |
| 2 | Study of different types of chemicals used in the preparation of slides. |
| 3 | Preparation of slides of Mitosis |
| 4 | Identification of stages of Mitosis. |
| 5 | Preparation of slides of Meiosis. |
| 6 | Identification of stages of Meiosis. |
| 7 | Identify and classify chromosomes based on size, centromere position, and banding patterns. |
| 8 | Identification of plants based on ploidy levels. |
| 9 | Use of mutations in crop improvement. |
| 10 | Analyze cytogenetic data using bioinformatics tools and databases. |
| 11 | Analyze case studies involving cytogenetic abnormalities or genetic disorders. |
| 12 | Overview of gene manipulation techniques for crop improvement. |

**Suggestive Readings:**

**Text Books:**


1. **TI.** Gupta, P. K. Cytogenetics. Rastogi Publications, Meerut.
2. **T2.** Genetics. By Prof B.D. Singh (2001). Kalyani publishers, New Delhi.


**Reference Books:**

**R2.**Principles of Plant Breeding, Allard, R.W

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|

| Course Outcomes  | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER I**

## Course: Principle of Plant Breeding

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-I** | | | |
|---|---|---|---|---|---|
| **Course Name** | Principle of Plant breeding | L | T | P | C |
| **Course Code** | AGB C603 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **Cob1** | Make the students list the historical development of plant breeding and its significance. |
| **Cob2** | Enable students to understand the concepts and principles of plant breeding |
| **Cob3** | To apply and design ethical breeding objectives for further development of varieties with desired quality for yield, adaptability and resistance towards biotic and abiotic stresses |
| **Cob4** | Select appropriate breeding methods of crop improvement in sexually and asexually propagated crop plants |

| | |
|---|---|
| **Cob5** | Assess the potential impact of biotechnology and other emerging technologies on future crop improvement. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To Define the important terms and concepts related to Plant Breeding and its history along with major achievements. | **L1** |
| **CO 2** | To Classify the different modes of reproduction in different types of crop plants. | **L2** |
| **CO 3** | To Apply the breeding objectives and prioritize traits for crop improvement. | **L3** |
| **CO 4** | To Calculate the changes in gene frequency leading to trait improvement in crop plants. | **L4** |
| **CO 5** | To create Non conventional Biotechnology methods for varietal improvement and conservation strategies for wider gene pool in crop plants. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| History of Plant Breeding (Pre and post-Mendelian era); Objectives of plant breeding, characteristics improved by plant breeding; Patterns of Evolution in Crop Plants- Centres of Origin-biodiversity and its significance. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Genetic basis of breeding self- and cross – pollinated crops including mating systems and response to selection – nature of variability, components of variation; Heritability and genetic advance, genotype x environment interaction; General and specific combining ability; Types of gene actions and implications in plant breeding; Plant introduction and role of plant genetic resources in plant breeding | | |
| **Unit-3** | | **Contact Hours: 05** |
| Self-incompatibility and male sterility in crop plants and their commercial exploitation. Pure line theory, pure line selection and mass selection methods; Line breeding, pedigree, bulk, | | |

| | | |
|---|---|---|
| backcross, single seed descent and multiline method; Population breeding in self-pollinated crops (diallel selective mating approach). | | |
| **Unit-4** | | **Contact Hours: 05** |
| Breeding methods in cross pollinated crops; Population breeding-mass selection and ear-to-row methods; S1 and S2 progeny testing, progeny selection schemes, recurrent selection schemes for intra and inter-population improvement and development of synthetics and composites; Hybrid breeding – genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds. | | |
| **Unit-5** | | **Contact Hours: 05** |
| Breeding methods in asexually/clonally propagated crops, clonal selection apomixes, clonal selection. Self-incompatibility and male sterility in crop plants and their commercial exploitation; Concept of plant ideotype and its role in crop improvement; Transgressive breeding, Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses, Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights. | | |

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | To know the Floral structure and biology of self-pollinated crops |
| 2 | To know the Floral structure and biology of cross pollinated crops |
| 3 | To perform Emasculation in Self Pollinated crops |
| 4 | To perform Emasculation in Cross Pollinated crops |
| 5 | To understand the concept of variation and selection in field condition |
| 6 | To understand the Important designs used in plant breeding experiments |
| 7 | To estimate heterosis and inbreeding depression in crops |
| 8 | To understand the methods of calculating mean, range, variances, standard variation |
| 9 | To know the Layout of field experiments in plant breeding |
| 10 | To learn the Induction of mutation through chemical mutagens |
| 11 | To know the prediction of performance of double cross hybrids through single cross hybrids |

| | |
|---|---|
| 12 | Development of hybrid seed through crossing |

**Suggestive Readings:**

**Text Books:**

1. **TI.** Singh, B. D. Plant Breeding. Kalyani Publishers. New Delhi.
2. **T2.** Genetics. By Prof B.D. Singh (2001). Kalyani publishers, New Delhi.

**Reference Books:**

**R2.**Principles of Plant Breeding, Allard, R.W

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER I**

**Course: Statistical Methods**

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-I** | | | |
|---|---|---|---|---|---|
| **Course Name** | Statistical Methods | L | T | P | C |
| **Course Code** | AGB C604 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **Cob1** | To know the principles and methods of statistical calculations used in agriculture. |
| **Cob2** | To study the statistical methods of analysis of data viz. quartile deviation, mean deviation, variances, standard deviation, coefficient of variation, moments, including skewness, Kurtosis and its measure. |
| **Cob3** | To understand the statistical methods in collection of any type of data, classification of data, Presentation of data, analysis of data, descriptive statistics, parametric and non-parametric tests, etc. |
| **Cob4** | To Analyze and make statistical hypothesis and design experiment in agriculture. |
| **Cob5** | To develop the ability to Correlate the results of statistical calculations and their validation with the available agricultural data. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To Identify the different types of central tendency. | **L1** |
| **CO 2** | To Classify the data for quantitative and qualitative and its statistical analysis. | **L2** |
| **CO 3** | To Apply the statistical methods in crop production and testing of hypothesis. | **L3** |
| **CO 4** | To Analyze the use of central tendency, correlation and regression analysis in agriculture experiments. | **L4** |
| **CO 5** | To create solutions through different statistical methods for solving the problems in agriculture in for crop improvements. | **L5 and L6** |

**Syllabus:**

| | | |
|---|---|---|
| **Unit-1** | **Data Classification** | **Contact Hours: 03** |

Classification, tabulation and graphical representation of data. Box-plot, Descriptive statistics. Exploratory data analysis; Theory of probability. Random variable and mathematical expectation.

| **Unit-2** | **Tests of significance** | **Contact Hours: 05** |
|---|---|---|

Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial; Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Large sample theory.

| **Unit-3** | **Correlation and regression** | **Contact Hours: 05** |
|---|---|---|

Introduction to theory of estimation and confidence-intervals. Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination. Polynomial regression models and their fitting. Profit regression analysis by least squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.

| **Unit-4** | **Non-parametric tests** | **Contact Hours: 05** |
|---|---|---|

Non-parametric tests – sign, Wilcoxon, Mann-Whitney U{test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

| **Unit-5** | **Cluster and principal component analysis** | **Contact Hours: 05** |
|---|---|---|

Introduction to multivariate analytical tools- Hotelling's T2 Tests of hypothesis about the mean vector of a multi-normal population. Classificatory problems and discriminant function, D2-statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Numerical on Fitting of binomial distribution |
| 2 | Numerical on Fitting of Poisson distribution |
| 3 | Numerical on Fitting of Normal distribution |
| 4 | Numerical on Chi- square tests |
| 5 | Numerical on t- test, one sample, two sample, paired |
| 6 | Numerical on F-test |

| | |
|---|---|
| 7 | Numerical on Karl Pearson's Correlation |
| 8 | Numerical on Spearman's Rank correlation, tied observation |
| 9 | Numerical on Non Parametric Tests – one sample tests |
| 10 | Numerical on Non Parametric Tests – two sample tests |
| 11 | Numerical on Randomized Completely Block Designs |
| 12 | Numerical Completely Randomized designs |

