## Department of Plant Pathology

### Name of the Programme M.Sc. (Ag) Plant Pathology

### Courses Offered

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Title of Course</th>
<th>Credit</th>
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<td>PL. PATH 501</td>
<td>Mycology</td>
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Name of the Programme M.Sc. (Ag) Plant Pathology

Minimum credit requirement

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Minimum credit requirements for different degree programmer

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Courses offer in Master Degree programme

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## Semester wise course distribution

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PL PATH 501 Mycology 2+1

Objective
To study the nomenclature, classification and characters of fungi.

Theory
UNIT I
Introduction, definition of different terms, basic concepts.

UNIT II
Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology.

UNIT III
Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi.

UNIT IV
The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

Practical
- Detailed comparative study of different groups of fungi.

Suggested Readings
<table>
<thead>
<tr>
<th>PL PATH 502</th>
<th>Plant Virology</th>
<th>2+1</th>
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**Objective**
To acquaint with the structure, virus-vector relationship, biology and management of plant viruses.

**Theory**

**UNIT I**
History of plant viruses, composition and structure of viruses.

**UNIT II**
Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction, virus vector relationship.

**UNIT III**
Virus nomenclature and classification, genome organization, replication and movement of viruses.

**UNIT IV**
Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics.

**UNIT V**
Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron-microscope and ultra-microtome.

**UNIT VI**
Origin and evolution, mechanism of resistance, genetic engineering, ecology, and management of plant viruses.

**Practical**
- Study of symptoms caused by viruses, transmission, assay of viruses
- Physical properties, purification, method of raising antisera, serological tests, electron microscopy and ultratomy, PCR.

**Suggested Readings**

PL PATH 503  Plant Bacteriology  2+1

Objective  
To acquaint with plant pathogenic prokaryote (procarya) and their structure, nutritional requirements, survival and dissemination.

Theory

UNIT I  
History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya. Importance of phytopathogenic bacteria.

UNIT II  
Evolution, classification and nomenclature of phytopathogenic procarya and important diseases caused by them.

UNIT III  
Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya.

UNIT IV  
General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios.

UNIT V  
Procaryotic inhibitors and their mode of action against phytopathogenic bacteria.

UNIT VI  
Survival and dissemination of phytopathogenic bacteria.

Practical

- Isolation, purification, identification and host inoculation of phytopathogenic bacteria, staining methods
- Biochemical and serological characterization, isolation of plasmid and use of antibacterial chemicals/antibiotics.

Suggested Readings

PL PATH 504  Principles of Plant Pathology  3+0

Objective  To introduce the subject of Plant Pathology, its concepts and principles.

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.

UNIT V  Disease management strategies.

Suggested Readings


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**Objective**

To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.

**Practical**

**UNIT I**

Methods to prove Koch’s postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens.

**UNIT II**

Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

**UNIT III**

Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

**Suggested Readings**

PL PATH 510  Seed Health Technology  2+1

Objective  To acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts/loses and management.

Theory

UNIT I  History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds.

UNIT II  Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens.

UNIT III  Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

UNIT IV  Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism.

Practical

- Conventional and advanced techniques in the detection and identification of seed-borne fungi, bacteria and viruses.
- Relationship between seed-borne infection and expression of the disease in the field.

Suggested Readings

PL PATH 511  Chemicals in Plant Disease Management  2+1

Objective  To impart knowledge on the concepts, principles and judicious use of chemicals in plant disease management.

Theory

UNIT I  History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals.

UNIT II  Classification of chemicals used in plant disease control and their characteristics.

UNIT III  Chemicals in plant disease control, viz., fungicides, bactericides, nematicides, antiviral chemicals and botanicals.

UNIT IV  Formulations, mode of action and application of different fungicides; chemotherapy and phytotoxicity of fungicides.

UNIT V  Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides.

UNIT VI  General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management.

