PROGRAM OUTCOMES, PROGRAM SPECIFIC OUTCOMES, COURSE OUTCOMES
M.Sc. Ag. Entomology

Programme outcome	Entomologists commonly work with Plant Breeders, Farmers, Agronomists, Horticulturists, Pathologists etc. in the fields, farms and gardens wherever plants grow. Additionally, Entomologists engage with biological scientists and engineers to create safer living arrangements and achieve high yield and potential boost to the Indian agriculture economy.
Programme specific outcome	Expertise in the identification, life history and ecology of insect pests and predators/ parasites as well as the basic principles and strategies of their management. Aspirants of Entomology, comprises with the basic knowledge and technologies used in Apiculture, Nematology, Sericulture, Biological control Toxicology, Economic Entomology etc. Interdisciplinary research work is also being carried out, with the different departments like Plant Pathology, Biochemistry, Molecular biology, Soil science, Horticulture, Agronomy etc. The knowledge acquired and skill developed in the field of entomology, help in recognizing the applications of latest technologies in all spheres of agriculture and develop crops with improved productivity thereby increasing farmers' income, better human health and decreased environmental pollution as well as meet out the future challenges in agricultural crops and storage grains.
Course	**Course Outcomes (COs)**
M.Sc. Ag. Entomology 1st Sem.	
Major	
Insect Morphology (ENT 501)	CO 1: Concepts of insect morphology their principles, utility and relevance CO2: Description of head- origin, **s**tructure and modification; types of mouthparts and antennae. CO3: Description of Thorax- Areas and sutures. Wings: structure and modifications, wing coupling apparatus and mechanism of flight. Legs: structure and modifications. CO 4: Description of abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs.
Insect Anatomy, Physiology and Nutrition (ENT 502)	CO 1: Understand the scope and importance of insect anatomy and physiology. CO 2: Described structure, modification and physiology of different systems. CO 3: The concept of thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapause. CO4: Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents. CO 5: Extra and intra-cellular microorganisms and their role in physiology; artificial diets.

Classification of Insects (ENT 504)	CO 1: Describes brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Superclass Hexapoda CO 2: Identification of classes by distinguishing characters, general biology. CO 3: Described habits, habitats and distinguishing characteristics of insect falling in different orders and economically important families contained in them.
Biological Control of Crop Pests and Weeds (ENT 507)	CO 1: Describes history, principles and scope of biological control; important groups of parasitoids, predators and pathogens. CO 2: Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. CO 3: Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. CO 4: Biological control of weeds using insects. CO 5: Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation.
Minors	
Principles of Plant Pathology (PL PATH 504)	CO 1: Describe in detail definitions, concept, history of plant disease. Provide basic understanding about biotic and abiotic factors and causes of plant disease CO 2: Develop an understanding about growth, reproduction and role of environment in plant diseases CO 3: Enumerate and explain 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 CO4: Develop an understanding about genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. CO 5**:** Explain in detail different plant management strategies
Compulsory Non-Creditable Courses	
Library and Information Services (PGS 501)	CO 1: Explains introduction to library and its services; Role of libraries in education, research and technology transfer. CO 2: 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. CO 3: Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.
Technical Writing and Communication Skills	CO 1: Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research

(PGS 502)	communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion). CO 2: Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription. CO 3: Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.
M.Sc. Ag. Entomology, 2nd Sem.	
Major	
Insect Ecology **(ENT 505)**	CO 1: Concepts of insect morphology their principles, utility and relevance CO2: Description of head- origin, **s**tructure and modification; types of mouthparts and antennae. CO3: Description of Thorax- Areas and sutures. Wings: structure and modifications, wing coupling apparatus and mechanism of flight. Legs: structure and modifications. CO4: Description of abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs.
Toxicology of Insecticides (ENT 508)	CO 1: Describe the definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India. CO 2: Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of insect growth regulators, microbials, botanicals, new promising compounds, etc. CO 3: Describes 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. CO 4: Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence. CO5: Insecticide residues, their significance and environmental implications. CO 6: Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.
Pests of Horticultural and Plantation Crops (ENT 512)	CO 1: Description of fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, ber, fig, citrus, aonla, pineapple, apple, peach and other temperate fruits. CO 2: Description of vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, French beans, chow-chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc. CO 3: Description of plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc. CO 4: Description of ornamental, medicinal and aromatic plants and pests

	in polyhouses/protected cultivation.
Minor	
Principles of Plant Disease Management (PL PATH 506)	**CO 1:** Explain the principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control, integrated control measures of plant diseases. **CO 2:** Describe the disease resistance and molecular approach for disease management. **CO 3:** Describe the foliage, seed and soil application of chemicals, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures **CO 4:** Understanding of history of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy, nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals
Supporting course	
Experimental Designs (STAT 512)	CO 1: understand various uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs. CO 2: Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications CO 3: Lattice design, alpha design - concepts, randomisation procedure, analysis and interpretation of results. CO 4: Response surfaces. Experiments with mixtures.
Compulsory Non-Creditable Courses	
Intellectual Property and Its Management in Agriculture (PGS 503)	CO 1: Understand historical perspectives and need for the introduction of Intellectual Property Right regime; CO 2: Describes the TRIPs and various provisions in TRIPS Agreement; CO 3: Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Treaty on Plant Genetic Resources for Food and Agriculture. CO 4: Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.
Basic Concepts in Laboratory Techniques (PGS 504)	CO 1: Describes about 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. CO 2: Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agrochemical 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. CO 3: Use and handling of microscope, laminar flow, vacuum pumps, viscometer.

M.Sc. Ag. Entomology, 3rd Sem.	
Major	
Principles of Integrated Pest Management (ENT 510)	CO 1: The concept and philosophy, ecological principles, economic threshold etc are understood for consideration of economic management strategy. CO2: Describe 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. CO3: Explained about the 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.
Techniques in Plant Protection (ENT 518)	CO 1: Pest control equipments, principles, operation, maintenance, selection. CO2: Methods of pesticides and biocontrol agent's application: seed dressing, soaking, root-dip treatment, dusting, spraying, application through irrigation water. CO 3: Protein isolation from the pest and host plant and its quantification using spectrophotometer and molecular weight determination using SDS/ PAGE. CO 4: Use of computer application for predicting/ forecasting pest attack and identification.
Minor	
Integrated Disease Management (PL PATH-516)	CO 1: Describe the introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications. CO 2: Understanding the development of IDM- basic principles, biological, chemical and cultural disease management. CO 3: Understanding the IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed- mustard, pearl millet, *kharif* pulses, vegetable crops and fruit crops.
Supporting course	
Remote Sensing and Geographical Information System (SPG 503)	CO 1: Describes the use of aerial photography, satellite imagery and geographic information system for the collection, storage and spatial analysis for geo-reference. Co 2: Future prospects of remote sensing in India, software used in remote sensing, GIS versus remote sensing, Introduction to GIS software.
Compulsory Non-Creditable Courses	
Agriculture Research Ethics and Rural Development Programmes (PGS 505)	CO 1: understand history of agriculture in brief; Global agricultural research system: need, scope, opportunities. CO 2: 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 Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthens the capacities at national and regional levels. CO 3: International fellowships for scientific mobility

Disaster Management (PGS 506)	CO1: Explains about Disaster Management- Efforts to mitigate natural disasters at national and global levels. CO2: International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. CO3: Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.
M.Sc. Ag. Entomology, 4th Sem.	
Master's Research (ENT 599)	CO 1: Identification of important pest problem of essential food and forage crops. CO 2: Minimizing the impact of those pests as major research objective, with emphasis on taxonomy, integrated management, toxicology etc.