

M.Sc. Ag. (Entomology) 2022-24

POST GRADUATE DEPARTMENT OF AGRICULTURE

SYLLABUS FOR THE BATCH FROM THE YEAR 2022 TO YEAR 2024

Programme Code: MENT

Programme Name: M.Sc. Ag. (Entomology)

(Semester III-IV)

Examinations: 2023-24



Khalsa College Amritsar

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(b) Subject to change in the syllabi at any time.
(c) Please visit the University website time to time

PROGRAMME OBJECTIVES (PO)

PO- 1. Students will impart detailed knowledge of entomology and specific knowledge of its allied branches.

PO- 2. Students will learn how insects were originated and where they are arranged in kingdom Animalia

PO- 3. Students will have a deeper understanding of several aspects of biology of insects

PO- 4. Students will get detailed information regarding behaviour and management of insect pests.

PO- 5. Students will have working knowledge of statistical methods and will be able to design basic statistical analyses and evaluate basic statistical information.

PROGRAMME SPECIFIC OUTCOMES (PSOS):

PSO- 1. Students will be able to categorise insects based on basic ecological, behavioural, developmental attributes and evolutionary history.

PSO- 2. Students will understand comparative morphology and anatomy of insects through dissection.

PSO- 3. Students will get to know about collection, preservation and identification of insects of different orders including pests and beneficial insects.

PSO- 4. Students will have hands-on training in preparation of artificial diets, rearing of insects and culturing of insect pathogens.

PSO- 5. Students will get acquainted with positive as well as negative impact of insects on agriculture, human health, and the environment.

PSO- 6. Students will have a deeper understanding of insect pest management strategies and will also learn about new advancements in pest management in fields and in warehouses.

PSO- 7. Students will get knowledge about population estimation of insect pests, losses caused by pests, crop modelling, designing and implementation of IPM.

PSO- 8. Students will check the efficacy of biocontrol agents and different groups of insecticides including botanicals and new promising compounds in laboratory as well as in the fields.

PSO- 9. Students will learn about estimation of insecticidal residues and their environmental implications.

PSO- 10. Students will acquire skill for designing of their experiments. They will also learn how to analyse statistical data and present results efficiently.

PSO- 11. Students will also learn about basics of plant pathology like epidemiology, detection, diagnosis and forecasting of plant diseases through survey, surveillance etc.

PSO- 12. Students will learn about quarantine restrictions imposed during import or export of agricultural produce and techniques for detection of pest infestations.

M.Sc. Ag. (Entomology) 2022-24

SEMESTER-I

Course Codes	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
ENT-511	Insect Morphology and Systematics	3 (2+1)	50+25+25	100	8-9
ENT-512	Insect Anatomy and Physiology	3 (2+1)	50+25+25	100	10-11
PPL-532 (Minor)	Quarantine in Plant Protection	3 (2+1)	50+25+25	100	12-13
STA-414	Statistical Methods for Research Workers	3 (2+1)	50+25+25	100	14-15
*PGS-501	Technical Writing & Communication Skills	1 (1+0)	100 (Th)	100	16-17
*PGS-502	Library and Information Services	1 (0+1)	100 (Pr)	100	18
*ENT-600	Masters' Research	4(0+4)	-----	S/US	19
Total		18(12+6*)			

* **Non-credit course**

Total Internal Assessment = 25% (House Test - 10%; Attendance - 10%; Conduct & Academic, Extra Curricular Activities - 5%).

M.Sc. Ag. (Entomology) 2022-24**SEMESTER-II**

Course Codes	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
ENT-521	Classification of Insects	3 (2+1)	50+25+25	100	20-21
ENT-522	Toxicology of Insecticides	3 (2+1)	50+25+25	100	22-23
PPL-541 (Minor)	Detection and Diagnosis of Plant Diseases	3 (2+1)	50+25+25	100	24-25
STA-524	Experimental Designs for Research Worker	3 (2+1)	50+25+25	100	26-27
*PGS-503	Agricultural Research and Publication Ethics	1(1+0)	100 (Th)	100	28-29
*ENT-600	Masters' Research	4(0+4)	-----	S/US	30
Total		17(12+5*)			

* **Non-credit course**

Total Internal Assessment = 25% (House Test - 10%; Attendance - 10%; Conduct & Academic, Extra Curricular Activities - 5%).

SEMESTER-III

Course Codes	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
ENT-531	Biological Control of Insect Pests	3 (2+1)	50+25+25	100	31-32
ENT-532	Integrated Pest Management	3 (2+1)	50+25+25	100	33-34
PPL-531 (Minor)	Epidemiology & Forecasting of Plant Diseases	3 (2+1)	50+25+25	100	35-36
ENT-591	Credit Seminar	1(1+0)	100	100	37
*PGS-504	Intellectual Property & its Management in Agriculture	1(1+0)	100 (Th)	100	38-39
*ENT-600	Masters' Research	6(0+6)	-----	S/US	40
Total		17(10+7*)			

* Non-credit course

Total Internal Assessment = 25% (House Test - 10%; Attendance - 10%; Conduct & Academic, Extra Curricular Activities - 5%).