**Suggestive Readings:**

**Text Books:**

**T1**. Dr. SRS Chandel. Agricultural Statistics Impact Printing Press, Kanpur.

**T2.** Prof. Abhijit Sharma, Assam Agriculture University: Agricultural Statistics, Kalyani Publishers

**Reference Books:**

**R1**. Prof. Rangasawamy: A Text Book of Agricultural Statistics, New Age Publications

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER I**

**Course: Experimental Designs**

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-I** | | | |
|---|---|---|---|---|---|
| **Course Name** | Experimental Designs | L | T | P | C |
| **Course Code** | AGB C 605 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To know the basic principles of experimental designs used in agriculture |
| **COb2** | To study the statistical methods of analysis of data viz. quartile deviation, mean deviation, variances, standard deviation, coefficient of variation, moments, including skewness, Kurtosis and its measure. |
| **COb3** | To understand the statistical methods in collection of any type of data, classification of data, Presentation of data, analysis of data, descriptive statistics, parametric and non-parametric tests, etc. |
| **COb4** | To Analyze and make statistical hypothesis and design experiment in agriculture. |
| **COb5** | To develop the ability to Correlate the results of statistical calculations and their validation with the available agricultural data. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| **CO** | **Outcome** | **BT Level** |
|---|---|---|
| **CO 1** | To Identify the different types of experimental designs | **L1** |
| **CO 2** | To Understand the data and interpretation for quantitative and qualitative analysis | **L2** |
| **CO 3** | To apply the importance coefficient of variation and standard deviation in interpretation of results | **L3** |
| **CO 4** | To analyze the use of Analysis of Variance, correlation and regression analysis in agriculture experiments | **L4** |

| | | |
|---|---|---|
| **CO 5** | To Create solutions through different statistical methods for solving the problems in agriculture | **L5 and L6** |

**Syllabus:**

| **Unit-1** | **Basic principles of Experimental design** | **Contact Hours: 03** |
|---|---|---|
| Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control, Uniformity trials, size and shape of plots and blocks. | | |
| **Unit-2** | **Different types of Experimental designs** | **Contact Hours: 05** |
| Analysis of variance; Completely randomized design, randomized block design and Latin square design, Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom. | | |
| **Unit-3** | **Factorial experiments** | **Contact Hours: 05** |
| Confounding in symmetrical factorial experiments, Factorial experiments with control treatment, Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs. | | |
| **Unit-4** | **Incomplete block design** | **Contact Hours: 05** |
| Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures. | | |
| **Unit-5** | **Uniformity trial** | **Contact Hours: 05** |
| Practical Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces | | |

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Numerical on Fitting of binomial distribution |
| 2 | Numerical on Fitting of Poisson distribution |
| 3 | Numerical on Fitting of Normal distribution |
| 4 | Numerical on Chi- square tests |
| 5 | Numerical on t- test, one sample, two sample, paired |

| | |
|---|---|
| 6 | Numerical on F-test |
| 7 | Numerical on Karl Pearson's Correlation |
| 8 | Numerical on Spearman's Rank correlation, tied observation |
| 9 | Numerical on Non Parametric Tests - one sample tests |
| 10 | Numerical on Non Parametric Tests - two sample tests |
| 11 | Numerical on Randomized Completely Block Designs |
| 12 | Numerical Completely Randomized designs |

**Suggestive Readings:**

**Text Books:**

**T1**. Dr. SRS Chandel. Agricultural Statistics Impact Printing Press, Kanpur.

**T2.** Prof. Abhijit Sharma, Assam Agriculture University: Agricultural Statistics, Kalyani Publishers

**Reference Books:**

**R1**. Prof. Rangasawamy: A Text Book of Agricultural Statistics, New Age Publications

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

## SEMESTER I

## Multi- Disciplinary Course: Disaster Management

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-I** | | | |
|---|---|---|---|---|---|
| **Course Name** | Disaster Management | L | T | P | C |
| **Course Code** | AGB N001 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Identify and describe the different types and effects of natural and man-made disasters, including floods, droughts, cyclones, earthquakes, landslides, nuclear disasters, and chemical disasters with an emphasis on their impact on agricultural productivity. |
| **COb2** | Explain the causes and impacts of climatic changes such as global warming, sea level rise, and ozone depletion on agriculture and food security, especially in the context of Uttarakhand and analyze their contribution to the occurrence and severity of natural disasters |
| **COb3** | Demonstrate knowledge of disaster management strategies by outlining national and global efforts to mitigate natural disasters on agriculture and evaluating the effectiveness of these strategies in various contexts, particularly in Uttarakhand |
| **COb4** | Examine the role and coordination of different entities such as NGOs, community-based organizations, media, and armed forces in disaster response, and assess their impact on disaster management at central, state, district, and local levels and emphasizing the importance of these roles in managing agricultural crises in Uttarakhand. |
| **COb5** | Design the International Strategy for Disaster Reduction and the national disaster management framework, considering financial arrangements, policy implications and propose improvements for effective disaster management and recovery in the agricultural sector, incorporating modern technologies and sustainable practices. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| CO 1 | Recall the key terms and concepts related to natural and man-made disasters and their impact on agriculture. | L1 |
| CO 2 | Understand and explain the interrelationships between climatic changes, natural disasters, and their effects on agricultural productivity and food security. | L2 |
| CO 3 | Apply principles of soil and water management to develop strategies for mitigating the impacts of natural and man-made disasters on agricultural productivity. | L3 |
| CO 4 | Analyze the role of different entities such as NGOs, community-based organizations, media, and armed forces in disaster response and assess their impact on disaster | L4 |
| CO 5 | Design a comprehensive International Strategy for Disaster Reduction and a national disaster management framework, considering financial arrangements and policy implications, for the agricultural sector. | L5 and L6 |

**Syllabus:**

| Unit-1 | Natural Disaster | Contact Hours: 3 |
|---|---|---|
| Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion. | | |
| **Unit-2** | **Man Made Disasters** | **Contact Hours:3** |
| Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents | | |

| Unit-3 | Management of Natural Disaster | Contact Hours: 2 |
|---|---|---|
| Disaster Management- Efforts to mitigate natural disasters at national and global levels. | | |
| **Unit-4** | **International & National Scheme for Disaster reduction.** | **Contact Hours: 3** |
| International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; | | |
| **Unit-5** | **Roles and Responsibilities in Disaster Management and Response** | **Contact Hours: 3** |
| Role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations; its importance in Uttarakhand point of view. | | |

**T1.**Vinod K. Sharma, "Disaster Management" Second Edition, Scientific International Pvt. Ltd. (New Delhi).

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10 mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|

| Course Outcomes  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

SEMESTER II

## Course: Cell Biology and Molecular Genetics

| | | | | | |
|---|---|---|---|---|---|
| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
| **Course Name** | Cell Biology and Molecular Genetics | L | T | P | C |
| **Course Code** | AGB C606 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To know about the principles of cell biology and molecular genetics |
| **COb2** | To study the different Mendelian genetics and Population genetics |
| **COb3** | To understand the Chromosomal structure and function in self-pollinated cross-pollinated and vegetative propagated crops |
| **COb4** | To distinguish between the chromosomal aberrations in crop plants |
| **COb5** | To develop skills in solving numeral problems of genetics |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|

| | | |
|---|---|---|
| **CO 1** | To define the ultrastructure and differences between eukaryotic and prokaryotic cells. | **L1** |
| **CO 2** | To understand the function of cell organelles, cell division and physiology and the principles of Mendelian genetics | **L2** |
| **CO 3** | To apply the knowledge of cell biology and DNA transcription and its regulation in prokaryotes and eukaryotes. | **L3** |
| **CO 4** | To analyze the transposable elements DNA sequences, Unique and repetitive sequences, gene amplification and its significance. | **L4** |
| **CO 5** | To evaluate signal transduction and interpret the role of genes in cell development in Cancer and cell aging. | **.L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Ultrastructure of the cell; Differences between eukaryotic and prokaryotic cells, macromolecules; Structure and function of cell wall, nuclear membrane and plasma membrane; Cellular Organelles – nucleus, plastidschloro/chromoplast, mitochondria endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Bioenergetics; Ultrastructure and function of mitochondria and biological membranes; Chloroplast and other photosynthetic organelles; Interphase nucleus- Structure and chemical composition; Cell division and physiology of cell division. | | |
| **Unit-3** | | **Contact Hours: 05** |
| Historical background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid, DNA transcription and its regulation – Transcription factors and their role; Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes – ribosomes, t-RNAs and translational factors. | | |
| **Unit-4** | | **Contact Hours: 05** |
| Transposable elements; Mechanisms of recombination in prokaryote; DNA organization in eukaryotic chromosomes – DNA content variation, types of DNA sequences – Unique and repetitive sequences; organelle genomes; Gene amplification and its significance | | |
| **Unit-5** | | **Contact Hours: 05** |

| | |
|---|---|
| Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging. | |
| **Practical** | **Suggested list of Exercises** |
| 1 | To Study of structure and function of compound Microscope |
| 2 | To perform study on Morphological and Gram staining of natural bacteria |
| 3 | To Study of the key differences of Prokaryotic and Eukaryotic Cell |
| 4 | To Study of Mitosis through permanent slides |
| 5 | To Study of Meiosis through permanent slides |
| 6 | Making slides of mitosis through onion roots |
| 7 | To Study the Transposable genetic elements and their types |
| 8 | To Study of DNA size by Gel Electrophoresis |

