Faculty of Agricultural Sciences (IAS)
Siksha 'O' Anusandhan, Deemed to be University

M. Sc. (Ag.) in Entomology

Programme Outcome:

- Enriched knowledge on recent developments in soil and crop management with respect to improvement and productivity, water and nutrient management and their interaction with integrated approach and the disease and pest management in integrated manner. The economic indices on package of practices develop and their transfer to farmers makes the students eligible for advanced studies at doctoral level.
- With specialized knowledge in a particular discipline of agricultural sciences, the students are worth to be absorbed in different fields of academics, research and extension under different organizations.
- Agriculture being the applied science, the skills as developed in the fields of crop improvement, crop production, crop protection and social science fields makes the students an asset for taking up the assignments both at organizational and field level.
- The knowledge, skill and expertise gained during the `study of course curriculum provides an opportunity to take up entrepreneurships holistically as a joint venture.

Programme Specific Objectives:

1. To develop professionalism, innovativeness as well as entrepreneurship skills in the field of plant protection specialization to Entomology and to make the students successful in perusing higher studies in the field of Entomology.

2. To make the students very clear about the fundamental concepts about insect morphology, systematics, anatomy, physiology and ecology.

3. To promote the different innovative approaches of pest management tactics in agriculture like physical control, mechanical control, biological control as well as chemical control giving importance with the concepts of ETL, EIL , GEP and other basic concepts regarding pest management.

4. To make the students understand about the basic research ethics, concepts and methodologies helpful to farming communities.

5. To develop the student ability and make them skilled in the field of commercial entomology like beekeeping, sericulture and lac culture.

Programe Specific Outcome (PSO):

1. Develop fundamental knowledge on different theories, concepts of basic and applied entomology
2. Skills of teaching, research and extension activities in the field of plant protection specialization to entomology.
3. Capability to implement Different basic and innovative tools of pest management in crop field benefiting the farming communities and their commercial use.
4. Entrepreneurship ability in the commercial field of entomology like bee keeping, sericulture and lac culture.
5. Skill in practical aspects like pesticide formulation, calculation of dose of specific pesticide as well as skill to handle different instruments in laboratory useful in entomological research.

EN 501: Insect Morphology 2(1+1)

Objective:

To acquaint the students with external morphology of the insect's body i.e., head, thorax and abdomen, their appendages and functions.

Outcomes

- Students will able to know the fundamentals of structural organization of insect
- Students will know the basic structure of head, thorax and abdomen.
- Students will know the art of preservation of insect body parts
- Preparation of permanent mount techniques will be learnt.

EN 502: Insect Anatomy, Physiology and Nutrition 3(2+1)

Objective

To impart knowledge to the students on basic aspects of anatomy of different systems, elementary physiology, nutritional physiology and their application in entomology.

Outcome

- Students will know the scope and importance of anatomy, physiology along with the fundamental knowledge about different internal organs, their physiology and functions
- An idea will be developed on thermodynamics and its role in insect physiology
- To know about details in insect nutrition and preparation of artificial diets.
- Knowledge on dissection of isects for comparative study of anatomy, preparation of permaet mouts, chromatographic analysis of free amino acids, determination of chitin in insect cuticle; examination of insect haemocytes; determination of respiratory quotient;

EN 503: Principles of Taxonomy 2(2+0)

Objective

To sensitize the students on the theory and practice of classifying organisms and the rules governing the same.

Outcome

- Students will know the basic ideas of Identification, purpose, methods-character matrix, taxonomic keys
- Students will be awared about ICZN and different organisations associated with biological classification.

EN 504: Classification Of Insects 3(2+1)

Objective

To introduce the students to the classification of insects up to the level of families with hands-on experience in identifying the families of insects.

Outcomes

- Students will know the basic knowledge of different concepts and theories of classification of insects
- Students will know the keys of classification and able to know the techniques of identification of insects.

EN 505: Insect Ecology **2(1+1)**

Objective

To teach the students the concepts of ecology, basic principles of distribution and abundance of organisms and their causes. Study life tables, organization of communities, diversity indicies. Train students in sampling methodology, calculation of diversity indicies, constructing life tables, relating insect population fluctuations to biotic and/or abiotic causes.

