M.Sc. (Agri.) Plant Pathology
Teaching Scheme & Curriculum
Semester 1

Subjects				Contact Hours/Week			Theory Marks		Practical/Viva Marks		Total Marks
Sr.	Name	Type	Credit	Lect	Tut	Lab	T	T	P	P	
1	Mycology	Major	3	2	-	2	50	50	-	-	100
2	Plant Virology	Major	3	2	-	2	50	50	-	-	100
3	Plant Pathogenic Prokaryotes	Major	3	2	-	2	50	50	-	-	100
4	Principles of Plant Pathology	Major	3	2	-	2	50	50	-	-	100
5	Concepts of Integrated Pest Management	Minor	2	2	-	0	50	50	-	-	100
6	Experimental Designs	Supporting	3	2	-	2	50	50	-	-	100
7	Library and Library Information Services	Non-Gradial	1	0	-	2			-	100	100
8	Basic Concepts in Laboratory Techniques	Non-Gradial	1	0	-	2			-	100	100
		Total	**19**	**12**	**-**	**14**					**800**

Lect *- Lecture,* ***Tut*** *- Tutorial,* ***Lab*** *- Lab,* ***T*** *- Theory,* ***P*** *- Practical*

Theory Passing %: *60* ***Practical Passing % :*** *60*

Prerequisite	Students should have basic knowledge of biology, microbiology, and plant sciences. Familiarity with cell structure, reproduction in microorganisms, taxonomy, and elementary concepts of plant pathology will help learners understand fungal biology, classification, life cycles, and their agricultural importance effectively.
Rationale	Mycology forms an important component of agricultural and biological sciences due to the significant role of fungi in ecosystem functioning, agriculture, industry, medicine, and plant diseases. The course provides comprehensive knowledge of fungal diversity, taxonomy, morphology, reproduction, and evolutionary relationships. It also develops an understanding of economically important fungi, plant pathogenic fungi, and modern approaches in fungal classification and molecular characterization. The course equips students with foundational and applied knowledge necessary for higher studies and research in plant pathology, microbiology, biotechnology, and agricultural sciences.
Course Title	**Mycology**
Credits	3 (2+1)
Objectives of the course	1. To introduce the fundamental concepts, terminology, history, and scope of mycology. 2. To develop understanding of the classification, morphology, reproduction, and life cycles of fungi and fungus-like organisms. 3. To study the distinguishing characteristics and economic importance of major fungal groups and plant pathogenic fungi. 4. To familiarize students with modern concepts of fungal nomenclature, culture preservation, herbarium techniques, and molecular characterization methods.
Syllabus	
Theory	**Unit I** Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Importance of culture collection and herbarium of fungi. Somatic characters and reproduction in fungi. Modern concept of nomenclature and classification, Classification of kingdom fungi: Stramenopila and Protists. **Unit II** The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota. Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota. **Unit III** Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota, Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi. **Unit IV** Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi.

Practical	➢ Detailed comparative study of different groups of fungi; ➢ Collection of cultures and live specimens; ➢ Saccardoan classification and classification based on conidiogenesis; ➢ Vegetative structures and different types of fruiting bodies produced by slime molds, stramenopiles and true fungi; ➢ Myxomycotina: Fructification, plasmodiocarp, sporangia, plasmodium and aethalia. Oomycota; ➢ Somatic and reproductory structures of Pythium, Phytophthora, downy mildews and Albugo, Zygomycetes: Sexual and asexual structures of Mucor, Rhizopus, General characters of VAM fungi. Ascomycetes; fruiting structures, Erysiphales, and Eurotiales; ➢ General identification characters of Pyrenomycetes, Discomycetes, Loculoascomycetes and Laboulbenio-mycetes, Basidiomycetes; characters, ultrastructures and life cycle patterns in Ustilaginomycetes and Teliomycetes, Deuteromycetes; ➢ Characters of Hyphomycetes and Coelomycetes and their teliomorphic and anamorphic states, Collection, preservation, culturing and identification of plant parasitic fungi; ➢ Application of molecular approaches and techniques for identification of fungal pathogens.
Course Outcomes	**CO1:** Explain the basic concepts, terminology, historical development, nomenclature, and classification systems of fungi and fungus-like organisms. **CO2:** Describe the morphological characteristics, reproduction, andlife cycle patterns of major groups of protists, stramenopiles, and lower fungi. **CO3:** Analyze the ultrastructure, taxonomy, and economic significance of representative genera belonging to Ascomycota and Basidiomycota. **CO4:** Evaluate the variability, host specificity, pathogenic significance, and molecular characterization of agriculturally important fungi including rusts, smuts, and mitosporic fungi.
Suggested Readings	1. Ainsworth GC, Sparrow FK and Susman HS. 1973. The Fungi – An Advanced Treatise. Vol. IV (A & B). Academic Press, New York. 2. Alexopoulos CJ, Mims CW and Blackwell M.2000. Introductory Mycology. 5th Ed. John Wiley & Sons, New York. 3. Maheshwari R. 2016. Fungi: Experimental Methods in Biology 2nd edn. CRC Press, US. 4. Mehrotra RS and Arneja KR. 1990. An Introductory Mycology. Wiley Eastern, New Delhi. 5. Sarbhoy AK. 2000. Text book of Mycology. ICAR, New Delhi. 6. Singh RS. 1982. Plant Pathogens – The Fungi. Oxford & IBH, New Delhi. 7. Webster J. 1980. Introduction to Fungi. 2nd Ed. Cambridge Univ. Press, Cambridge, New York.Nakasome HY and Paull RE. 1998. *Tropical Fruits*. CAB International.