SEMESTER-IV

Course Codes	Course Title	Credit Hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
ENT-541	Insect Ecology	3 (2+1)	50+25+25	100	41-42
ENT-542	Plant Resistance to Insects	3 (2+1)	50+25+25	100	43-44
*PGS-505	Disaster Management	1(1+0)	100(Th)	100	45-46
*ENT-600	*Masters' Research	6(0+6)	--	S/US	47
Total		13(6+7*)			

* Non-credit course

Total Internal Assessment = 25% (House Test - 10%; Attendance - 10%; Conduct & Academic, Extra Curricular Activities - 5%).

SEMESTER-I

ENT-511

Insect Morphology and Systematics

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives:

1. To learn the external morphology of insects (i.e., to learn about the features of insects which help to distinguish one kind of insect from another).
2. To study specializations and adaptability of structures such as the mouthparts, antennae, legs, wings and pronotum
3. To understand how an insect life, functions, and reproduces.

Course Content:

Theory:

Section-A: Evolution of insect body form. Primary and secondary segmentation, structure of typical secondary segment.

Section-B: Different theories regarding segmentation of insect head. Comparative morphological characteristics of insects and their bearing in insect classification.

Section-C: Insect sense organs. Mechanism of flight. Insect Systematics- history and importance.

Section-D: Taxonomic categories. Taxonomic keys. Important rules of Zoological nomenclature. Ethics in taxonomy. Zoogeographical regions of world.

Practical:

Comparative study of morphological characteristics of representative type of insects. Collection and preservation of insects and their identification with the help of taxonomic keys. Preparation of taxonomic keys.

Suggested Reading

1. Chapman RF. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge.
2. Chu HF. 1992. How to Know Immature Insects. William Brown Publication, Iowa.
3. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publishers, New Delhi.
5. Gillott C. 1995. Entomology, 2nd Ed. Plenum Press, New York, London.

M.Sc. Ag. (Entomology) 2022-24

6. Gullan PJ and Cranston PS. 2000. The Insects, An Outline of Entomology, 2nd Ed. Blackwell Science, UK.
8. Richards OW and Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman and Hall, London.
9. Snodgrass RE. 1993. Principles of Insect Morphology. Cornell Univ. Press, Ithaca.
10. Tembore DB. 2000. Modern Entomology, Himalaya Publishing House, Mumbai.
11. Stehr FW. 1998. Immature Insects. Vols. I, II. Kendall Hunt Publication, Iowa.

Course Outcomes:

CO- 1. To get detailed information regarding evolution of insects, their segmentation and theories regarding segmentation of insect head.

CO- 2. Students will get to know about comparative morphological characteristics, sense organs and flight mechanisms of insects.

CO- 3. Students will get acquainted with history and importance of insect systematics, taxonomic categories and ethics in taxonomy.

CO- 4. They will learn important rules of zoological nomenclature, preparation of taxonomic keys and usage of these keys in identification of insects.

SEMESTER-I

ENT-512

Insect Anatomy and Physiology

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

4. Question paper should be set strictly according to the syllabus.
5. The language of questions should be straight & simple.
6. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
7. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives:

1. To study the different systems (digestive, circulatory, respiratory, reproductive, excretory, nervous, sensory, endocrine, and exocrine) of insects
2. To learn the basic form and function of the insects
3. To study the physiological role of the various systems in insect survival
4. To study the role of physiology in the basic behaviour of insects

Course Content:

Theory:

Section-A: Importance and scope of insect anatomy and physiology. Structure and physiology of insect integument.

Section-B: Comparative study of anatomy and physiology of digestive, circulatory, respiratory, reproductive.

Section-C: Comparative study of anatomy and physiology of excretory, nervous, sensory, endocrine and exocrine systems.

Section-D: Embryonic and post-embryonic developments. Diapause Insect nutrition, inter- and intracellular micro-organisms. Artificial diets.

Practical:

Study of comparative anatomy of various organ systems of insects through dissection and preparation of mounts of internal organs. Experiments to highlight physiological significance of cuticle, digestive, circulatory, respiratory, excretory, endocrine and exocrine systems. Formulation and preparation of artificial diets for rearing of insects.

Suggested Reading

1. Chapman RF. 1998. Insects: Structure and Function. ELBS Ed., London.
2. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publishers, New Delhi.
3. Gullan PJ and Cranston PS. 2000. The Insects: An Outline of Entomology, 2nd Ed. Blackwell Science, UK.

M.Sc. Ag. (Entomology) 2022-24

4. Kerkut GA and Gilbert LI. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. I-XIII. Pergamon Press, New York.
5. Patnaik BD. 2002. Physiology of Insects. Dominant Publishers, New Delhi.
6. Richards OW and Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Vol. 1.
7. Structure, Physiology and Development. Chapman and Hall, New York.
8. Simpson SJ. 2007. Advances in Insect Physiology, Vol. 33, Academic Press (Elsevier), London, UK.
9. Wigglesworth VB. 1984. Insect Physiology. 8th Ed. Chapman and Hall, New York.

Course Outcomes:

- CO- 1. Students will learn the importance and scope of insect anatomy and physiology.
- CO- 2. They will get to know about basic structure and physiology of exoskeleton of insects.
- CO- 3. They will analyse and integrate information pertaining to specific physiological system. They will learn to compare functioning of specific physiological systems in different insect orders.
- CO- 4. Students will study embryonic and post-embryonic development of insects and role of nutrition in development of insects.