Outcome

- Students will know the basic concepts and ideas of ecology
- Syudents will be trained with the sampling methods, calculation of diversity indices, constructing life tables.

EN 506: Insect Pathology **2(1+1)**

Objective

To teach the students about various microbes that are pathogenic to insects, factors that affect their virulence; provide hands-on training in identification, isolation, culturing various pathogens and assessing pathogenicity.

Outcome

- Students will be acquainted with equipment used in insect pathology laboratory
- Students will be able to know the Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens
- Students will be familiarized with the techniques of extraction of pathogens and the mass production techniques of pathogens.. Bioassays to determine median lethal doses.
- Knowledge on mass production techniques of pathogens. Safety and registration of microbial pesticides. Use of insect pathogens in integrated management of insect pests.

EN 507: Biological Control of crop pests and weeds **2(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.

Outcome:

- Students will know the importance and basic knowledge of biocontrol
- Students will be trained with mass production techniques and field evaluation of different bioagents.
- Knowledge on identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers, field collection of parasitoids and predators. Hands-on training in culturing, identification of common insect pathogens

EN 508: Toxicology of insecticides 3(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.

Outcomes

- Students will know about bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action and pesticide appliances.
- Students will know about the safe use of insecticide according to their toxicity and also sensitized about the resistance and resurgence issues.
- Students will know about the insecticide dose calculation and some basics about their application

EN 509: Plant Resistance to Insects 2(1+1)

Objective

To familiarize the students with types, basis, mechanisms and genetics of resistance in plants to insects and role of plant resistance in pest management.

Outcome

- Students will know the importance and concept of host plant resistance and the role of resistance in integrated pest management.
- Knowledge on Screening techniques for measuring resistance; measurement of plant characters and working out their correlations with plant resistance; testing of resistance in important crops; bioassay of plant extracts of susceptible/resistant varieties; demonstration of antibiosis, tolerance and antixenosis.

EN 510: `Principles of Integrated Pest Management 2(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.

Outcomes

- Knowledge on 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
- Students will know about the tools of pest management and their integration-legislative, cultural, physical and mechanical methods.
- Students will be familiarized with pest survey and surveillance, forecasting and types of surveys. crop modeling; designing and implementing IPM system.

EN 511: Pests of Field Crops 2(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.

Outcome

- Students will able identify the different harmful insect pests of different field crops and estimation of infestation and losses in different crops
- Students will know about the integrated management tools and techniques to manage the insect pests

EN 512: Pests of Horticultural And Plantation Crops 2(1+1)

Objective

To impart knowledge on major pests of horticultural and plantation crops regarding the extent and nature of loss, seasonal history, their integrated management.

Outcome

- Students will able identify the different harmful insect pests of different horticultural crops.
- Students will know about the integrated management tools and techniques to manage the insect pests

EN 513: Storage Entomology 2(1+1)

Objective

To focus on requirement and importance of grain and grain storage, to understand the role of stored grain pests and to acquaint with various stored grain pest management techniques for avoiding losses in storage.

Outcome

- Students will be familiarized with the stored grains/seed insect pests and nature of damage caused by them; detection of insect infestation in stored food grains;
- Estimation of losses in stored food grains; determination of moisture content in stored food grains; familiarization of storage structures, demonstration of preventive and curative measures

EN 514: Insect Vectors Of Plant Viruses And Other Pathogens 2(1+1)

Objective

To teach the students about the different groups of insects that vector plant pathogens, vector-plant pathogen interaction, management of vectors for controlling diseases.

Outcome

- Know and identify the particular vectors.
- Basic principles and techniques on culturing and handling of vectors

- Students will able to demonstrate the virus transmission through vectors- aphids, leafhoppers and whiteflies.

EN 515: General Acarology 2(1+1)

Objective

To aquaint the students with external morphology of different groups of mites, train in identification of commonly occurring families of plant associated mites, provide information about important mite pests of crops and their management.

Outcome

- Students will be acquianted with external morphology of different groups of mites
- Students will know about the collection and preservation and culturing of mites.
- studying different rearing techniques for mites.
- Knowledge on the management tools of different phytophagous mites which will be further useful for employability.

EN 516: Soil Arthropods And Their Management 2(1+1)

Objective

To impart knowledge about the different groups of arthropods found in soil, interaction between the different groups, and role of soil arthropods in humus formation. Hands-on training in sampling and identification of different groups of soil arthropods.