Practical

- Acquaintance with formulation of different fungicides and plant protection appliances.
- Formulation of fungicides, bactericides and nematicides.
- *In vitro* evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides based on active ingredients against pathogens
- Persistence, compatibility with other agrochemicals; detection of naturally occurring fungicide resistant mutants of pathogen
- Methods of application of chemicals.

Suggested Readings

PL PATH 516 Integrated Disease Management 2+1

Objective
To emphasize the importance and need of IDM in the management of diseases of important crops.

Theory
UNIT I
Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications.

UNIT II
Development of IDM- basic principles, biological, chemical and cultural disease management.

UNIT III
IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed mustard, pearlmillet, kharif pulses, vegetable crops and fruit crops.

Practical
Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM; demonstration of IDM in certain crops as project work.

Suggested Readings
ENT 507 | Biological Control of Crop Pests and Weeds | 1+1

**Objective**
To train the students with theory and practice of biological control, mass production techniques and field evaluation of various biological control agents like parasitoids, predators and various entomopathogenic microorganisms.

**Theory**

**UNIT I**
History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control - importation, augmentation and conservation.

**UNIT II**
Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects.

**UNIT III**
Mass production of quality biocontrol agents - techniques, formulations, economics, field release/application and evaluation.

**UNIT IV**
Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies - Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

**Practical**
- Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers.
- Visits (only where logistically feasible) to bio-control laboratories to learn rearing and mass production of egg, egg-larval, larval, larval-pupal and pupal parasitoids, common predators, microbes and their laboratory hosts, phytophagous natural enemies of weeds.
- Field collection of parasitoids and predators.
- Hands-on training in culturing, identification of common insect pathogens.
- Quality control and registration standards for biocontrol agents.

**Suggested Readings**

Minor course

ENT 508  Toxicology of Insecticides  2+1

Objective
To orient the students with structure and mode of action of important insecticides belonging to different groups, development of resistance to insecticides by insects, environmental pollution caused by toxic insecticides and their toxicological aspects.

Theory

UNIT I  Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.

UNIT II  Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrazoles, insect growth regulators, microbials, botanicals, new promising compounds, etc.

UNIT III  Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides—synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.

UNIT IV  Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.

UNIT V  Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

Practical
- Insecticide formulations and mixtures.
- Quality control of pesticide formulations; laboratory and field evaluation of bioefficacy of insecticides.
- Bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action.
- Toxicity to beneficial insects.
- Pesticide appliances. Working out doses and concentrations of pesticides.
- Visit to toxicology laboratories. Good laboratory practices.

Suggested Readings

Minor course

ENT 510  Principles of Integrated Pest Management  1+1

Objective
To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Train students in computation of ETL, implementing IPM programmes.

Theory

UNIT I
History and origin, definition and evolution of various related terminologies.

UNIT II
Concept and philosophy, ecological principles, economic threshold concept, and economic consideration.

UNIT III
Tools of pest management and their integration- legislative, cultural, physical and mechanical methods; 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.

Practical

- 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.
- Computation of EIL and ETL; crop modeling.
- Designing and implementing IPM system.

Suggested Readings

Minor course

ENT 511  Pests of Field Crops  1+1

Objective
To familiarize the students about nature of damage and seasonal incidence of insect pests that cause loss to major field crops and their effective management by different methods.

Theory
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors.

UNIT I
Insect pests of cereals and millets and their management. Polyphagous pests grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.).

UNIT II
Insect pests of pulses, tobacco, oilseeds and their management.

UNIT III
Insect pests of fibre crops, forages, sugarcane and their management.

Practical
- Field visits, collection and identification of important pests and their natural enemies.
- Detection and estimation of infestation and losses in different crops.
- Study of life history of important insect pests.

Suggested Readings

Nair MRGK. 1986. Insect and Mites of Crops in India. ICAR, New Delhi.
STAT 511  Statistical Methods for Applied Sciences  3+1

Objective
The student is exposed statistical methods and statistical inference to help them in understanding the concepts involved in data presentation, analysis and interpretation.