SEMESTER-I

PPL-532

Quarantine in Plant Protection

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives:

1. To impart knowledge to the students on basic concepts of pest and pesticide, Different Quarantine Law
2. To impart knowledge on WTO Regulations, VHT techniques, Symptomatic diagnosis and other techniques to detect pest/pathogen infestations

Course Content:

Theory:

Section A: Definition of pest and pesticides and transgenics as per Govt. notification. Relative importance and quarantine for domestic and international. Quarantine restrictions in the movement of agricultural produce including seeds and planting material. Case histories of exotic pests and diseases and their status.

Section B: Plant protection organization in India. Acts related to registration of pesticides and transgenics. History of quarantine legislations. PQ Order 2003. Environmental Acts and APEDA. Industrial registration. Import and Export of bio-control agents. Special requirements for biopesticide registration.

Section C: Identification of pest and disease-free areas. Contamination of food with toxigens of micro-organisms and their elimination. Symptomatic diagnosis and other techniques to detect pest/pathogen infestations.

Section D: VHT and other safer techniques of disinfection and salvaging of infected material. WTO regulations. Non-tariff barriers. Pest risk analysis and good laboratory practices for pesticide laboratories. Pesticide industry. Sanitary and phytosanitary measures.

Practical:

Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations.

Suggested Readings:

1. Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.
2. Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

Course Outcomes:

CO1: Thorough knowledge about application of biological, cultural, chemical and biocontrol agents and to study about compatibility and integration in IDM.

CO2: Demonstration of IDM in certain crops as project work.

CO3: To study about IDM and its adaptation in important crops Kharif pulses, vegetable and fruit crops.

SEMESTER-I

STA-414: Statistical Methods for Research Workers

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives: The aim of this course is to understand the basics of statistical methods and their applications in agriculture. It helps the students in understanding, analyzing and interpreting the agricultural data. It also helps in making appropriate decisions in agricultural research findings.

Course Content:

Theory

Section-A: Probability and fitting of standard frequency distribution, sampling techniques, sampling distributions, mean and standard error.

Section-B: Simple partial, multiple and intra- class correlation and multiple regression.

Section-C: Tests of significance, students'-t, chi-square and large sample tests, confidence intervals.

Section-D: Analysis of variance for one way and two-way classification with equal cell frequencies, transformation of data.

Practical:

Fitting of distributions, samples and sampling distributions, correlation and regression, tests of significance and analysis of variance.

Note: Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students will use scientific calculators to analyse the data.

Suggested Reading:

1. Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
2. Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.

3. Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
4. Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
5. Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
6. Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
7. Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
8. Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed. John Wiley
9. <http://freeststatistics.altervista.org/en/learning.php>.
10. <http://www.statsoft.com/textbook/stathome.html>.

Course Outcomes:

- Get knowledge on the concept of probability, sampling techniques, mean, standard error etc.
- Understand the correlation and regression analysis.
- Apply T-Test, chi-square and large sample tests.

SEMESTER-I

*PGS 501 Technical Writing and Communication Skill

Time: 3 hours

Maximum Marks: 100

Theory: 100

Credit hours: 1(1+0)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

Course objectives: 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).

Course Content:

Theory:

Technical Writing- Various forms of technical writing-theses, technical papers, reviews, electronics communication etc: qualities of technical writing: parts of research communication- title page, content page, authorship, preface, introduction, review of literature, materials and methods, experimental results, documentation; photographs and drawings with suitable captions; pagination; citation; writing of abstracts; précis; synopsis; editing and proof reading. Communication Skills-defining communication; types of communication- verbal and non-verbal; assertive communication; assertive communication: using language for effective communication; techniques of dyadic communication- message pacing and message chunking, self-disclosure mirroring, expressing conversation intent; paraphrasing; vocabulary building- word roots, prefixes, Greek and Latin roots.

Suggested Reading:

1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
3. Collins' Cobuild English Dictionary. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
7. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
8. Mohan K. 2005. Speaking English Effectively. MacMillan India.
9. Richard WS. 1969. Technical Writing.
10. Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
11. Wren PC and Martin H. 2006. High School English Grammar and Composition.

S. Chand & Co.

Course outcomes:

On completing the course, the students will be able to:

- Understand the basic components of definitions, descriptions, process explanations and other common forms of technical writing.
- Understand various stages of the writing process and apply them to technical and workplace writing tasks.
- Integrate material collected from primary and secondary sources with their own ideas in research papers.

SEMESTER -I

***PGS 502**

Library and Information Services

Time: 3 hours

Maximum Marks: 100

Practical: 100

Credit hours: 1 (0+1)

Instructions for the Paper Setters:

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4×15= 60 Marks)

Course 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.

Course Content:

Practical:

Introduction to Library and its services: Five laws of library science: type of documents; classification and cataloguing; organization of documents; sources of information-primary, secondary and tertiary; current awareness and SDI services; tracing information from references sources; library survey; preparation of bibliography; use of Online Public Access Catalogue; use of CD-Rom databases and other computerized library services, CeRA, J-Gate; use of Internet including search engines and its resources, e-resources and access methods.