**Suggestive Readings:**

**Text Books:**

**TI.**Crop Breeding and Biotechnology, Hari Har Ram, Kalyani Publishers, Ludhiana.

**T2.**Plant Breeding, Singh, B.D. Kalyani Publishers. New Delhi /Ludhiana

**Reference Books:**

**R1.**Essentials of Plant Breeding, By Singh, Phundan, Kalyani Publishers Ludhiana/ New Delhi

**R2.**Principles of Plant Breeding, Allard, R.W

**R3.**Genetics. By Prof B.D. Singh (2001). Kalyani publishers, New Delhi.

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

SEMESTER II

## Course: Biotechnology for crop Improvement

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
|---|---|---|---|---|---|
| **Course Name** | Biotechnology for crop Improvement | L | T | P | C |
| **Course Code** | AGB C607 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To know about the principles of cell biology and molecular genetics |
| **COb2** | To study the different Mendelian genetics and Population genetics |
| **COb3** | To understand the Chromosomal structure and function and its sequencing for QTL mapping |
| **COb4** | To analyse the use of Marker assisted selection techniques in Plant breeding |
| **COb5** | To develop skills in solving male sterility and pre and post fertilization barriers through tissue culture interventions |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To define Biotechnology and its relevance in agriculture and describe its scope in plant breeding. | **L1** |
| **CO 2** | To Understand the role of plant tissue culture in Plant propagation in in vitro condition and for conservation of genetic resources. | **L2** |
| **CO 3** | To apply the knowledge of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques to interpret about Biochemical and Molecular markers and mapping populations (F2s, back crosses, RILs, NILs and DH). | **L3** |
| **CO 4** | To Analyze the molecular mapping and tagging of agronomically important traits and also explain gene pyramiding, Marker assisted selection and molecular breeding. | **L4** |
| **CO 5** | To evaluate the role of Recombinant DNA technology, vector-mediated gene transfer and support of biotechnology applications in male sterility/hybrid breeding, molecular farming, Nanotechnology and its applications in crop improvement programme. | **.L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation. | | |
| **Unit-3** | | **Contact Hours: 05** |
| Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing | | |

techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR,SNPs, ESTs etc.), mapping populations (F2s, back crosses, RILs, NILs and DH).

| **Unit-4** | | **Contact Hours: 05** |
|---|---|---|

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding, Marker assisted selection and molecular breeding; Genomics and geno-informatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression, Generation of EDVs.

| **Unit-5** | | **Contact Hours: 05** |
|---|---|---|

Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector-mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases. Biotechnology applications in male sterility/hybrid breeding, molecular farming. MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights, Bioinformatics & Bioinformatics tools, Nanotechnology and its applications in crop improvement programmes.

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Laboratory Organization of a plant tissue culture lab |
| 2 | Preparations of solutions |
| 3 | Safety Measures in Lab |
| 4 | Principles and Practices of Equipments in Lab |
| 5 | To study the procedure and principle sterilization in plant tissue culture |
| 6 | Preparation of MS Media |
| 7 | Study about Inoculation |
| 8 | Plant tissue culture of Meristem |

**Suggestive Readings:**

**Text Books:**

**TI.**Crop Breeding and Biotechnology, Hari Har Ram, Kalyani Publishers, Ludhiana.

**T2.**Plant Breeding, Singh, B.D. Kalyani Publishers. New Delhi /Ludhiana

**Reference Books:**

**R1.** Singh B. D. Biotechnology, Expanding Horizons. Kalyani Publishers, New Delhi.

**R2.** Gupta P. K. Elements of Biotechnology. Rastogi Publications, Meerut.

**R3.** Chopra V. L. & Nasim, A. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH. New Delhi

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER II**

## **Course:** Principles of Quantitative Genetics

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
|---|---|---|---|---|---|
| **Course Name** | Principles of Quantitative Genetics | L | T | P | C |
| **Course Code** | AGB C608 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To know about the principles of cell biology and molecular genetics |
| **COb2** | To study the different Mendelian genetics and Population genetics |
| **COb3** | To understand the Chromosomal structure and function in self-pollinated cross-pollinated and vegetative propagated crops |

| | |
|---|---|
| **COb4** | To distinguish between the chromosomal aberrations in crop plants |
| **COb5** | To develop skills in solving numeral problems of genetics |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To Remember the mendelian traits *vs* polygenic traits, multiple factor hypothesis and also examine the analysis of continuous variation and the variations associated with polygenic trait, nature of gene action and linkage effects | **L1** |
| **CO 2** | To Understand the Generation mean analysis; Mating designs- Diallel, partial diallel, line x tester analysis, NCDs and TTC and also point out the concepts of combining ability and gene action; Analysis of genotype x environment interaction, models for GxE analysis and stability parameters. | **L2** |
| **CO 3** | To apply the principles of Experiential designs and Statistical packages for the Analysis of Variance (ANOVA) and also estimate expected variance components, random and fixed models; MANOVA, biplot analysis and compare the means and variances for significance. | **L3** |
| **CO 4** | To analyze the results of experimental designs of plant breeding and its application in genetic variability and diversity studies | **L4** |
| **CO 5** | To Evaluate the QTL mapping, approaches to apply MAS in Plant breeding by support of selection based on marker and simultaneous selection based on marker and phenotype | **.L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Mendelian traits vs polygenic traits - nature of quantitative traits and its inheritance - Multiple factor hypothesis - analysis of continuous variation; Variations associated with polygenic traits - phenotypic, genotypic and environmental - non-allelic interactions; Nature of gene action - additive, dominance, epistatic and linkage effects. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Principles of Analysis of Variance (ANOVA) - Expected variance components, random and | | |

| | | |
|---|---|---|
| fixed models; MANOVA, biplot analysis; Comparison of means and variances for significance. | | |
| **Unit-3** | | **Contact Hours: 05** |
| Designs for plant breeding experiments – principles and applications; Genetic diversity analysis – metro glyph, cluster and D2 analyses - Association analysis - phenotypic and genotypic correlations; Path analysis and Parent - progeny regression analysis; Discriminant function and principal component analyses; Selection indices - selection of parents; Simultaneous selection models- concepts of selection - heritability and genetic advance. | | |
| **Unit-4** | | **Contact Hours: 05** |
| Generation mean analysis; Mating designs- Diallel, partial diallel, line x tester analysis, NCDs and TTC; Concepts of combining ability and gene action; Analysis of genotype x environment interaction - adaptability and stability; Models for GxE analysis and stability parameters; AMMI analysis – principles and interpretation. | | |
| **Unit-5** | | **Contact Hours: 05** |
| QTL mapping; Strategies for QTL mapping - desired populations for QTL mapping - statistical methods in QTL mapping - QTL mapping in Genetic analysis; Marker assisted selection (MAS) - Approaches to apply MAS in Plant breeding - selection based on marker - simultaneous selection based on marker and phenotype - factors influencing MAS. | | |

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Estimation of heritability and genetic advance - Covariance analysis |
| 2 | Metroglyph analysis- Grouping of clusters and interpretation - Cluster analysis - Construction of cluster diagrams and dendrograms |
| 3 | D2 analysis- Grouping of clusters and interpretation - Cluster analysis - Construction of cluster diagrams and dendrograms |
| 4 | Exercise on Correlation analysis |
| 5 | Exercise on Path analysis |
| 6 | Estimation of heterosis : standard, mid-parental and better-parental heterosis |
| 7 | Estimation of inbreeding depression |
| 8 | Exercise on Generation mean analysis |
| 9 | Line x tester analysis and interpretation of results |
| 10 | Exercise on triple test cross |

| | |
|---|---|
| 11 | Diallel analysis: Griffing's methods I and II |
| 12 | Diallel analysis: Hayman's graphical approach |

**Suggestive Readings:**

**Text Books:**


1. **TI.** Singh, P. & Narayanan S. S. Biometrical Techniques in Plant Breeding. Kalyani Publishers. New Delhi.
2. Singh R. K. & Choudhary B. D. Biometrical Methods in Quantitative Genetics. Kalyani Publishers. New Delhi.
3. Nadarajan, N. & Gunasekaran, M.Quantitative Genetics and Biometrical Techniques in Plant Breeding. Kalyani Publishers. New Delhi.