Theory

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

UNIT II
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 III

UNIT IV

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

Practical
• Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Nonparametric tests.

Suggested Readings
Electronic Statistics Text Book
Supporting course

STAT 512  Experimental Designs  2+1

Objective
The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I  Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

UNIT II  Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT III  Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV  Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V  Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

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.

Suggested Readings

Design Resources Server www.iasri.res.in/design.
### Non-Credit Compulsory Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Theory</th>
<th>Practical</th>
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</thead>
<tbody>
<tr>
<td>PGS 501</td>
<td>Library and Information Services</td>
<td>1(0+1)</td>
<td>1(0+1)</td>
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<tr>
<td><strong>Objective</strong></td>
<td>To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.</td>
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<tr>
<td><strong>Practical</strong></td>
<td>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; ere sources access methods.</td>
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<tr>
<td>PGS 504</td>
<td>Basic Concepts in Laboratory Techniques</td>
<td>1(0+1)</td>
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<tr>
<td><strong>Objective</strong></td>
<td>To acquaint the students about the basics of commonly used techniques in laboratory.</td>
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<tr>
<td><strong>Practical</strong></td>
<td>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; Neutralization 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, sand bath, water bath, oil bath; 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</td>
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</table>

**Suggested Readings**


| PGS 505     | Agriculture Research, Research Ethics and Rural Development Program's | 1(1+0) |           |
| **Objective** | To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government. |
| **Theory** | 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 II  
Research ethics research integrity, research safety in laboratories, welfare of animals used in 
research, computer ethics, standards and problems in research ethics.

UNIT III  
Concept and connotations of rural development, rural development policies and strategies. Rural 
development programmes Community Development Programme, Intensive Agricultural District 
Programme, Special group – Area Specific Programme, Integrated Rural Development 
Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-
Governmental Organisations. Critical evaluation of rural development policies and programmes. 
Constraints in implementation of rural policies and programmes.

Suggested Readings

Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.  

PGS 506  
Disaster Management 1(1+0)

Objective  
To introduce learners to the key concepts and practices of natural disaster management; to equip 
them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I  
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 II  
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 III  
Disaster Management- Efforts to mitigate natural disasters at national and global levels. 
International Strategy for Disaster reduction. Concept of disaster management, national disaster 
management framework; financial arrangements; 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.

Suggested Readings


PGS 502  
Technical Writing and Communications Skills 1(0+1)

Objective  
To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the 
students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

- Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, 
etc; Various parts of thesis and research communications (title page, authorship contents page, preface, 
introduction, review of literature, material and methods, experimental results and discussion); Writing of 
abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research 
communications; illustrations, photographs and drawings with suitable captions; pagination, numbering 
of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-
reading; Writing of a review article.
• **Communication Skills** - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern Weak forms in connected speech Participation in group discussion Facing an interview; presentation of scientific papers.

**Suggested Readings**


**PGS 503 Intellectual Property and Its management in Agriculture 1(1+0)**

**Objective**

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

**Theory**

- Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; 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; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