Course outcomes:

- Understand the definitions, descriptions, process explanations and other common forms of technical writing.
- Understand how to follow the stages of the writing process and apply them to technical and workplace writing tasks
- Synthesize and integrate material collected from primary and secondary sources with their own ideas while writing research papers.

SEMESTER-I

***ENT-600**

Masters' Research

S/US

Credits hours: 4(0+4)

SEMESTER-II

ENT-521

Classification of Insects

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives:

The course aims to:

1. Identify hexapods to order and the majority of common insects to family by sight.
2. Identify adult insects to order and family using dichotomous keys.
3. Collect insects and field data in different habitats using a variety of techniques.
4. Curate insect specimens properly, including labelling, pinning, point mounting, and preserving in ethanol.
5. Describe the taxonomic process: how species are described, named, and classified.
6. Explain how key innovations in the life history of insects led to their incredible diversity.
7. Interpret phylogenetic trees depicting the evolutionary relationships among insects.

Course Content:

Theory:

Section-A: History of insect classification and its importance. Introduction to phylogeny of insects.

Section-B: Classification of Superclass Hexapoda including all the classes with special emphasis on Class Insecta.

Section-C: Distinguishing morphological characters along with the habits and habitats of insects belonging to economically important families of Apterygota and Endopterygota orders of Class Insecta.

Section-D: Distinguishing morphological characters along with the habits and habitats of insects belonging to economically important families of exopterygota orders of Class Insecta.

Practical:

Collection and preservation of insects. Identification of insects up to family level. Field visits to collect insects of different orders.

Suggested Reading

1. CSIRO 1990. The Insects of Australia: A Text Book for Students and Researchers. 2nd Ed. Vols. I and II, CSIRO. Cornell Univ. Press, Ithaca.
2. Freeman S and Herron JC. 1998. Evolutionary Analysis. Prentice Hall, New Delhi.
3. Gullan PJ and Cranston PS. 2010. The Insects: An outline of Entomology. 4th Ed. Wiley-Blackwell Publications, West Sussex, UK.
4. Mayr E. 1971. Principles of Systematic Zoology. Tata McGraw Hill, New Delhi.
5. Richards OW and Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman and Hall, London.
6. Ross HH. 1974. Biological Systematics. Addison Wesley Publ. Company.
7. Triplehorn CA and Johnson NF. 1998. Borror and DeLong's Introduction to the Study of Insects. 7th Ed. Thomson/ Brooks/ Cole, USA/ Australia

Course Outcomes:

- CO- 1. Students will know about the history and importance of insect classification.
- CO- 2. To get knowledge about phylogeny of insects and classification of superclass Hexapoda.
- CO- 3. Students will learn about distinguishing morphological characters, habits and habitats of insects belonging to economically important families of different orders of class Insecta.

SEMESTER-II

ENT-522

Toxicology of Insecticides

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives:

The course aims to:

1. Outline the history of insecticides
2. Recognize the major classes of insecticide and understand their mode of action
3. List and describe processes involved in toxic dynamics of insecticides
4. Become aware of the limitations of insecticide use such as resistance and environmental contamination
5. Develop a basic understanding on performing insect bioassay

Course Content:

Theory:

Section-A: Definition, importance, scope, basic principle of insecticide toxicology and its relationship with other disciplines. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, neonicotinoids, oxadiazines, phenylpyrozoles etc.

Section-B: Structure and mode of action of botanicals and new promising compounds etc. Criteria, methods, problems and solutions of bioassay. Evaluation of insecticide toxicity, joint action of insecticides, synergism, potentiation and antagonism,

Section-C: Factors affecting toxicity of insecticides, selectivity and phytotoxicity. Insecticide metabolism, pest resistance to insecticides, mechanisms and types of resistance, insecticide resistance management and pest resurgence.

Section-D: 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 formulation and mixtures, quality control of pesticide formulations. Working out doses and concentrations of pesticides for laboratory and field evaluation for their bioefficacy, bioassay techniques, probit analysis, evaluation of insecticide toxicity and joint

action. Toxicity to beneficial insects. Preparation of working standard solutions of pesticides, Sampling, extraction, clean-up and estimation of insecticide residues by various methods, calculations and interpretation of data, visit to toxicology laboratories, good laboratory practices.

Suggested Reading

1. Chattopadhyay SB. 1985. Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi.
2. Dodia DA, Petel IS and Petal GM. 2008. Botanical Pesticides for Pest Management. Scientific Publisher (India), Jodhpur.
3. Dovener RA, Mueninghoff JC and Volgar GC. 2002. Pesticides formulation and delivery systems: meeting the challenges of the current crop protection industry. ASTM, USA
4. Gupta HCL.1999. Insecticides: Toxicology and Uses. Agrotech Publ., Udaipur.
5. Ishaaya I and Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi.
6. Ishaaya I and Degheele D. 1998. Insecticides with Novel Modes of Action: Mechanism and Application. Norosa Publishing House, New Delhi.
7. Krieger RI. 2001. Handbook of Pesticide Toxicology. Vol-II. Academic Press. Orlando Florida.
8. Mathews GA. 2002. Pesticide Application Methods. 4th Ed. Intercept. UK.
9. Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.
10. Otto D and Weber B. 1991. Insecticides: Mechanism of Action and Resistance. Intercept Ltd.,UK.
11. Pedigo LP and Marlin ER. 2009. Entomology and Pest Management, 6th Edition, Pearson Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
12. Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.
13. Prakash A and Rao J. 1997. Botanical Pesticides in Agriculture. Lewis Publication, New York.
14. Roy NK. 2006. Chemistry of Pesticides. Asia Printograph Shahdara Delhi.