Falconer D.S. & Mackay J. Introduction to Quantitative Genetics. Longman.


**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|

| Course Outcomes  | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER II**

## Course: Heterosis Breeding

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
|---|---|---|---|---|---|
| **Course Name** | Heterosis Breeding | L | T | P | C |
| **Course Code** | AGB C609 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To know about the principles of heterosis and inbreeding depression |
| **COb2** | To study the different heterotic pools of germplasm |
| **COb3** | To understand the mode of seed production in self-pollinated cross-pollinated and vegetative propagated crops |
| **COb4** | To distinguish self incompatible and compatible genus and species of field crops |
| **COb5** | To develop skills in creating of F1 seeds for exploitation heterosis in field crops |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To remember the heterosis in natural population and inbred population and also examine genetic consequences of selfing and crossing in self-and cross-pollinated and asexually propagated crops | **L1** |
| **CO 2** | To Understand the heterotic pools in germplasm/genetic stocks, inbreds and their improvement and also calculate the Inbreeding depression and estimation, importance of inbreeding in exploitation of heterosis | **L2** |
| **CO 3** | To apply the principles of male sterility and self-incompatibility in heterosis breeding and development of hybrids and also classify hybrid seed production system and commercial exploitation of heterosis. | **L3** |
| **CO 4** | To analyze the problems in Hybrid seed production and fertilization barriers | **L4** |
| **CO 5** | To Evaluate the exploitation of heterosis in sexual and asexual methods of reproduction in self and cross pollinated crops. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Historical aspect of heterosis - Nomenclature and definitions of heterosis - Heterosis in natural population and inbred population; Evolutionary aspects - Genetic consequences of selfing and crossing in self-and cross-pollinated and asexually propagated crops. | | |

| Unit-2 | | Contact Hours: 05 |
|---|---|---|
| Pre Mendelian and Post-Mendelian ideas - Genetic theories of heterosis – Physiological, Biochemical and molecular factors underlining heterosis; theories and their estimation; - Evolutionary concepts of heterosis. | | |
| **Unit-3** | | **Contact Hours: 05** |
| Prediction of heterosis from various crosses- Inbreeding depression, frequency of inbreeding and residual heterosis in F2 and segregating populations, importance of inbreeding in exploitation of heterosis – case studies. - Relationship between genetic distance and expression of heterosis – case studies; Divergence and Genetic Distance analyses-morphological and molecular genetic distance in predicting heterosis, Development of heterotic pools in germplasm/genetic stocks and inbreds, their improvement for increasing heterosis. | | |
| **Unit-4** | | **Contact Hours: 05** |
| Types of male sterility and use in heterosis breeding; Maintenance, transfer and restoration of different types of male sterility; Use of self incompatibility in development of hybrids; Hybrid seed production system: 3-line, 2-line and 1-line system; Development of inbreds and parental lines- A, B and R lines – functional male sterility; Commercial exploitation of heterosis-maintenance breeding of parental lines in hybrids. | | |
| **Unit-5** | | **Contact Hours: 05** |
| Fixation of heterosis in self, cross and often cross pollinated crops, asexually/clonally propagated crops; Male sterile line creation and diversification in self-pollinated, cross pollinated and asexually propagated crops; problems and prospects; Apomixis in fixing heterosis-concept of single line hybrid. Organellar heterosis and complementation Creation of male sterility through genetic engineering and its exploitation in heterosis. Heterosis breeding in wheat, rice, cotton, maize, pearl millet, sorghum and oilseed crops. . | | |

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Estimation of heterotic parameters in self-pollinated crops |
| 2 | Estimation of heterotic parameters in cross pollinated crops |
| 3 | Estimation of heterotic parameters in asexually propagated crops |
| 4 | Hybrid seed production in self-pollinated crops |
| 5 | Hybrid seed production in cross-pollinated crops |
| 6 | Exercise on Male sterility in Rice |

| | |
|---|---|
| 7 | Exercise on Male sterility in Maize |
| 8 | CMS system of breeding |
| 9 | GMS system of breeding |
| 10 | CGMS system of breeding |
| 11 | Hybrid breeding at National level |
| 12 | Hybrid breeding at International level |

**Suggestive Readings:**

**Text Books:**


1. Singh, P. & Narayanan S. S. (1993). Biometrical Techniques in Plant Breeding. Kalyani Pulishers. New Delhi.
2. Singh R. K. & Choudhary B. D. (1987). Biometrical Methods in Quantitative Genetics. Kalyani Publishers. New Delhi.

Proceedings of Genetics and Exploitation of Heterosis in Crops - An International Symposium CIMMYT (1998). Mexico.


**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER II**

**Multi- Disciplinary Course II:** Intellectual Property And Its Management In Agriculture (NC)

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
|---|---|---|---|---|---|
| **Course** | Intellectual Property And Its Management In | L | T | P | C |

| | | | | | |
|---|---|---|---|---|---|
| **Name** | Agriculture (NC) | | | | |
| **Course Code** | AGB N002 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Identify and describe the different types and effects of natural and man-made disasters, including floods, droughts, cyclones, earthquakes, landslides, nuclear disasters, and chemical disasters with an emphasis on their impact on agricultural productivity. |
| **COb2** | Explain the causes and impacts of climatic changes such as global warming, sea level rise, and ozone depletion on agriculture and food security, especially in the context of Uttarakhand and analyze their contribution to the occurrence and severity of natural disasters |
| **COb3** | Demonstrate knowledge of disaster management strategies by outlining national and global efforts to mitigate natural disasters on agriculture and evaluating the effectiveness of these strategies in various contexts, particularly in Uttarakhand |
| **COb4** | Examine the role and coordination of different entities such as NGOs, community-based organizations, media, and armed forces in disaster response, and assess their impact on disaster management at central, state, district, and local levels and emphasizing the importance of these roles in managing agricultural crises in Uttarakhand. |
| **COb5** | Design the International Strategy for Disaster Reduction and the national disaster management framework, considering financial arrangements, policy implications and propose improvements for effective disaster management and recovery in the agricultural sector, incorporating modern technologies and sustainable practices. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To Recall historical perspectives and need for the introduction of Intellectual | **L1** |

| | | |
|---|---|---|
| | Property Right regime; TRIPs and various provisions in TRIPS Agreement. | |
| **CO 2** | To discuss the Intellectual Property and Intellectual Property Rights (IPR) and its benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties | **L2** |
| **CO 3** | To Apply the fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection. | **L3** |
| **CO 4** | To Analyze the National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture | **L4** |
| **CO 5** | To Evaluate the current regulation and propose recommend technologies of Licensing and summarize Material transfer agreements, Research collaboration Agreement, License Agreement. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | **TRIPS** | **Contact Hours: 3** |
|---|---|---|
| Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement | | |
| **Unit-2** | **Indian Patent** | **Contact Hours:3** |
| Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties | | |
| **Unit-3** | **PPVFRA** | **Contact Hours: 2** |
| Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection | | |
| **Unit-4** | **National biodiversity Board** | **Contact Hours: 3** |
| National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture | | |

| Unit-5 | Material Transfer Agreement | Contact Hours: 3 |
|---|---|---|
| Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement. | | |