**Suggested Readings**

### Name of the Programme M.Sc. (Ag) Plant Pathology

### Semester wise course distribution

<table>
<thead>
<tr>
<th>Course</th>
<th>Course Title</th>
<th>Code</th>
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<tbody>
<tr>
<td><strong>Semester I</strong></td>
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<tr>
<td><strong>Major</strong></td>
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<tr>
<td>Mycology</td>
<td></td>
<td>PL. PATH 501</td>
<td>3 (2+1)</td>
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<tr>
<td>Plant Virology</td>
<td></td>
<td>PL. PATH 502</td>
<td>3 (2+1)</td>
</tr>
<tr>
<td>Principles of Plant Pathology</td>
<td></td>
<td>PL. PATH 504</td>
<td>3 (3+0)</td>
</tr>
<tr>
<td>Chemicals in Plant Disease Management</td>
<td></td>
<td>PL. PATH 511</td>
<td>3 (2+1)</td>
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<tr>
<td><strong>Minor</strong></td>
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<tr>
<td>Principles of Integrated Pest Management</td>
<td></td>
<td>ENT 510</td>
<td>2 (1+1)</td>
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<tr>
<td><strong>Supporting</strong></td>
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<tr>
<td>Statistical Methods for Applied Sciences</td>
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<td>STAT 511</td>
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<tr>
<td>Intellectual Property Rights and its management in agriculture</td>
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<td>PGS 503</td>
<td>1 (1+0)</td>
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<tr>
<td>Basic concepts in Laboratory Techniques</td>
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<tr>
<td>Human Value and Professional Ethics</td>
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<tr>
<td><strong>Semester II</strong></td>
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<td><strong>Major</strong></td>
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<tr>
<td>Plant Bacteriology</td>
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<td>PL. PATH 503</td>
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<tr>
<td>Detection and Diagnosis of Plant Diseases</td>
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<td>PL. PATH 505</td>
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<td>Seed Health Technology</td>
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<td>PL. PATH 510</td>
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<tr>
<td>Integrated Disease Management</td>
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<td>PL. PATH 516</td>
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<tr>
<td>Toxicology of Insecticides</td>
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<td>ENT 508</td>
<td>3 (2+1)</td>
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<tr>
<td>Pests of Field Crops</td>
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<td>ENT 511</td>
<td>2 (1+1)</td>
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<tr>
<td>Biological Control of Crop Pests and Weeds</td>
<td></td>
<td>ENT 507</td>
<td>2 (1+1)</td>
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<tr>
<td><strong>Supporting</strong></td>
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<tr>
<td>Experimental Designs</td>
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<td>STAT 512</td>
<td>3 (2+1)</td>
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<tr>
<td>Technical Writing and Communication Skill</td>
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<td>PGS 502</td>
<td>1 (1+0)</td>
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<tr>
<td>Agricultural Research Ethics and Rural Development Programme</td>
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<td>PGS 505</td>
<td>1 (1+0)</td>
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<tr>
<td>Disaster Management</td>
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<td>PGS 506</td>
<td>1 (1+0)</td>
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<tr>
<td><strong>Semester III</strong></td>
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<tr>
<td>Written Comprehensive Examination</td>
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<tr>
<td>Masters Seminar</td>
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<td>PL. PATH 591</td>
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<tr>
<td>Masters Research</td>
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<td>PL. PATH 599</td>
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<tr>
<td><strong>Semester VI</strong></td>
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<tr>
<td>Masters Research</td>
<td></td>
<td>PL. PATH 599</td>
<td>10 (0+10)</td>
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</table>
PL PATH 501 Mycology 2+1

Objective
To study the nomenclature, classification and characters of fungi.

Theory
UNIT I
Introduction, definition of different terms, basic concepts.

UNIT II
Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology.

UNIT III
Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi.

UNIT IV
The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

Practical
- Detailed comparative study of different groups of fungi.

Suggested Readings
PL PATH 502  Plant Virology  2+1

Objective  To acquaint with the structure, virus-vector relationship, biology and management of plant viruses.

Theory

UNIT I  History of plant viruses, composition and structure of viruses.

UNIT II  Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction, virus vector relationship.

UNIT III  Virus nomenclature and classification, genome organization, replication and movement of viruses.

UNIT IV  Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics.

UNIT V  Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron-microscope and ultra-microtome.

UNIT VI  Origin and evolution, mechanism of resistance, genetic engineering, ecology, and management of plant viruses.

Practical

- Study of symptoms caused by viruses, transmission, assay of viruses
- Physical properties, purification, method of raising antisera, serological tests, electron microscopy and ultratomy, PCR.

Suggested Readings

Objective
To acquaint with plant pathogenic prokaryote (procarya) and their structure, nutritional requirements, survival and dissemination.