Course Outcomes:

CO- 1. Students will get to know about importance, scope and basic principle of insecticide toxicology and its relationships with other disciplines.

CO- 2. To learn about the structure and mode of action of different groups of insecticides including botanicals and new promising compounds

CO- 3. Students will learn the mechanisms of resistance development in insects against insecticides and how we can manage the problem of insecticide resistance.

SEMESTER-II

PPL-541

Detection and Diagnosis of Plant Diseases

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives

The course aims to:

1. To impart knowledge to the students about detection and diagnosis of various plant pathogens, their isolation, preservation
2. To impart knowledge on various plant pathological lab techniques

Course Content:

Theory:

Section A: Isolation of pathogens using selective media, pure culture techniques. Methods to prove Koch's postulates with biotroph and necrotroph pathogens.

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

Section C: Microscopic techniques and staining methods, chromatography, phase contrast and electron microscopy, spectrophotometer, ultracentrifuge and electrophoretic apparatus. Serological and molecular techniques for detection of plant pathogens.

Section D: Evaluation of fungicides and bactericides. Data collection and preparation of reports.

Practical:

Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens. Use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida. 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.

Suggested Readings:

1. Baudoin ABAM, Hooper GR, Mathre DE & Carroll RB. 1990. Laboratory Exercises in Plant Pathology: An Instructional Kit. Scientific Publ., Jodhpur.
2. Dhingra OD & Sinclair JB. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo. Fox RTV. 1993. Principles of Diagnostic Techniques in Plant Pathology. CABI Wallington.
3. Mathews REF. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Boca Raton, Tokyo.
4. Pathak VN. 1984. Laboratory Manual of Plant Pathology. Oxford & IBH, New Delhi.
5. Forster D & Taylor SC. 1998. Plant Virology Protocols: From Virus Isolation to Transgenic Resistance. Methods in Molecular Biology. Humana Press, Totowa, New Jersey.
6. Matthews REF. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Florida.
7. Noordam D. 1973. Identification of Plant Viruses, Methods and Experiments. Cent. Agric. Pub. Doc. Wageningen.
8. Trigiano RN, Windham MT & Windham AS. 2004. Plant Pathology- Concepts and Laboratory Exercises. CRC Press, Florida. Chakravarti BP. 2005. Methods of Bacterial Plant Pathology. Agrotech, Udaipur.

Course Outcomes:

- CO1: Thorough knowledge about Proving Koch postulates with biotrophs and necrotroph pathogens.
- CO3: To study about Principles, construction and working of different microscopic techniques and staining methods.
- CO4: To demonstrate evaluation of fungicides and bactericides against different diseases.

SEMESTER-II

STA-524: Experimental Designs for Research Worker

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 10 marks (comprising of 10 short answer type questions of 1 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A, B, C, D) and the candidates will attempt 4 question (one from each section). All questions will carry equal marks (10).

Course Objectives:

The aim of this course is to understand the basics of statistical methods and their applications in agriculture. It helps the students in understanding, analyzing, and interpreting the agricultural data. It also helps in making appropriate decisions in agricultural research findings.

Course Content:

Theory:

Section-A: Need for designing of experiments- characteristics of a good design, basic principles- randomization, replication and local control, uniformity trials- size and shape of plots and blocks, analysis of variance and interpretation of data.

Section-B: Completely randomized, randomized block and latin square design, multiple comparison tests, factorial experiments- interpretation of main effects and interactions,

Section-C: Orthogonality and partitioning of degrees of freedom confounding in 2^3 , 2^4 and 3^3 designs, split and strip plot designs, crossover designs and balanced incomplete block designs, response surface designs, switch over trials and long term experiments;

Section-D: Selection of experimental design, mechanical errors in field experiments and methods of reducing it, presentation of research results.

Practical:

Uniformity trials, completely randomized, randomized block and latin square designs, missing plot and analysis, of covariance, 2^3 , 2^4 and 3^3 simple and confounded experiments, split and strip plot designs, cross over and balanced incomplete block designs.

Note: Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students are allowed to use scientific calculators to analysis is the data.

Note: Students are allowed to use scientific calculator in University examinations; statistical tables will be provided to students in examinations. No rigorous mathematical proofs are expected from students; stress will be on application only.

Suggested Reading:

1. Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
2. Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
3. Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.
4. Federer WT. 1985. Experimental Designs. MacMillan.
5. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
6. Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
7. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.
8. www.drs.icar.gov.in.

Course Outcome:

CO- 1. The course Experimental Design for Research Workers enables students to learn about the formation of Experimental units, plots and blocks, random implementation of considered factors on experimental units, and the procurement of samples representing the whole experimental population.

CO-2. The context of this course enables students to analyze agricultural experimental data such as to identify the factors effectively different in their effects. Study of different layout of designs enable students to analyze data generated from various layouts of factors applied.