Prerequisite	Students should possess basic knowledge of microbiology, genetics, molecular biology, and plant pathology. Understanding of cell structure, nucleic acids, host-pathogen interactions, and fundamentals of plant diseases will help learners comprehend the biology, transmission, diagnosis, and management of plant viruses.
Rationale	Plant viruses are major constraints to agricultural productivity and food security worldwide. The study of plant virology provides essential knowledge regarding virus structure, classification, replication, host interactions, transmission mechanisms, diagnosis, epidemiology, and disease management. This course enables students to understand modern diagnostic and resistance strategies, including molecular and biotechnological approaches used in plant virus detection and control. The course also develops scientific understanding and practical competency required for advanced studies, research, and applications in plant pathology, biotechnology, and crop protection.
Course Title	**Plant Virology**
Credits	3 (2+1)
Objectives of the course	1. To introduce the history, economic importance, classification, morphology, and structural organization of plant viruses and related infectious agents. 2. To develop understanding of viral genome organization, replication, transmission, and host-virus interactions in plants. 3. To familiarize students with modern diagnostic techniques and resistance mechanisms used in plant virus detection and management. 4. To study the epidemiology, ecology, and integrated management strategies of diseases caused by plant viruses.
Syllabus	
Theory	**Unit I** History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and baculo viruses, satellite viruses, satellite RNAs, phages, viroids and prions. Origin and evolution of viruses and their nomenclature and classification . **Unit II** Genome organization, replication in selected groups of plant viruses and their movement in host. Response of the host to virus infection: biochemical, physiological, and symptomatical changes. Transmission of viruses and virus-vector relationship. Isolation and purification of viruses. **Unit III** Detection and identification of plant viruses by using protein and nucleic acid based diagnostic techniques. Natural (R-genes) and engineering resistance to plant viruses. **Unit IV** Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses.
Practical	➢ Study of symptoms caused by plant viruses (followed by field visit); ➢ Isolation and biological purification of plant virus cultures; ➢ Bioassay of virus cultures on indicator plants and host differentials; ➢ Transmission of plant viruses (Mechanical, graft and vector and study of disease development);