Theory

UNIT I
History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya. Importance of phytopathogenic bacteria.

UNIT II
Evolution, classification and nomenclature of phytopathogenic procarya and important diseases caused by them.

UNIT III
Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya.

UNIT IV
General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios.

UNIT V
Procaryotic inhibitors and their mode of action against phytopathogenic bacteria.

UNIT VI
Survival and dissemination of phytopathogenic bacteria.

Practical
- Isolation, purification, identification and host inoculation of phytopathogenic bacteria, staining methods
- Biochemical and serological characterization, isolation of plasmid and use of antibacterial chemicals/antibiotics.

Suggested Readings
PL PATH 504  Principles of Plant Pathology  3+0

Objective
To introduce the subject of Plant Pathology, its concepts and principles.

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.

UNIT V
Disease management strategies.

Suggested Readings

PL PATH 505  Detection and Diagnosis of Plant Diseases  0+2

Objective  To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.

Practical

UNIT I  Methods to prove Koch’s postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens.

UNIT II  Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

UNIT III  Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

Suggested Readings


PL PATH 510  Seed Health Technology  2+1

Objective  To acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts/loses and management.

Theory

UNIT I  History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds.

UNIT II  Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens.

UNIT III  Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

UNIT IV  Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism.

Practical

- Conventional and advanced techniques in the detection and identification of seed-borne fungi, bacteria and viruses.
- Relationship between seed-borne infection and expression of the disease in the field.

Suggested Readings

### PL PATH 511  Chemicals in Plant Disease Management  2+1

**Objective**  
To impart knowledge on the concepts, principles and judicious use of chemicals in plant disease management.

**Theory**

**UNIT I**  
History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals.

**UNIT II**  
Classification of chemicals used in plant disease control and their characteristics.

**UNIT III**  
Chemicals in plant disease control, viz., fungicides, bactericides, nematicides, antiviral chemicals and botanicals.

**UNIT IV**  
Formulations, mode of action and application of different fungicides; chemotherapy and phytotoxicity of fungicides.

**UNIT V**  
Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides.

**UNIT VI**  
General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management.

**Practical**

- Acquaintance with formulation of different fungicides and plant protection appliances.
- Formulation of fungicides, bactericides and nematicides.
- *In vitro* evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides based on active ingredients against pathogens
- Persistence, compatibility with other agro-chemicals; detection of naturally occurring fungicide resistant mutants of pathogen
- Methods of application of chemicals.

**Suggested Readings**


Objective
To emphasize the importance and need of IDM in the management of diseases of important crops.

Theory
UNIT I
Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications.

UNIT II
Development of IDM- basic principles, biological, chemical and cultural disease management.

UNIT III
IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed mustard, pearl millet, kharif pulses, vegetable crops and fruit crops.

Practical
Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM; demonstration of IDM in certain crops as project work.

Suggested Readings


## Minor course

**ENT 507**  
**Biological Control of Crop Pests and Weeds**  
1+1

### Objective
To train the students with theory and practice of biological control, mass production techniques and field evaluation of various biological control agents like parasitoids, predators and various entomopathogenic microorganisms.

### Theory

**UNIT I**
 History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation.

**UNIT II**
 Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects.

**UNIT III**
 Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation.

**UNIT IV**
 Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

### Practical

- Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers.
- Visits (only where logistically feasible) to bio-control laboratories to learn rearing and mass production of egg, egg-larval, larval, larval-pupal and pupal parasitoids, common predators, microbes and their laboratory hosts, phytophagous natural enemies of weeds.
- Field collection of parasitoids and predators.
- Hands-on training in culturing, identification of common insect pathogens.
- Quality control and registration standards for biocontrol agents.

### Suggested Readings

ENT 508  Toxicology of Insecticides  2+1

Objective
To orient the students with structure and mode of action of important insecticides belonging to different groups, development of resistance to insecticides by insects, environmental pollution caused by toxic insecticides and their toxicological aspects.