CO-3. Also the topics taught to students in last section enable them to represent their results derived from research in technical and expressive way.

Note: Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students are allowed to use scientific calculators to analysis is the data.

Note: Students are allowed to use scientific calculator in university examinations; statistical tables will be provided to students in examinations. No rigorous mathematical proofs are expected from students; stress will be on application only.

SEMESTER-II

*PGS-503 - Agricultural Research and Publication Ethics

Time: 3 Hours

Maximum marks: 100

Theory: 100

Credit hours: 1 (1+0)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

Course objective: the main objective of the course is 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.

Course Content:

Theory:

Section A: Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Section B: Publication ethics: definition, introduction and importance. Best practices/standards setting initiative and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, type.

Section C: Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals. Ethics with respect to science and research. Intellectual honesty and research integrity.

Section D: Scientific misconduct: Falsification, Fabrication, and Plagiarism (FFP); Redundant publication: duplicate and overlapping publication, salami slicing; selective reporting and misrepresentation of data.

Suggested Readings:

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
4. Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

Course Outcomes: After successful completion of this course students are expected: • To be familiar with the national and international institutions involved in research and about various research ethics and the problems faced by researchers. • To be acquainted with the various rural development programmes and the problems being faced in the implementation of the policies designed for rural development.

SEMESTER-II

Master's Research

***ENT-600**

S/US

Credits hours: 4(0+4)

SEMESTER-III

ENT-531

Biological Control of Insect Pests

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

Course Objectives

The course aims:

1. To study the concept, history and scope, ecological basis of biological control, natural enemies: predators, parasitoids and insect pathogens (mode of action, application, epizootics), advantages and disadvantages, characteristics of bio-control agents
2. To learn about procedure of biological control: introduction; enhancement of bio control agents (introduction, conservation, mass culture, augmentation, release, monitoring and importation); rearing techniques of bio-control agents and their host insects; role of biological control in IPM

Course Content:

Theory

Section A

Principles and scope of biological control.

Techniques in biological control-Introduction, Inoculation and Augmentation.

Biology and host seeking behaviour of predatory and parasitic groups (Coleoptera, Hymenoptera, Neuroptera, Reduviid bugs) of insects.

Section B

Role of insect pathogens (Bt, NPV, Entomopathogenic fungi) and their mode of action. Biological control of weeds using insects.

Techniques for mass production of quality biocontrol agents. Various formulations and economics of bioagents. Field application and evaluation.

Section C

Analysis of successful biological control projects. Trends and future possibilities of biological control.

Section D

Importation of natural enemies and quarantine regulations. Biotechnology in biological control. Semiochemicals in biological control

Practical:

1. Identification of common natural enemies of crop pests and weed killers.
2. Techniques for rearing of natural enemies.
3. Quality control and registration standards for biocontrol agents.

M.Sc. Ag. (Entomology) 2022-24

4. Field collection of parasitoids and predators.
5. Hands- on training in culturing and identification of common insect pathogens.
6. Visits (only where logistically feasible) to bio- control laboratories to learn rearing and mass production of natural enemies of crop pests and weeds and their laboratory hosts.

Course Outcomes:

CO- 1. Students will learn about various biocontrol agents used to prevent the attack of pests to promote eco-friendly control methods.

CO- 2. They will learn the mass multiplication techniques of biocontrol agents through hands-on training and can earn good money from industrial production of biocontrol agents.

CO- 3. To check the field efficacy of various formulations of biocontrol agents.

CO- 4. To understand the trends and future possibilities of biological control and study the role of biotechnology and semio chemicals in biological control.

SEMESTER-III

ENT-532

Integrated Pest Management

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

Course Objectives

The course aims to:

1. Be able to analyse pest problems, determine if management is necessary, and make appropriate recommendations using IPM techniques.
2. Be familiar with different methods of pest management - their benefits and limitations.
3. Understand the value of beneficial insects.

Course Content:

Theory:

Section A

History and origin. Definition and evolution of various related terminologies.

Concept and philosophy of IPM. Ecological principles of IPM. Constraints in IPM implementation.

Types and methods of determination of crop losses and economic thresholds.

Section B

Integration of different pest management methods.

Use of semiochemicals in pest management programmes.

Pest survey and surveillance, forecasting, types of surveys (Fixed and rapid survey including remote sensing methods) different sampling techniques, factors affecting surveys.

Section C

Political, social and legal implications of IPM.

Pest and pesticide risk analysis, assessment and management, Pest quarantine measures and cost benefit ratios.

Section D

Case studies of successful IPM programmes for Cotton, Rice, Sugarcane, Vegetable crops and fruit crops. National and international set-ups for integrated pest management.

Practicals

1. Characterization of agro-ecosystems.
2. Sampling methods and factors affecting sampling.
3. Population estimation methods.

4. Crop loss assessments, potential losses, avoidable losses, unavoidable losses.
5. Computation of EIL and ETL.
6. Crop modelling, designing, and implementing IPM system.