**Reference Books**


1. **T1.** Erbisch F. H. & Maredia K. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw Hill Education, US
3. Intellectual Property Rights in Animal Breeding and Genetics. CABI. Saha R. (Ed.). Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House., India


**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Assignment | ☑ | | 10 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | | | | | Level 1 |
| Practical Exam | ☑ | | | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|

| Outcomes  | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER II**

**Multi- Disciplinary Course III:** Library And Information Services

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
|---|---|---|---|---|---|
| **Course Name** | Library And Information Services | L | T | P | C |
| **Course Code** | AGB N003 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Recall the library and its services and also identify the role of libraries in education, research and technology transfer. |
| **COb2** | To gather review of literature through survey, Online Public Access Catalogue |
| **COb3** | To classify the information from primary sources, secondary sources and tertiary sources and also understand their intricacies |
| **COb4** | To Analyze the information from Abstracts of Review of literature |
| **COb5** | To evaluate the purpose of e-resources access methods for enhancing knowledge and gathering information. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| CO 1 | To Recall the library and its services and also identify the role of libraries in education, research and technology transfer along with label of classification systems and organization of library | L1 |
| CO 2 | To Explain the literature survey, citation techniques/preparation of bibliography and also CD-ROM Databases, Online Public Access Catalogue and other computerized library services | L2 |
| CO 3 | To Apply the sources of information and classify the primary sources, secondary sources and tertiary sources and also understand the intricacies of abstracting and indexing services like Science Citation Index, Biological Abstracts. | L3 |
| CO 4 | To Analyze the information from Abstracts, CABI Abstracts, etc. for tracing information from reference sources | L4 |
| CO 5 | To Evaluate the internet including search engines and its resources and choose e-resources access methods for enhancing knowledge and gathering information. | L5 and L6 |

**Syllabus:**

| Unit-1 | Library and its classification | Contact Hours: 3 |
|---|---|---|
| Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library | | |
| **Unit-2** | **Sources of Information** | **Contact Hours:3** |
| Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts | | |
| **Unit-3** | **Abstract and Review of Literature** | **Contact Hours: 2** |
| Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; | | |

| | | |
|---|---|---|
| Literature survey; | | |
| **Unit-4** | **Public Access and Bibliography** | **Contact Hours: 3** |
| Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services | | |
| **Unit-5** | **E resources** | **Contact Hours: 3** |
| Use of Internet including search engines and its resources; e-resources access methods. | | |

| **Practical** | **Suggested List of Exercises** |
|---|---|
| 1 | Introduction to library and its services |
| 2 | Role of libraries in education, research and technology transfer |
| 3 | Citation techniques |
| 4 | Preparation of bibliography |
| 5 | Use of CD-ROM Databases |
| 6 | Online Public Access Catalogue |
| 7 | Use of Internet including search engines and its resources; e-resources access methods. |

**Reference Books**

**T1.** Richard E. Bopp R. E. & Smith, L. C. Reference and Information Services: An Introduction, 4th Edition (Library and Information Science Text Series), ABC-CLIO eBook Collection, Santa Barbara, CA

**Assessment Scheme:**

| **Component** | **Adopted for this Course** | **Duration** | **Weightage** | **Date & Time** | **Venue** | **Levels** |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Assignment | ☑ | | 10 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | | | | | Level 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Practical Exam | ☑ | | | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Assignment | ☑ | | 10 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | | | | | Level 1 |
| Practical Exam | ☑ | | | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER II**

**Multi- Disciplinary Course IV:** Technical Writing And Communications Skills (NC)

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-II** | | | |
|---|---|---|---|---|---|
| **Course Name** | Technical Writing And Communications Skills (NC) | L | T | P | C |
| **Course Code** | AGB N004 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Identify the requirements in technical writing and list various forms of scientific writings like thesis, technical papers, reviews, manuals, |
| **COb2** | Explain the importance of tenses, parts of speech, clauses, punctuation marks intechnical writing. |

| | |
|---|---|
| **COb3** | Demonstrate the skills attained in technical writing and presentation of research papers in conferences and seminars |
| **COb4** | Examine the abstracts, summaries, a review article *etc*. in preparation of hypothesis for the research work. |
| **COb5** | Design future research proposals and case studies with the knowledge of technical and soft skills |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To learn the technical writing of scientific writings like thesis, technical papers, reviews, manuals. | **L1** |
| **CO 2** | To understand the communication skills like grammar (tenses, parts of speech, clauses, punctuation marks. | **L2** |
| **CO 3** | To Apply the various parts of communication skills in thesis writing and research communications | **L3** |
| **CO 4** | To Analyze the abstracts, summaries, a review article *etc*. in preparation of hypothesis for the research work. | **L4** |
| **CO 5** | To Evaluate the strength and weakness during participation in group discussion, facing an interview and presentation of scientific papers. | **L5 and L6** |

**Syllabus:**

| | | |
|---|---|---|
| **Unit-1** | **Technical Writing** | **Contact Hours: 3** |

| | | |
|---|---|---|
| Recall the technical writing and list various forms of scientific writings like thesis, technical papers, reviews, manuals | | |
| **Unit-2** | **Communication Skills** | **Contact Hours:3** |
| Explain communication skills like grammar (tenses, parts of speech, clauses, punctuation marks) and also point out error analysis (common errors) and also select concord, collocation, phonetic symbols and transcription. | | |
| **Unit-3** | **Thesis writing** | **Contact Hours: 2** |
| Describe about various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion. | | |
| **Unit-4** | **Research paper writing** | **Contact Hours: 3** |
| Prepare the abstracts, summaries, a review article *etc*. and apply commonly used abbreviations in the thesis and research communications, illustrations, photographs and drawings with suitable captions, numbering of tables and illustrations and also choose editing and proof-reading | | |
| **Unit-5** | **Interview and Public presentation** | **Contact Hours: 3** |
| Reframe accentual pattern like weak forms in connected speech and recommend participation in group discussion, facing an interview and presentation of scientific papers | | |

| **Practical** | **Suggested lists of practical** |
|---|---|
| 1 | Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; |
| 2 | Various parts of thesis and research communications |
| 3 | Writing of abstracts |
| 4 | Writing of summaries |
| 5 | Writing of précis |
| 6 | Writing of citations |
| 7 | Writing of a review article |
| 8 | Facing an interview |

**Text books**


1. Chicago Manual of Style. 14th Ed. Prentice Hall of India.New Delhi
2. Collins' Cobuild English Dictionary. Harper Collins.
3. Gordon HM & Walter JA. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
4. Hornby A. S. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press. England
5. James H. S. Handbook for Technical Writing. NTC Business Books.


**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Assignment | ☑ | | 10 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | | | | | Level 1 |
| Practical Exam | ☑ | | | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

## SEMESTER III

### Course: Breeding for Quality Traits

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-III** | | | |
|---|---|---|---|---|---|
| **Course Name** | **Breeding for Quality Traits** | L | T | P | C |
| **Course Code** | AGB C701 | 1 | 0 | 1 | 2 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Make the students list the historical development of plant breeding and its significance. |
| **COb2** | Enable students to understand the concepts and principles of plant breeding |
| **COb3** | To apply and design ethical breeding objectives for further development of varieties with desired quality for yield, adaptability and resistance towards biotic and abiotic stresses |
| **COb4** | Select appropriate breeding methods of crop improvement in sexually and asexually propagated crop plants |
| **COb5** | Assess the potential impact of biotechnology and other emerging technologies on future crop improvement. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| **CO** | **Outcome** | **BT Level** |
|---|---|---|