Outcome

- Students will acquainted with sampling, extraction methods and identification of various types of soil fauna; estimation and assessment of soil arthropod population; techniques and culturing soil invertebrates.
- Students will be concerned about management options and techniques of harmful and beneficial soil arthropods which will create the employability in further future.

EN 517: Vertebrate Pest Management 2(1+1)

Objective

To impart knowledge on vertebrate pests like birds, rodents, mammals etc.of different crops, their biology, damage they cause and management strategies.

Outcome

- Students will be able to identify different vertebrate harmful pests and beneficial organisms.
- Students will acquinted with the different management strategies to combat the loss by the vertebrate pests.
- Students will able to assess the damage and estimate the control operation.

EN 518: Techniques In Plant Protection 1(0+1)

Objective

To acquaint the students with appropriate use of plant protection equipments and techniques related to microscopoy, computation, pest forecasting, electrophoresis etc.

Outcome

- Students will know about the manufacturing details, principles, operation methodologies of different pest control equipments.
- Students will also know about the protein isolation techniques, tissue culture techniques in plant protection which will create employability.

EN 519: Commercial Entomology 2(1+1)

Objective

To familiarize the students with entrepreneurial opportunities in entomology, provide information on productive insects and their products, as well as insect pests of public health and veterinary importance and their management.

Outcome

- Students will able to know the basic knowledge regarding the biology and basic concepts of apiculture, sericulture and lac culture
- Students will know the techniques and tools of apiculture, sericulture and lac culture and the commercial aspects which will helpful to create employability.

- Students will be familiarized with entrepreneurial opportunities in entomology, provide information on productive insects and their products, as well as insect pests of public health and veterinary importance and their management.

EN 520: Plant Quarantine 2(2+0)

Objective

To acquaint the learners about the principles and the role of Plant Quarantine in containment of pests and diseases, plant quarantine regulations and set-up.

Outcome

- The students will know Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material.
- Knowledge on different acts, rules, regarding quarantine, Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.

EN 591: Masters seminar 1(0+1)

Objectives:

To develop capacity among the students to select reseaech topic on important issues, preparation of power point covering the topic in different subheads, presentation style, eloquence and to develop ability to answer the questions.

Outcomes:

The students can select topic of research on emerging and important issues and present on powerpoint.

EN 599: Masters Research 20(0+20)

Objectives:

To expose the students on research methodology, selection of researchable issues, preparation of synopsis and execution of programme following suitable experiment design

Outcomes:

Students can select a research topic, prepare synopsis and execute the programme as per suitable design.

Pl Path 504: Principles Of Plant Pathology 3(3+0)

Objective

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

OUTCOME

- Knowledge on strategies for management of plant diseases.
- Knowledge on molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.
- Student will know about pathogenesis.

Pl Path 511: Diseases Of Fruits, Plantation And Ornamental Crops

3(2+1)

Objective

To acquaint with diseases of fruits, plantation, ornamental plants and their management.

Outcome

- Knowledge on Collection and dry preservation of diseased specimens.
- Baic ideas on symptoms and etiology of different diseases of fruits, plantation and ornamental crops so that identification process will be easier.
- Students will e expertized on the management tools and techniques which will be further useful for employability.

STAT-510: Experimental Designs 3(2+1)

Objective

I. This course is meant for students of agricultural and animal sciences other than Statistics.
II. Designing an experiment is an integrated component of research in almost all sciences.
III. The students would be exposed to concepts of Design of Experiments.

Outcome

I. It will enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.
II. The knowledge of design will significantly affect about pair-wise comparison of treatments.
III. The inference about certain treatment from the pair-wise comparison will cost less with more output.
IV. Varietal development leads for job creation.

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.

Outcome:

1. Identify library services and availability of resources in order to develop a realistic overall plan for research to achieve a manageable focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis.
2. Identify keywards, synonyms and related terms in order to flexible search information resources including: Internet, electronic library catalogs and print materials.
3. Identify the range of information source types available (such as peer-reviewed journals), newspaper articles, books, reference sources, etc) their distinguishing characteristics and intended audience, in order to select those appropriate based on the information need.
4. Identify the features and content of different research tools (such as database, catalogs and websites) in order to search those most appropriate to the information need.