Suggested Reading

1. Dhaliwal GS and Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publishers, New Delhi.
2. Horowitz AR and Ishaaya I. 2004. Insect Pest Management: Field and Protected Crops. Springer, New Delhi.
3. Ignacimuthu SS and Jayaraj S. 2007. Biotechnology and Insect Pest Management. Elite Publ., New Delhi.
4. Norris RF, Caswell-Chen EP and Kogan M. 2002. Concepts in Integrated Pest Management. Prentice Hall, New Delhi.
5. Pedigo RL. 2002. Entomology and Pest Management. 4th Ed. Prentice Hall, New Delhi.
6. Subramanyam B and Hagstrum DW. 1995. Integrated Management of Insects in Stored Products. Marcel Dekker, New York.

Course Outcomes:

- CO- 1. Students will get knowledge about origin, history, concept, philosophy, and ecological principles of IPM.
- CO- 2. They will be able to assess crop losses, economic thresholds, and cost benefit ratios.
- CO- 3. They will be acquainted with different sampling techniques and insect-pest population estimation methods.
- CO- 4. Students will learn about designing and implementation of IPM programmes for different crops and constraints in IPM implementation.

SEMESTER-III

PPL 531

Epidemiology and Forecasting of Plant Diseases

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

Course Objectives

The course aims:

1. To impart knowledge to the students on basic concepts of disease epidemiology its history and importance in the disease development
2. To impart knowledge on survey and surveillance, vigilance and crop loss assessment models
3. To know about principles and pre-requisites of disease forecasting, procedures of modelling disease growth and disease prediction

Course Content:

Theory:

Section A: Epidemic concept and historical development, pathometry and crop growth stages, epidemic growth and analysis.

Section B: Common and natural logarithms, function fitting area under disease progress curve and correction factors, inoculum dynamics, population biology of pathogens, temporal spatial variability in plant pathogens.

Section C: Survey, surveillance and vigilance, crop loss assessment and models. Principles and pre-requisites of forecasting, systems and factors affecting various components of forecasting's, some early forecasting

Section D: Procedures based on weather and inoculum potential, modelling disease growth and disease prediction.

Practical:

Measuring diseases, spore dispersal and trapping, weather recording, survey, multiplication of inoculum, computerized data analysis, function fitting, model preparation and validation.

Suggested Reading

1. Campbell CL and Madden LV. 1990. Introduction to Plant Disease Epidemiology. John Wiley & Sons, New York Restructured and Revised Syllabi of Post-graduate Programmes Vol. 1224
2. Cooke B, Jones DM and Gereth KB. 2018 The Epidemiology of Plant Diseases. Springer Publications.

3. Cowling EB and Horsefall JG. 1978. Plant Disease. Vol. II. Academic Press, New York.
4. Laurence VM, Gareth H and Frame Van den Bosch (Eds.). The Study of Plant Disease Epidemics. APS, St. Paul, Minnesota.
5. Nagarajan S and Murlidharan K. 1995. Dynamics of Plant Diseases. Allied Publ., New Delhi.
6. Thresh JM. 2006. Plant Virus Epidemiology. Advances in Virus Research 67, Academic Press, New York.
7. Van der Plank JE. 1963. Plant Diseases Epidemics and Control. Academic Press, New York.
8. Zadoks JC and Schein RD. 1979. Epidemiology and Plant Disease Management. Oxford Univ. Press, London.

Course Outcomes:

CO1. To get thorough knowledge about measuring diseases, spore dispersal and trapping of different plant diseases and to study about weather recording, survey, multiplication of inoculums of diseased samples.

CO2. To know about computerized data analysis, function fitting, model preparation and validation

CO3. To study about survey, surveillance, vigilance, crop loss assessment and models used in different plant diseases.

ENT-591

**SEMESTER-III
CREDIT SEMINAR**

**Maximum Marks: 100
Credits hours: 1(1+0)**

SEMESTER-III

*PGS-504

Intellectual Property and its management in Agriculture

Time: 3.00hrs.

Maximum Marks: 100

Theory: 100

Credits hours: 1(1+0)

Instructions for the paper setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 20 marks (comprising of 10 short answer type questions) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A,B,C,D) and the candidate will attempt 4 questions (one from each section). All questions will carry equal 20 marks.

Course 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.

Course Content:

Theory:

Section A: 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.

Section B: 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.

Section C: Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity.

Section D: International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings:

1. Erbisch FH and Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.

4. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
5. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
6. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.

Course outcomes:

After the successful completion of this course students will be able to:

- Use different tools of IPR for their rights.
- They will be able to guide the innovative farmers regarding various IPR tools and their use for protection of their rights.

SEMESTER-III

***ENT-600**

***Masters' Research**

S/US
Credits hours: 6(0+6)

SEMESTER-IV

ENT-541

Insect Ecology

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

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

Course Content:

Theory:

Section-A: Basic concepts of ecology. Organization levels. Ecosystem concept. Food chain. Characteristics of insect populations. Physical environment, its influence on abundance, distribution, rate of increase and diapauses in insects.

Section-B: Concept of intrinsic rate of increase. Biotic factors, intraspecific competition, logistic theory. Interspecific relationships, prey/predator models, effect of food and space on insects. Natural balance, population dynamics and regulation.

Section-C: Defense mechanisms against predators/parasitoids. Estimation of dispersal, migration and mortality factors. Life-tables and their application. Systems approach to ecology.