| | | |
|---|---|---|
| **CO 1** | To remember the important quality parameters of cereals, pulse and oil seed crops | **L1** |
| **CO 2** | To understand the different genetics of carbohydrates, proteins, fats, vitamins, amino acids and anti-nutritional factors for Nutritional improvement | **L2** |
| **CO 3** | To Apply the breeding objectives and prioritize traits for crop improvement. | **L3** |
| **CO 4** | To Analyze the Breeding strategies of the Quality traits, achievements and application in Indian context | **L4** |
| **CO 5** | To create methods for varietal improvement and through value addition in crop plants. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Developmental biochemistry and genetics of carbohydrates, proteins, fats, vitamins, amino acids and anti-nutritional factors - Nutritional improvement - A human perspective - Breeding for grain quality parameters in rice and its analysis - Golden rice and aromatic rice – Breeding strategies, achievements and application in Indian context - Molecular basis of quality traits and their manipulation in rice - Post harvest manipulation for quality improvement. | | |
| **Unit-2** | | **Contact Hours: 05** |
| Breeding for baking qualities in wheat; Characters to be considered and breeding strategies - Molecular and cytogenetic manipulation for quality improvement in wheat - Breeding for quality improvement in barley and oats. | | |
| **Unit-3** | | **Contact Hours: 05** |
| Breeding for quality improvement in Sorghum and pearl millet; Quality protein maize – Concept and breeding strategies – Breeding for quality improvement in forage crops - Genetic resource management for sustaining nutritive quality in crops | | |
| **Unit-4** | | **Contact Hours: 05** |
| Breeding for quality in pulses - Breeding for quality in groundnut, sesame, sunflower and minor oilseeds – Molecular basis of fat formation and manipulation to achieve more PUFA in oil crops; Genetic manipulation for quality improvement in cotton | | |
| **Unit-5** | | **Contact Hours: 05** |
| Genetic engineering protocols for quality improvement – Achievements made - Value addition | | |

| | |
|---|---|
| in crops; Classification and importance - Nutritional genomics and Second generation transgenics. | |
| **Practical** | **Suggested list of Exercises** |
| 1 | Exercise on Grain quality evaluation in rice |
| 2 | Correlating ageing and quality improvement in rice |
| 3 | Exercise on Quality analysis in millets |
| 4 | Estimation of anti-nutritional factors like tannins in different varieties/hybrids; |
| 5 | A comparison - Quality parameters evaluation in wheat; Quality parameters evaluation in pulses, Quality parameters evaluation in oilseeds |
| 6 | Value addition in crop plants |
| 7 | Post -harvest processing of major field crops |
| 8 | Quality improvement in crops through tissue culture techniques |
| 9 | Evaluating the available populations like RIL, NIL etc. for quality improvement using MAS procedures |

**Suggestive Readings:**

**Text Books:**


1. **TI.** Singh, B. D. Plant Breeding. Kalyani Publishers. New Delhi.
2. **T2.** Genetics. By Prof B.D. Singh (2001). Kalyani publishers, New Delhi.


**Reference Books:**


**R1.** Principles of Plant Breeding, Allard, R.W

R2. Qureshi, A. M. Q.; Zahoor Ahmad Dar Z A; Wani S. H. Quality breeding in field crops. Springer, Cham, Switzerland.


**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes  Course Outcomes  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

## SEMESTER III

### Course: Maintenance Breeding, Concepts of Variety Release and Seed Production

| | | | | | |
|---|---|---|---|---|---|
| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-III** | | | |
| **Course Name** | Maintenance Breeding, Concepts of Variety Release and Seed Production | L | T | P | C |
| **Course Code** | AGB C702 | 1 | 0 | 1 | 2 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To remember the principles of seed varietal development and maintenance, and seed certification standards |
| **COb2** | To Enable students to understand the Distinctiveness, Uniformity and Stability (DUS) testing guidelines and descriptors for major crops |
| **COb3** | To apply factors responsible for genetic deterioration of varieties during seed production |

| | |
|---|---|
| **COb4** | To Select appropriate breeding methods of crop improvement in sexually and asexually propagated crop plants during seed multiplication process of nucleus, breeders, foundation, certified |
| **COb5** | To Assess the seed certification procedures; seed laws and plant variety protection regulations in India and International systems |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To remember the varietal development and maintenance, variety testing, release and notification systems in India | **L1** |
| **CO 2** | To understand the Distinctiveness, Uniformity and Stability (DUS) testing guidelines and descriptors for major crops and demonstrate the genetic purity concept and use in maintenance breeding | **L2** |
| **CO 3** | To Apply the factors responsible for genetic deterioration of varieties, relate the importance of isolation distance, and apply the principles of seed production and methods of nucleus and breeder seed production. | **L3** |
| **CO 4** | To Analyze the seed multiplication process of nucleus, breeders, foundation, certified and relate the quality seed production technology of self and cross-pollinated crop varieties | **L4** |
| **CO 5** | To evaluate seed certification procedures; seed laws and plant variety protection regulations in India and International systems. | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Variety Development and Maintenance; Definition- variety, cultivar, extant variety, essentially derived variety, independently derived variety, reference variety, farmers' variety, hybrid, and population; Variety testing, release and notification systems in India and abroad. | | |
| **Unit-2** | | **Contact Hours: 05** |
| DUS testing- DUS Descriptors for major crops; Genetic purity concept and maintenance breeding. | | |

| Unit-3 | | Contact Hours: 05 |
|---|---|---|
| Factors responsible for genetic deterioration of varieties - safeguards during seed production; Maintenance of varieties in self and cross-pollination crops- isolation distance; Principles of seed production; Methods of nucleus and breeder seed production | | |
| **Unit-4** | | **Contact Hours: 05** |
| Generation system of seed multiplication -nucleus, breeders, foundation, certified, - Quality seed production technology of self and cross-pollinated crop varieties viz. cereals & millets (wheat, barley, paddy, pearlmillet, sorghum, maize and ragi etc.); Pulses (greengram, blackgram, cowpea, pigeonpea, chickpea, fieldpea, lentil); Oilseeds (groundnut, soybean, sesame, castor, sunflower, safflower, linseed, rapeseed and mustard); fibres (cotton, jute) and forages (guar, forage sorghum, teosinte, oats, berseem, lucerne | | |
| **Unit-5** | | **Contact Hours: 05** |
| Seed certification procedures; Seed laws and plant variety protection regulations in India and international systems | | |

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Identification of suitable areas/locations for seed production |
| 2 | Ear-to-row method and nucleus seed production - |
| 3 | Main characteristics of released and notified varieties, hybrids and parental lines; |
| 4 | Identification of important weeds/objectionable weeds |
| 5 | Determination of isolation distance and planting ratios in different crops; |
| 6 | Seed production techniques of varieties in different crops |
| 7 | Hybrid seed production technology of important crops |

**Suggestive Readings:**

**Text Books:**


1. **TI.** Agarwal R. L. Seed Technology. 2nd Ed. Oxford & IBH. New York.
2. **T2.** Chhabra A. K. Practical Manual of Floral Biology of Crop Plants. Department of Plant Breeding. CCS HAU Hisar


**Reference Books:**


**R1.** Principles of Plant Breeding, Allard, R.W

R2. Kelly A. F. Seed Production of Agricultural Crops. Longman.

R3. Poehlman JM & Borthakur D. Breeding Asian Field Crops. Oxford, UK

Singh BD. 2005. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER III**

**Course:** Breeding for Biotic and Abiotic Stress Resistance

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-III** | | | |
|---|---|---|---|---|---|
| **Course Name** | Breeding for Biotic and Abiotic Stress Resistance | L | T | P | C |
| **Course Code** | AGB C703 | 2 | 0 | 2 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To remember the plant breeding objectives with special reference to biotic and abiotic stress resistance |
| **COb2** | To Enable students to understand the classification of biotic and abiotic stresses in major field crops |
| **COb3** | To apply the genetic mechanisms of resistance to biotic stresses –Horizontal and vertical resistance in crop plants and abiotic defence mechanisms like antibiosis, tolerance |
| **COb4** | To Select appropriate breeding methods to stresses caused by toxicity, deficiency and pollutants/contaminants in soil, water and environment |
| **COb5** | To Assess the gene-for-gene hypothesis, Acquired and induced immunity and systemic acquired resistance (SAR) |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| **CO** | **Outcome** | **BT Level** |
|---|---|---|
| **CO 1** | To remember the plant breeding objectives with special reference to biotic and abiotic stress resistance, gene-for-gene hypothesis and concepts of signal transduction and other host-defence mechanisms against viruses and bacteria | **L1** |
| **CO 2** | To understand the classification of biotic and abiotic stresses and physiological and phenological responses | **L2** |
| **CO 3** | To Apply the genetic mechanisms of resistance to biotic stresses –Horizontal | **L3** |