Theory

UNIT I  Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.

UNIT II  Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds, etc.

UNIT III  Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiating and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.

UNIT IV  Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.

UNIT V  Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

Practical

- Insecticide formulations and mixtures.
- Quality control of pesticide formulations; laboratory and field evaluation of bioefficacy of insecticides.
- Bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action.
- Toxicity to beneficial insects.
- Pesticide appliances. Working out doses and concentrations of pesticides.
- Visit to toxicology laboratories. Good laboratory practices.

Suggested Readings

**Minor course**

**ENT 510**  
**Principles of Integrated Pest Management**  
**1+1**

**Objective**  
To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Train students in computation of ETL, implementing IPM programmes.

**Theory**

**UNIT I**  
History and origin, definition and evolution of various related terminologies.

**UNIT II**  
Concept and philosophy, ecological principles, economic threshold concept, and economic consideration.

**UNIT III**  
Tools of pest management and their integration - legislative, cultural, physical and mechanical methods; 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.

**Practical**

- 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.
- Computation of EIL and ETL; crop modeling.
- Designing and implementing IPM system.

**Suggested Readings**


Minor course

ENT 511 Pests of Field Crops 1+1

Objective
To familiarize the students about nature of damage and seasonal incidence of insect pests that cause loss to major field crops and their effective management by different methods.

Theory
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors.

UNIT I
Insect pests of cereals and millets and their management. Polyphagous pests grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.).

UNIT II
Insect pests of pulses, tobacco, oilseeds and their management.

UNIT III
Insect pests of fibre crops, forages, sugarcane and their management.

Practical
- Field visits, collection and identification of important pests and their natural enemies.
- Detection and estimation of infestation and losses in different crops.
- Study of life history of important insect pests.

Suggested Readings
Nair MRGK. 1986. Insect and Mites of Crops in India. ICAR, New Delhi.
Supporting course

STAT 511  Statistical Methods for Applied Sciences  3+1

Objective
The student is exposed statistical methods and statistical inference to help them in understanding the concepts involved in data presentation, analysis and interpretation.

Theory

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

UNIT II
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 III

UNIT IV

UNIT V
Introduction to multivariate analytical tools- Hotelling's $T^2$ Tests of hypothesis about the mean vector of a multinormal population. Classificatory problems and discriminant function, $D^2$-statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.

Practical
- Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Nonparametric tests.

Suggested Readings
Supporting course

STAT 512 Experimental Designs 2+1

Objective
The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I
Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

UNIT II
Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT III
Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV
Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V
Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

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.

Suggested Readings

Design Resources Server www.iasri.res.in/design.
Non-Credit Compulsory Courses

PGS 501  Library and Information Services  1(0+1)

Objective  To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

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; ere sources access methods.

PGS 504  Basic Concepts in Laboratory Techniques  1(0+1)

Objective  To acquaint the students about the basics of commonly used techniques in laboratory.

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; Neutralization 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, sand bath, water bath, oil bath; 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

Suggested Readings


PGS 505  Agriculture Research, Research Ethics and Rural Development Program's  1(1+0)

Objective  To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory  UNIT I  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 II Research ethics research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III Concept and connotations of rural development, rural development policies and strategies. Rural development programmes Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.

PGS 506 Disaster Management 1(1+0)

Objective To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I 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 II 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 III Disaster Management Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; 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.

Suggested Readings


PGS 502 Technical Writing and Communications Skills 1(0+1)

Objective To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

- Technical Writing Various forms of scientific writings theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.
- **Communication Skills** - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern Weak forms in connected speech Participation in group discussion Facing an interview; presentation of scientific papers.

**Suggested Readings**


**PGS 503 Intellectual Property and Its management in Agriculture**

**Objective**

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

**Theory**

- Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; 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; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

**Suggested Readings**

The Indian Acts - Patents Act, 1970 and amendments; 