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). While the emphasis will be on writing, oral communication of scientific and technical information will form an important component of the course, as well.

Outcomes

By the end of this course students will be able to

- Develop skills that will enable to produce clear and effective scientific and technical documents.
- Use visual items in effectively constructing meaning in communication situations.
- Create clear, concise technical documents that effectively use style and grammar and information structure in ways that create meaning with the reader.

- Collaborate effectively in various writing situations, including planning, creating, and managing, evaluating, editing and revising document production

PGS 503 (e-Course) 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.

Outcome:

1. Exposure to various types intellectual property rights.
2. Idea on various acts and organization related to IPR.
3. Knowledge on protection of plant varieties under UPOV and PPV & FR Act of India. Plant breeders rights, and Farmers rights.

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

Objective

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

Outcome:

- A brief knowledge on the safety protocols to be followed in a laboratory and handling of various equipments present in the laboratory.
- Knowledge on preparations of several standard solutions, agro-chemical doses, buffers,etc for laboratory and field purposes.
- Testing the seed viability, pollen viability and description of flowering plants.

\PGS 505 (e-Course)

Agricultural Research, Research Ethics And Rural Development Programmes 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.

Outcomes

- By the end of this course scholars will be sensitize about the basic issues related with agricultural research, ethics in research as well as rural development.

- The scholars will be also educated about principles and philosophy of rural development and various ongoing rural and community development programmes and policies.
- Students will also be motivated towards practising and promoting ethics in research and developmental endeavours.

PGS 506: Disaster Management 1(1+0)

Objectives

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.

Outcome

- A brief knowledge on nature and effects of different natural disasters and their management
- Knowledge on different types of man-made disasters and their management
- Appraisal on different organizations involved in disaster management at national and global level

Course Mapping

		Course Outcomes	PROGRAMME OUTCOMES				PROGRAMME SPECIFIC OUTCOMES				
Name of the Course	Course Code		PO1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
Insect Morphology	EN- 501	CO1	✓				✓				
		CO2	✓	✓			✓				
		CO3		✓	✓		✓	✓			
		CO4		✓	✓		✓	✓	✓		
	EN-502	CO1	✓				✓				

Insect Anatomy, Physiology and Nutrition		CO2	✓				✓				
		CO3		✓	✓			✓	✓		
		CO4		✓	✓			✓	✓	✓	
Principles of Taxonomy	EN-503	CO1	✓	✓			✓	✓			
		CO2	✓	✓			✓	✓			
Classification of Insects	EN- 504	CO1		✓						✓	
		CO2		✓	✓		✓				✓
Insect Ecology	EN-505	CO1	✓				✓				
		CO2	✓	✓	✓		✓	✓	✓		
Insect Pathology	EN-506	CO1	✓	✓	✓		✓	✓	✓		
		CO2	✓	✓			✓	✓			
		CO3		✓	✓			✓	✓		
		CO4				✓			✓	✓	✓
Biological Control of crop pests and weeds	EN- 507	CO1	✓				✓				
		CO2		✓	✓	✓		✓	✓	✓	✓
		CO3		✓				✓			
Toxicology of insecticides	EN-508	CO1		✓	✓	✓		✓	✓	✓	✓
		CO2		✓				✓			
		CO3			✓	✓	✓	✓			✓
Plant Resistance to Insects	EN-509	CO1	✓				✓				
		CO2		✓				✓			✓

Principles of Integrated Pest Management	EN-510	CO1		✓	✓			✓	✓		✓
		CO2	✓				✓				
		CO3		✓	✓	✓		✓	✓		✓
Pests of Field Crops	EN-511	CO1	✓				✓				
		CO2	✓		✓	✓			✓	✓	
Pests of Horticultural And Plantation Crops	EN-512	CO1	✓				✓				
		CO2	✓		✓	✓			✓	✓	
Storage Entomology	EN-513	CO1	✓				✓				
		CO2	✓		✓	✓			✓	✓	
Insect Vectors Of Plant Viruses And Other Pathogens	EN-514	CO1	✓				✓				
		CO2	✓				✓				
		CO3	✓				✓				
General Acarology	EN 515	CO1	✓				✓				
		CO2		✓				✓	✓		
		CO3		✓				✓			
		CO4				✓				✓	✓
Soil arthropods and their management	EN 516	CO1	✓				✓				
		CO2		✓	✓				✓	✓	
Vertebrate Pest Management	EN 517	CO1	✓				✓				
		CO2		✓				✓			