| | | |
|---|---|---|
| | and vertical resistance in crop plants, phenotypic screening methods for major pests and disease, correlating using marker data and gene pyramiding methods and their implications | |
| **CO 4** | To Analyze the genetics of abiotic stress resistance and breeding for resistance to stresses caused by toxicity, deficiency and pollutants/contaminants in soil, water and environment | **L4** |
| **CO 5** | To evaluate methods of exploitation of wild relatives as a source of resistance to biotic and abiotic factors in major field crops and transgenic management of biotic and abiotic stresses and the use of Marker Assisted Selection procedures for resistance | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Importance of plant breeding with special reference to biotic and abiotic stress resistance; Classification of biotic stresses – major pests and diseases of economically important crops - Concepts in insect and pathogen resistance; Analysis and inheritance of resistance variation; Host defence responses to pathogen invasions- Biochemical and molecular mechanisms; Acquired and induced immunity and systemic acquired resistance (SAR); Host-pathogen interaction, gene-for-gene hypothesis, molecular evidence for its operation and exceptions; Concept of signal transduction and other host-defence mechanisms against viruses and bacteria | | |
| **Unit-2** | | **Contact Hours: 05** |
| Types and genetic mechanisms of resistance to biotic stresses –Horizontal and vertical resistance in crop plants. Quantitative resistance/Adult plant resistance and Slow rusting resistance - Classical and molecular breeding methods - Measuring plant resistance using plant fitness; Behavioural, physiological and insect gain studies. Phenotypic screening methods for major pests and diseases; Recording of observations; Correlating the observations using marker data - Gene pyramiding methods and their implications. | | |
| **Unit-3** | | **Contact Hours: 05** |
| Classification of abiotic stresses - Stress inducing factors –moisture stress/drought and water logging & submergence; Acidity, salinity/alkalinity/sodicity; High/low temperature, wind, etc. Stress due to soil factors and mineral toxicity; Physiological and Phenological responses | | |
| **Unit-4** | | **Contact Hours: 05** |
| Emphasis of abiotic stresses in developing breeding methodologies. Genetics of abiotic stress | | |

resistance; Genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low/freezing temperatures; Utilizing MAS procedures for identifying resistant types in important crops like rice, sorghum, wheat, cotton etc; Breeding for resistance to stresses caused by toxicity, deficiency and pollutants/contaminants in soil, water and environment.

| **Unit-5** | | **Contact Hours: 05** |
|---|---|---|

Exploitation of wild relatives as a source of resistance to biotic and abiotic factors in major field crops - Transgenics in management of biotic and abiotic stresses, use of toxins, protease inhibitors, lectins, chitnases and Bt for diseases and insect pest management- Achievements Practical Phenotypic screening techniques for sucking pests and chewing pests – Traits to be observed at plant and insect level - Phenotypic screening techniques for nematodes and borers; Ways of combating them. Breeding strategies - Weeds – ecological, environmental impacts on the crops; Breeding for herbicide resistance - Evaluating the available populations like RIL, NIL etc. for pest resistance; Use of standard MAS procedures - Phenotypic screening methods for diseases caused by fungi and bacteria; Symptoms and data recording; use of MAS procedures - Screening forage crops for resistance to sewage water and tannery effluents; Quality parameters evaluation - Screening crops for drought and flood resistance; factors to be considered and breeding strategies - Screening varieties of major crops for acidity and alkalinity- their effects and breeding strategies; Understanding the climatological parameters and predisposal of biotic and abiotic stress factors- ways of combating them

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Gene pyramiding in Rice |
| 2 | Equipment's used in breeding for biotic and abiotic stress |
| 3 | Vertifolia effect and its importance in VR and HR |
| 4 | Gene-for-gene hypothesis its importance |
| 5 | Breeding for resistance to stresses caused by toxicity |
| 6 | Breeding for resistance to stresses caused by deficiency |
| 7 | Transgenics in management of biotic and abiotic stresses |

**Suggestive Readings:**

**Text Books:**

1. **TI.** Singh B.D. Plant breeding, kalyani publication, New Delhi

**Reference Books:**

**R1.** Principles of Plant Breeding, Allard, R.W

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

## SEMESTER III

## Course: Mutagenesis and Mutation Breeding

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-III** | | | |
|---|---|---|---|---|---|
| **Course Name** | Mutagenesis and Mutation Breeding | L | T | P | C |
| **Course Code** | AGB C704 | 2 | 0 | 2 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To remember the nature and classification of mutations, describe the detection and use of mutations in lower and higher organisms |
| **COb2** | To understand the chemical mutagens their classification and properties their mode of action and explain the factors influencing chemical mutagenesis |
| **COb3** | To apply the treatment methods using physical and chemical mutagens and evaluate the effects of physical and chemical mutagens |
| **COb4** | To Assess the mutagen effects in different generations and estimation of mutagenic efficiency and effectiveness |
| **COb5** | To Evaluate the factors influencing the mutant spectrum and learning the use of mutagens in creating oligogenic and polygenic variations, procedures for micro-mutations breeding/polygenic mutations and illustrate the achievements and use mutagens in genomics, allele mining, tilling |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| **CO** | **Outcome** | **BT Level** |
|---|---|---|
| **CO 1** | To remember the nature and classification of mutations, describe the detection and use of mutations in lower and higher organisms | **L1** |
| **CO 2** | To understand the chemical mutagens their classification and properties their mode of action and explain the factors influencing chemical mutagenesis | **L2** |
| **CO 3** | To apply the treatment methods using physical and chemical mutagens and evaluate the effects of physical and chemical mutagens | **L3** |
| **CO 4** | To Analyze mutagen effects in different generations and estimation of mutagenic efficiency and effectiveness | **L4** |

| | | |
|---|---|---|
| **CO 5** | To evaluate the factors influencing the mutant spectrum and learning the use of mutagens in creating oligogenic and polygenic variations, procedures for micro-mutations breeding/polygenic mutations and illustrate the achievements and use mutagens in genomics, allele mining, tilling | **L5 and L6** |

**Syllabus:**

| **Unit-1** | | **Contact Hours: 03** |
|---|---|---|
| Mutation and its history - Nature and classification of mutations: spontaneous and induced mutations, micro and macro mutations, pre and post adaptive mutations - Detection of mutations in lower and higher organisms – para-mutations | | |
| **Unit-2** | | **Contact Hours: 05** |
| Mutagenic agents: physical -- Radiation types and sources: Ionising and non-ionizing radiations viz., X rays, γ rays, , □ and β particles, protons, neutrons and UV rays - Radiobiology: mechanism of action of various radiations (, photoelectric absorption, Compton scattering and pair production) and their biological effects –RBE and LET relationships | | |
| **Unit-3** | | **Contact Hours: 05** |
| Effect of mutations on DNA - Repair mechanisms operating at DNA, chromosome, cell and organism level to counteract the mutation effects - Dosimetry - Objects and methods of treatment - Factors influencing mutation: dose rate, acute vs chronic irradiation, recurrent irradiation, enhancement of thermal neutron effects - Radiation sensitivity and modifying factors: External and internal sources- Oxygen, water content, temperature and nuclear volume , Chemical mutagens- Classification - Base analogues, antibiotics, alkylating agents, acridine dyes and other mutagens: their properties and mode of action - Dose determination and factors influencing chemical mutagenesis - Treatment methods using physical and chemical mutagens - Combination treatments; Other causes of mutation - direct and indirect action, comparative evaluation of physical and chemical mutagens | | |
| **Unit-4** | | **Contact Hours: 05** |
| Observing mutagen effects in M1 generation: plant injury, lethality, sterility, chimeras etc., - Observing mutagen effects in M2 generation - Estimation of mutagenic efficiency and effectiveness – spectrum of chlorophyll and viable mutations -– Mutations in traits with continuous variation. | | |
| **Unit-5** | | **Contact Hours: 05** |
| Factors influencing the mutant spectrum: genotype, type of mutagen and dose, pleiotropy and linkage etc. - Individual plant based mutation analysis and working out effectiveness and | | |

efficiency in M3 generation - Comparative evaluation of physical and chemical mutagens for creation of variability in the same species – Case studies. Use of mutagens in creating oligogenic and polygenic variations – Case studies - In vitro mutagenesis – callus and pollen irradiation; Handling of segregating generations and selection procedures; Validation of mutants; Mutation breeding for various traits (disease resistance, insect resistance, quality improvement etc) in different crops- Procedures for micro-mutations breeding/polygenic mutations- Achievements of mutation breeding- varieties released across the world- Problems associated with mutation breeding. Use of mutagens in genomics, allele mining, TILLING

| **Practical** | **Suggested list of Exercises** |
|---|---|
| 1 | Learning the precautions on handling of mutagens |
| 2 | Monitoring – safety regulations and safe transportation of radioisotopes |
| 3 | Visit to radio isotope laboratory |
| 4 | learning on safe disposal of radioisotopes |
| 5 | Hazards due to chemical mutagens |
| 6 | Treating the plant propagates at different doses of physical mutagens |
| 7 | Treating the plant propagates at different doses of chemical mutagens |