	➢ Plant virus purification (clarification, concentration, centrifugation, high resolution separation and analysis of virions), Electron microscopy for studying viral particle morphology; ➢ Antisera production, Detection and diagnosis of plant viruses with serological (ELISA), nucleic acid (Non-PCR–LAMP, Later flow micro array and PCR based techniques); ➢ Exposure to basic bio-informatic tools for viral genome analysis and their utilization in developing detection protocols and population studies (BLASTn tool, Primer designing software, Bioedit tool, Claustal X/W, MEGA Software).
Course Outcomes	**CO1:** Explain the history, economic significance, morphology, classification, and nomenclature of plant viruses and related infectious agents. **CO2:** Describe the genome organization, replication, transmission mechanisms, and host responses associated with plant virus infection. **CO3:** Analyze diagnostic techniques and resistance strategies employed for detection and management of plant viruses. **CO4:** Evaluate the epidemiology, ecology, spread, and integrated management practices of plant virus diseases under field conditions.
Suggested Readings	1. Bos L. 1964. Symptoms of Virus Diseases in Plants. Oxford & IBH., New Delhi. 2. Brunt AA, Krabtree K, Dallwitz MJ, Gibbs AJ and Watson L. 1995. Virus of Plants: Descriptions and Lists from VIDE Database. CABI, Wallington. 3. Gibbs A and Harrison B. 1976. Plant Virology – The Principles. Edward Arnold, London. 4. Hull R. 2002. Mathew's Plant Virology. 4th Ed. Academic Press, New York. 5. Noordam D. 1973. Identification of Plant Viruses, Methods and Experiments. Oxford & IBH, New Delhi. 6. Wilson C. 2014. Applied Plant Virology. CABI Publishing England. 7. Webster A and Looney N. Cherries: Crop Physiology, Production and Uses. CABI. 8. Westwood MN. 2009. Temperate Zone Pomology: Physiology and Culture. Timber Press, USA

Prerequisite	Students should possess foundational knowledge of microbiology, cell biology, genetics, and plant pathology. Basic understanding of microbial structure, metabolism, and host–pathogen interactions will facilitate comprehension of phytopathogenic prokaryotes and their role in plant diseases.
Rationale	Phytopathogenic prokaryotes constitute an important group of plant pathogens responsible for significant agricultural losses worldwide. Understanding the biology, taxonomy, variability, pathogenicity, and management of these microorganisms is essential for effective disease diagnosis and sustainable crop protection. This course provides comprehensive knowledge of bacterial structure, physiology, genetics, and mechanisms of disease development, along with modern approaches in classification and disease management. The course also strengthens learners' understanding of molecular and applied aspects of plant bacteriology relevant to agricultural research, diagnostics, and disease management programs.
Course Title	**Plant Pathogenic Prokaryotes**
Credits	3 (2+1)
Objectives of the course	1. To provide fundamental knowledge of the structure, organization, and evolution of phytopathogenic prokaryotes. 2. To develop understanding of growth, nutrition, pathogenicity, survival, and dispersal mechanisms of plant pathogenic prokaryotes. 3. To familiarize students with taxonomy, nomenclature, biochemical, and molecular characterization of phytopathogenic bacteria and related organisms. 4. To impart knowledge of genetic variability, bacteriophages, plasmids, and management strategies for diseases caused by phytopathogenic prokaryotes.
Syllabus	
Theory	**Unit I** Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and gram positive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccaride structure; Membrane transport; fimbrae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (S-layer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas. **Unit II** Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of phytopathogenic prokaryotes. **Unit III** Taxonomy of phytopathogenic prokarya: Taxonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes. **Unit IV** Variability among phytopathogenic prokarya: general mechanism of

	variability (mutation); specialized mechanisms of variability (sexual like process in bacteria conjugation; transformation; transduction); and horizontal gene transfer. **Unit V** Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infection of host cells; phage multiplication cycle; Classification of phages, Use of phages in plant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes.Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes.
Practical	➢ Study of symptoms produced by phytopathogenic prokaryotes; ➢ Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria; ➢ Stains and staining methods; ➢ Biochemical and serological characterization; ➢ Isolation of genomic DNA plasmid; ➢ Use of antibacterial chemicals/ antibiotics; ➢ Isolation of fluorescent Pseudomonas; ➢ Preservation of bacterial cultures; ➢ Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences; ➢ Diagnosis and management of important diseases caused by bacteria and mollicutes.
Course Outcomes	**CO1:** Explain the structure, organization, evolution, and functional components of phytopathogenic prokaryotic cells. **CO2:** Describe the growth requirements, infection mechanisms, virulence factors, and survival strategies of phytopathogenic prokaryotes. **CO3:** Classify and differentiate phytopathogenic bacteria, phytoplasmas, and spiroplasmas using taxonomic, biochemical, and molecular approaches. **CO4:** Analyze mechanisms of genetic variability, bacteriophage interactions, plasmid functions, and apply suitable management strategies for diseases caused by phytopathogenic prokaryotes.
Suggested Readings	1. Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York. 2. Jayaraman J and Verma JP. 2002. Fundamentals of Plant Bacteriology. Kalyani Publishers, Ludhiana. 3. Mount MS and Lacy GH. 1982. Phytopathogenic Prokaryotes. Vols. I, II Academic Press, New York. 4. Salle AJ. 1979. Fundamental Principles of Bacteriology 7th edn. 5. Verma JP, Varma A and Kumar D. (Eds). 1995. Detection of Plant Pathogens and their Management. Angkor Publ., New Delhi.