		CO3			✓	✓			✓	✓	
Techniques In Plant Protection	EN 518	CO 1		✓				✓			
		CO2			✓	✓			✓		
Commercial Entomology	EN 519	CO1	✓				✓				
		CO2		✓	✓			✓	✓		
		CO3				✓				✓	✓
Plant Quarantine	EN 520	CO1	✓				✓				
		CO2		✓				✓			
Masters seminar	EN 591	CO1	✓				✓				
Masters Research	EN 599	CO1	✓	✓	✓		✓	✓	✓		
Library and Information Service	PGS 501	CO1	✓	✓			✓	✓			
		CO2	✓	✓			✓	✓			
		CO3	✓	✓			✓	✓			
		CO4	✓	✓			✓	✓			
Technical writing and communication skill	PGS 502	CO1	✓	✓			✓	✓			
		CO2	✓	✓			✓	✓			
		CO3	✓	✓			✓	✓			
		CO4	✓	✓			✓	✓			
Intellectual Property And Its Management In Agriculture	PGS 503	CO1	✓				✓				
		CO2	✓				✓				

		CO3		✓	✓			✓			
Basic concepts in laboratory techniques	PGS 504	CO1	✓				✓	✓			
		CO2		✓				✓			
		CO3		✓				✓			
Agricultural research, research ethics and rural development programmes	PGS 505	CO1	✓	✓			✓	✓			
		CO2	✓				✓				
		CO3	✓	✓			✓				
Disaster Management	PGS 506	CO1	✓				✓				
		CO2		✓							
		CO3		✓			✓		✓		
Principles of plant pathology	PL PATH 504	CO1	✓				✓				
		CO2		✓				✓			✓
		CO3	✓				✓				
Diseases of Fruits, Plantation and Ornamental Crops	PL PATH 511	CO1	✓				✓				
		CO2		✓	✓				✓		✓
		CO3	✓	✓				✓			
Experimental Design	STAT 510	CO1	✓	✓				✓	✓		✓
		CO2	✓	✓			✓		✓		✓
		CO3	✓	✓			✓		✓		✓
		CO4	✓	✓			✓		✓		✓

Mapping of COs vs. Employability/ Entrepreneurship/ Skill development				
Name of the Course	**Course Code**	**Employability**	**Entrepreneurship**	**Skill development**
Insect Morphology	EN 501			Y
Insect Anatomy, Physiology and Nutrition	EN 502			Y
Principles of Taxonomy	EN 503			Y
Classification of insects	EN 504			Y
Insect Ecology	EN 505			Y
Biological Control of crop pests and weeds	EN 507	Y		Y
Toxicology of insecticides	EN 508		Y	
Principles of Integrated Pest Management	EN 510	Y		Y
Pests of Field Crops	EN 511	Y		Y
Pests of Horticultural And Plantation Crops	EN 512	Y		Y
Storage Entomology	EN 513	Y		Y
Commercial Entomology	EN 519	Y	Y	Y
Masters Seminar	EN 591			Y
Masters Research	EN 599	Y		
Principles of Plant Pathology	PL PATH 504	Y		Y
Experimental Design	STAT 510	Y		Y
Diseases of Fruits, Plantation and Ornamental Crops	PL PATH 511	Y		Y
Insect Pathology	EN 506	Y		Y
Plant Resistance to Insects	EN 509			Y
General Acarology	EN 515	Y		Y
Insect Vectors Of Plant Viruses And Other Pathogens	EN 514			Y
Soil Arthropods And Their Management	EN 516	Y		Y
Vertebrate Pest Management	EN 517	Y		Y
Techniques In Plant Protection	EN 518	Y		Y
Plant Quarantine	EN 520			Y
Library Information and Services	PGS 501			Y
Technical Writing and Communication Skills	PGS 502			Y
Intellectual Property and its management in Agriculture	PGS 503	Y		Y
Basic concepts in Laboratory Techniques	PGS 504	Y		Y

Agricultural Research, Research Ethics and Rural Development Programmes	PGS 505			Y
Disaster Management	PGS 506	Y		Y