**Suggestive Readings:**

**Text Books:**

1. **TI.** Singh B.D. Plant breeding, kalyani publication, New Delhi

**Reference Books:**

**R1.** Principles of Plant Breeding, Allard, R.W

**Assessment Scheme:**

| **Component** | **Adopted for this Course** | **Duration** | **Weightage** | **Date & Time** | **Venue** | **Levels** |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 10 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10mins | 05 | | | Level 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**SEMESTER III**

## Multi- Disciplinary Course 5:

## Agricultural Research, Research Ethics And Rural Development Programmes

| **Program** | Masters of Science Agriculture (Genetics and Plant | **Semester-III** |
|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| | Breeding) | | | | |
| **Course Name** | **Agricultural Research, Research Ethics And Rural Development Programmes** | L | T | P | C |
| **Course Code** | AGB N005 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | Identify and Recall the State the global agricultural research system: need, scope, opportunities, National agricultural research systems (NARS), Consultative group on international agricultural research (CGIAR), International agricultural research centres (IARC) and partnership with NARS. |
| **COb2** | Explain the interrelationships between climatic changes, natural disasters, and their effects on agricultural productivity and food security |
| **COb3** | To apply research ethics, standards and problems in research ethics |
| **COb4** | To Examine role of policies and strategies, IRDP, Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-governmental organisations, Constraints in implementation of rural policies and programmes. |
| **COb5** | To describe the International Strategy Agriculture Research Organization and functioning of agricultural research systems at national and international levels in the various policy implications, for Food security |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| **CO 1** | To Recall the State the global agricultural research system: need, scope, opportunities, National agricultural research systems (NARS), Consultative group on international agricultural research (CGIAR), International agricultural research centres (IARC) and partnership with NARS | **L1** |

| | | |
|---|---|---|
| **CO 2** | To Understand the interrelationships between climatic changes, natural disasters, and their effects on agricultural productivity and food security. | **L2** |
| **CO 3** | To Apply the research ethics, standards and problems in research ethics. | **L3** |
| **CO 4** | To Analyze the role of policies and strategies, IRDP, Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-governmental organisations, Constraints in implementation of rural policies and programmes | **L4** |
| **CO 5** | To evaluate the Agriculture Research Organization and functioning of agricultural research systems at national and international levels in the various policy implications, for Food security | **L5 and L6** |

**Syllabus:**

| **Unit-1** | **History of Agriculture and Role in promoting food security** | **Contact Hours: 3** |
|---|---|---|
| History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility | | |
| **Unit-2** | **Research ethics** | **Contact Hours:3** |
| Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics | | |
| **Unit-3** | **Rural development policies and strategies** | **Contact Hours: 2** |
| Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme | | |
| **Unit-4** | **Integrated Rural Development Programme** | **Contact Hours: 3** |
| Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives | | |
| **Unit-5** | **Non-Governmental Organisations** | **Contact Hours: 3** |
| Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and | | |

| |
|---|
| programmes |

**Text Books**

1. **T1.** Bhalla GS & Singh G. Indian Agriculture - Four Decades of Development. Sage Publ. Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
2. Rao B.S.V. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ. New Delhi

**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10 mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |

**Skill Enhancement Course I (SEC):** Basic Concepts In Laboratory Techniques (NC) AGB N006

| **Program** | Masters of Science Agriculture (Genetics and Plant Breeding) | **Semester-III** | | | |
|---|---|---|---|---|---|
| **Course Name** | Basic Concepts In Laboratory Techniques (NC) | L | T | P | C |
| **Course Code** | AGB N006 | 2 | 0 | 1 | 3 |

**Course Objectives:**

**This course ensures that the students understand how:**

| | |
|---|---|
| **COb1** | To Define the safety and handling of chemical substances, drying of solvents/chemicals, weighing and preparation of solutions of different strengths and their dilution and handling techniques of solutions |
| **COb2** | To Understand the preparation of solutions of acids, buffers of different strengths and pH values, use of laboratory equipment's |
| **COb3** | To Apply the experimental protocols in chemical analysis |
| **COb4** | To Analyze the experimental results from tissue culture media experiments and testing for seed viability, invitro tissue culture techniques in crop plants |
| **COb5** | To evaluate the trouble shooting of the various lab experiments while conduct of experimental results and finding. |

**Course Outcomes:**

**Towards the end of the course, the students will be able to:**

| CO | Outcome | BT Level |
|---|---|---|
| CO 1 | To Define the safety and handling of chemical substances, drying of solvents/chemicals, weighing and preparation of solutions of different strengths and their dilution and handling techniques of solutions | L1 |
| CO 2 | To Understand the preparation of solutions of acids, buffers of different strengths and pH values, use of laboratory equipment's | L2 |
| CO 3 | To Apply the experimental protocols in chemical analysis | L3 |
| CO 4 | To Analyze the experimental results from tissue culture media experiments and testing for seed viability, invitro tissue culture techniques in crop plants | L4 |
| CO 5 | To evaluate the trouble shooting of the various lab experiments while conduct of experimental results and finding. | L5 and L6 |

**Syllabus:**

| | | | |
|---|---|---|---|
| | **Unit-1** | **Safety Regulations in the Laboratory** | **Contact Hours: 3** |
| | Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. | | |
| | **Unit-2** | **Preparation of Stock solutions** | **Contact Hours:3** |
| | Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions | | |
| | **Unit-3** | **Preparation of working samples** | **Contact Hours: 2** |
| | Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values | | |
| | **Unit-4** | **Running of Equipment's for experiments** | **Contact Hours: 3** |

| | | | |
|---|---|---|---|
| | Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing | | |
| | **Unit-5** | **Experiment protocol execution** | **Contact Hours: 3** |
| | Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy | | |

| **Practical** | **Suggested list of Exercises** | |
|---|---|---|
| 1 | Safety measures while in Lab | |
| 2 | Use of various glass ware and instruments present in lab | |
| 3 | Preparation of different agro-chemical doses in field | |
| 4 | Use and handling of microscope | |
| 5 | Preparation of media | |
| 6 | Seed viability testing | |
| 7 | testing of pollen viability | |
| 8 | Tissue culture of crop plants; | |
| 9 | | |

**Text Books**


1. **T1.** Furr A. K. CRC Hand Book of Laboratory Safety. CRC Press. Florida, US.
2. Gabb M. H. & Latchem W. E. A Handbook of Laboratory Solutions. Chemical Publ. Co. Florida, US


**Assessment Scheme:**

| Component | Adopted for this Course | Duration | Weightage | Date & Time | Venue | Levels |
|---|---|---|---|---|---|---|
| Test I | ☑ | 1hr | 20 | | | Levels 1 to 2 |
| Test II | ☑ | 1hr | 20 | | | Levels 1 to 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Assignment | ☑ | | 05 | | | Levels 1 to 5 |
| Surprise Quiz | ☑ | 10 mins | 05 | | | Level 1 |
| Practical Exam | ☑ | 1hr | 20 | | | Levels 3 to 6 |
| Comprehensive Exam | ☑ | 3hr | 50 | | | Levels 3 to 5 |

**Course Outcomes – Program Outcomes (CO – PO) Mapping**

| Program Outcomes □<br><br>Course Outcomes □ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 3 |
| CO5 | 1 | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 3 |