Prerequisite	Students should have foundational knowledge of basic biology, microbiology, genetics, and plant sciences. Familiarity with cell biology, biochemistry, and introductory concepts of plant physiology will support understanding of plant-pathogen interactions and disease resistance mechanisms.
Rationale	This course provides fundamental and advanced knowledge of plant pathology with emphasis on the nature, development, and management of plant diseases. It introduces students to the biology of plant pathogens, host-pathogen interactions, and molecular mechanisms governing disease resistance. The course is designed to develop analytical and applied understanding of disease development and resistance breeding, thereby supporting sustainable crop protection and modern agricultural practices in alignment with contemporary advances in plant health management and biotechnology.
Course Title	**Principles of Plant Pathology**
Credits	3 (2+1)
Objectives of the course	1. To impart fundamental knowledge regarding concepts, causes, and historical development of plant pathology. 2. To explain the biology, survival, dispersal, and environmental relationships of major plant pathogens. 3. To develop understanding of host-pathogen interactions, disease development processes, and plant defense mechanisms. 4. To acquaint students with genetic and molecular approaches for developing disease-resistant crop varieties.
Syllabus	
Theory	**Unit I** Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. **Unit II** Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. **Unit III** Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. **Unit IV** Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.
Practical	➢ Basic plant pathological techniques; ➢ Isolation, inoculation and purification of plant pathogens and proving Koch's postulates; ➢ Techniques to study variability in different plant pathogens; ➢ Purification of enzymes, toxins and their bioassay; ➢ Estimation of growth regulators, phenols, phytoalexins in resistant and susceptible plants.
Course Outcomes	**CO1:** Explain the basic concepts, importance, history, and causal factors associated with plant diseases. **CO2:** Describe the growth, reproduction, survival, dispersal, and environmental relationships influencing plant pathogens and disease

	development. **CO3:** Analyze host-pathogen interactions, mechanisms of infection, disease development, and plant defense responses at physiological and biochemical levels. **CO4:** Evaluate genetic and molecular approaches involved in disease resistance, including resistance genes, marker-assisted selection, and genetic engineering strategies.
Suggested Readings	1. Agrios GN. 2005. Plant Pathology. 5th Ed. Academic Press, New York. 2. Heitefuss R and Williams PH. 1976. Physiological Plant Pathology. Springer Verlag, Berlin, New York. 3. Mehrotra RS and Aggarwal A. 2003. Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi. 4. Singh RP. 2012. Plant Pathology 2nd edn. Kalyani Publishers, New Delhi. 5. Singh RS. 2017. Introduction to Principles of Plant Pathology. 5th edn. MedTech, New Delhi. 6. Singh DP and Singh A. 2007. Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi. 7. Upadhyay RK. and Mukherjee KG. 1997. Toxins in Plant Disease Development and Evolving Biotechnology. Oxford & IBH, New Delhi.

Prerequisite	Student should know the basic concepts of insect biology, ecology, and pest identification before studying Integrated Pest Management (IPM). Basic understanding of crop production, agro-ecosystems, and the role of natural enemies in pest regulation is required. Knowledge of different pest control methods such as cultural, biological, and chemical control is essential. Understanding of environmental and economic aspects of pest management is important for sustainable agriculture.
Rationale	Integrated Pest Management (IPM) is an important approach that focuses on sustainable and eco-friendly pest control strategies. It reduces excessive dependence on chemical pesticides and promotes the use of biological and cultural methods. The subject helps in maintaining ecological balance while ensuring effective pest management. It also supports safe food production and minimizes environmental and health hazards.
Course Title	**Concepts of Integrated Pest Management**
Credits	2 (2+0)
Objectives of the course	1. To understand the principles and concepts of Integrated Pest Management (IPM). 2. To identify major pests and their natural enemies in different agro-ecosystems. 3. To apply cultural, biological, and chemical methods for effective pest management. 4. To evaluate sustainable and eco-friendly pest control strategies for crop protection.
Syllabus	

Theory	**Unit I** History, origin, definition and evolution of various terminologies. Importance of resistance, principles, classification, components, types and mechanisms of resistance. National and international level crop protection organizations; insecticide regulatory bodies; synthetic insecticide, bio-pesticide and pheromone registration procedures; label claim of pesticides – the pros and cons. **Unit II** Concept and philosophy, ecological principles, economic threshold concept and economic consideration. Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects. **Unit III** Tools of pest management and their integration- legislative, quarantine regulations, cultural, physical and mechanical methods; semiochemicals, biotechnological and bio-rational approaches in IPM. Pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost- benefit ratios and partial budgeting; case studies of successful IPM programmes. ITK-s in IPM, area-wide IPM and IPM for organic farming; components of ecological engineering with successful examples. **Unit IV** Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessment direct losses, indirect losses, potential losses, avoidable losses, unavoidable losses; global and Indian scenario of crop losses. Computation of EIL and ETL; crop modeling; designing and implementing IPM system. Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; gene transfer, successful examples of resistant crop varieties in India and world.
Practical	-
Course Outcomes	**CO1:** Explain the principles and components of Integrated Pest Management (IPM) in crop protection. **CO2**: Identify major pests and beneficial organisms in different agro-ecosystems. **CO3**: Apply suitable IPM strategies using cultural, biological, and chemical methods. **CO4**: Assess the effectiveness of eco-friendly pest management practices for sustainable agriculture.
Suggested Readings	1. Dhaliwal GS and Arora R. 2003. *Integrated Pest Management – Concepts and Approaches.* Kalyani Publishers, New Delhi. 2. Horowitz AR and Ishaaya I. 2004. *Insect Pest Management: Field and Protected Crops*. Springer, New Delhi. 3. Ignacimuthu SS and Jayaraj S. 2007. *Biotechnology and Insect Pest Management*. Elite Publ., New Delhi. 4. Norris RF, Caswell-Chen EP and Kogan M. 2002. *Concepts in Integrated Pest Management.* Prentice Hall, New Delhi. *5.* Pedigo RL. 2002. *Entomology and Pest Management.* 4th Ed. Prentice Hall, New Delhi. *6.* Subramanyam B and Hagstrum DW. 1995. *Integrated Management of*

	Insects in Stored Products. Marcel Dekker, New York.

Prerequisite	Students should have basic knowledge of statistics, data analysis, and elementary mathematical concepts at the undergraduate level.
Rationale	Experimental design is a fundamental component of scientific research in agricultural and allied sciences. Proper planning, layout, and statistical analysis of experiments improve precision, reduce experimental error, and ensure reliable interpretation of research findings. This course provides essential knowledge of experimental designs and analysis techniques widely used in agricultural research.
Course Title	**Experimental Designs**
Credits	3(2+1)
Objectives of the course	1. To impart knowledge on the principles and importance of experimental design in scientific research. 2. To explain different experimental designs and their statistical analysis procedures. 3. To develop understanding of factorial experiments, confounding, covariance analysis, and incomplete block designs. 4. To provide practical exposure in layout planning, analysis, and interpretation of experimental data.
Syllabus	
Theory	**Unit I** Need for designing experiments; characteristics of a good design; basic principles of experimental design – randomization, replication and local control. **Unit II** Uniformity trials; size and shape of plots and blocks; analysis of variance; Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD). **Unit III** Factorial experiments (symmetrical as well as asymmetrical); orthogonality and partitioning of degrees of freedom; concept of confounding. **Unit IV** Split plot and strip plot designs; analysis of covariance and missing plot techniques in randomized block and Latin square designs; transformations; Balanced Incomplete Block Design (BIBD), resolvable designs and their applications; lattice design and alpha design – concepts, randomization procedures, analysis and interpretation of results; response surface methodology; combined analysis.
Practical	➢ Analysis of uniformity trial data ➢ Formation of plots and blocks ➢ Fairfield Smith Law ➢ Analysis of data obtained from CRD, RBD and LSD ➢ Analysis of factorial experiments ➢ Analysis with missing data ➢ Analysis of split plot and strip plot designs
Course Outcomes	**CO1**: Explain the need, principles, and characteristics of experimental designs used in agricultural and applied science research.

	CO2: Apply appropriate experimental designs such as CRD, RBD, LSD, factorial, split plot, and strip plot designs for research experiments. **CO3**: Analyze experimental data using ANOVA, covariance analysis, confounding techniques, and incomplete block designs. **CO4**: Interpret experimental results and perform practical data analysis for scientific research and decision-making.
Suggested Readings	1. Experimental Designs. 1957. 2nd Ed. John Wiley. 2. Design and Analysis of Experiments. 1999. Springer. 3. Design and Analysis of Experiments. 2012. 8th Ed. John Wiley. 4. Experimental Designs. 1985. MacMillan. 5. Design and Analysis of Experiments. 1953. Oliver & Boyd. 6. Handbook on Analysis of Agricultural Experiments. 1979. IASRI Publications. 7. The Agricultural Field Experiment. 1983. John Wiley. 8. ICAR Directorate of Research Services

Prerequisite	Students should possess basic knowledge of academic communication, information resources, and computer applications. Familiarity with internet usage and elementary research methodology will facilitate effective understanding of library systems and information retrieval techniques.
Rationale	The course is designed to acquaint students with modern library systems, information sources, and digital resource management essential for higher education and research. It enables learners to develop competencies in literature search, referencing, citation practices, and utilization of electronic information resources. The course also promotes information literacy skills necessary for academic writing, research documentation, and efficient access to scientific knowledge in the digital era.
Course Title	**Library and Information Services**
Credits	1(0+1)
Objectives of the course	1. To familiarize students with the structure, functions, and services of libraries in education and research. 2. To develop understanding of various information sources, indexing, and abstracting services used in scientific research. 3. To enhance skills in literature survey, citation techniques, bibliography preparation, and information retrieval. 4. To enable students to effectively use digital library resources, online databases, internet tools, and e-resources for academic purposes.
Syllabus	
Theory	-
Practical	Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science

	Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; resources access methods.
Course Outcomes	**CO1:** Explain the role, functions, and organization of libraries and classify different sources of scientific information. **CO2:** Describe abstracting, indexing, and citation services and interpret their significance in academic and research activities. **CO3:** Apply literature survey methods, reference management techniques, and bibliography preparation in scholarly work. **CO4:** Demonstrate the use of digital library tools, online databases, internet search engines, and e-resource access methods for efficient information retrieval.
Suggested Readings	-

Prerequisite	Students should possess basic knowledge of laboratory practices, elementary chemistry, biology, and plant sciences acquired at the undergraduate foundation level. Familiarity with common laboratory instruments, solution preparation, and safety protocols will facilitate effective understanding of practical laboratory operations and experimental techniques.
Rationale	This course is designed to develop essential laboratory competencies and technical skills required in agricultural and biological sciences. It provides hands-on training in laboratory safety, handling of chemicals and instruments, preparation of solutions and media, sterilization techniques, and basic biotechnological procedures. The course enhances students' practical proficiency, accuracy in experimentation, and scientific handling of laboratory resources necessary for research and field applications.
Course Title	**Basic Concepts in Laboratory Techniques**
Credits	1(0+1)
Objectives of the course	1. To familiarize students with laboratory safety procedures and proper handling of chemicals, glassware, and scientific instruments. 2. To develop practical skills in preparation of solutions, buffers, media, and agro-chemical formulations for laboratory and field applications. 3. To impart knowledge and hands-on training in sterilization techniques, viability testing, and tissue culture methods in crop plants. 4. To enable students to apply standard laboratory methodologies and botanical terminology in scientific experimentation and plant description.
Syllabus	
Theory	-
Practical	➢ 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; ➢ Weighing and preparation of solutions of different strengths and their dilution; ➢ Handling techniques of solutions; ➢ 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; ➢ Use and handling of microscope, laminar flow, vacuum pumps, viscometer, ➢ thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; ➢ Electric wiring and earthing; ➢ 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.
Course Outcomes	**CO1:** Explain laboratory safety measures, chemical handling procedures, and the operational principles of common laboratory instruments and equipment. **CO2:** Demonstrate the preparation, dilution, neutralization, and handling of chemical solutions, buffers, acids, and agro-chemical doses using standard laboratory techniques. **CO3:** Apply sterilization methods, media preparation techniques, seed and pollen viability testing, and tissue culture practices in laboratory experiments. **CO4:** Analyze and interpret botanical characteristics of flowering plants using standard taxonomic terminology and scientific laboratory practices.
Suggested Readings	1. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press. Common Academic Regulations for PG and Ph.D. Programmes Restructured and Revised Syllabi of Post-graduate Programmes Vol. 2 2. Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.