Section-D: Abundance and diversity of insects, its causes and estimates. Pest outbreaks and forecasting. Sampling considerations for population estimates of insects in different habitats. Pest management as applied ecology.

Practical:

Measurement of microenvironment- maintenance of physical factors, calculation of rate of increase (r_m), stable age distribution and fitting of logistic curve for population growth. Determination of distribution pattern, and size and number of samples. Estimation of population of different groups of insect pests. Measurement of insect diversity. Life-tables for determining mortality factors.

Suggested Reading

1. Burges HD and Hussey NW. (Eds). 1971. Microbial Control of Insects and Mites. Academic Press, London.

2. De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman and Hall, New York.
3. Dhaliwal GS and Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publishers, New Delhi.
4. Gerson H and Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman and Hall, New York.
5. Huffaker CB and Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London.
6. Ignacimuthu SS and Jayaraj S. 2003. Biological Control of Insect Pests. Phoenix Publ., New Delhi.
7. Saxena AB. 2003. Biological Control of Insect Pests. Anmol Publ., New Delhi.
8. Van Driesche and Bellows TS. Jr. 1996. Biological Control. Chapman and Hall, New York.

Course Outcomes:

It would help in different aspects of interactions of insects with different abiotic factors of ecosystem like temperature, relative humidity, light, air and water currents, influence of biotic Factors like intraspecific Interactions – Competition, Sex relations, Reproduction, Parental care, Cooperation, aggregation, colonial and social life and interspecific interactions like competition, Commensalism, Symbiosis, Parasitism – host interactions, Predators-prey interaction. The concept of population dynamics, different modes for sampling, population Growth, Causes of Population Fluctuations, Host plant insect interactions, Biochemical adaptation against environmental stress – Hibernation, Aestivation, Dormancy, Quiescence, Diapause, Polymorphism and Swarming in different insects.

SEMESTER-IV

ENT-542

Plant Resistance to Insects

Time: 3 Hours

Maximum Marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

Course Objectives:

1. Understand the mechanism of plant resistance against insects.
2. Role of plant morphological and physiological features in plant resistance against insect pests.
3. Understand the role of entomologist in breeding of crops.

Course Content:

Theory:

Section-A: History and importance of host plant resistance. Principles, classification, components, types and mechanisms of resistance. Insect-host plant relationships.

Section-B: Theories and bases of host-plant selection. Chemical ecology. Tritrophic relations. Volatiles and secondary plant substances. Basis of resistance.

Section-C: Factors affecting plant resistance including biotypes and measures to combat them. Screening techniques. Breeding for insect resistance in crop plants.

Section-D: Exploitation of wild plant species and gene transfer. Successful examples of resistant crop varieties in India and world. Role of biotechnology in plant resistance to insects.

Practical:

Screening techniques for measuring resistance. Measurement of plant characters and working out their correlations with plant resistance. Testing of resistance in important crops. Demonstration of antibiosis, tolerance and antixenosis.

Suggested Reading

1. Dhaliwal GS and Singh R. (Eds). 2004. Host Plant Resistance to Insects -Concepts and Applications. Panima Publ., New Delhi.
2. Maxwell FG and Jennings PR. (Eds). 1980. Breeding Plants Resistant to Insects. John Wiley and Sons, New York.
3. Painter RH. 1951. Insect Resistance in Crop Plants. MacMillan, London.

4. Panda N and Khush GS. 1995. Plant Resistance to Insects. CABI, London.
5. Smith CM. 2005. Plant Resistance to Arthropods – Molecular and Conventional Approaches. Springer, Berlin.

Course Outcome:

After the completion of the course the students will be acquainted with insect-host plant relationship, bases of host plant resistance to insects, and different factors influencing feeding of plants by insects. The students will also learn about the role of biotechnology in insect-pest management.

SEMESTER-IV

***PGS-505**

Disaster Management

Time: 3 Hours

Maximum Marks: 100

Theory: 100

Credit hours: 1(1+0)

Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of nine questions, out of which first question of 20 marks (comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Of the remaining 8 questions, two questions will be asked from each section (A,B,C,D) and the candidate will attempt 4 questions (one from each section). All questions will carry equal marks (20).

Course objective: Objective of this course is to get the students aware about various kinds of natural disasters, man-made disasters and its its management.

Course Content:

Theory:

Unit I: Definition and types of disaster

Hazards and Disasters, Risk and Vulnerability in disasters, Natural and Man-made disasters, earthquakes, floods drought, landslide, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

Unit II: Study of Important disasters

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landslides and its managements case studies of disasters in Sikkim (e.g. Earthquakes, Landslide). Social, Economics and Environmental impact of disasters.

Unit III: Mitigation and Management techniques of disasters

Basic principles of disaster management, Disaster Management cycle, Disaster Management policy, National and State bodies for disaster management, Early Warning Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

Unit IV: Training, awareness program and project on disaster management

Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

Suggested readings:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)

M.Sc. Ag. (Entomology) 2022-24

2. Damon, P. Copola, (2006) Introduction to International Disaster Management, ButterworthHeineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Course outcomes:

After the successful completion of this course students will be able to:

- Understand the types of natural and man-made disasters.
- They will know the management techniques in any natural or man-made disaster situation.
- They will also get familiar with various kinds of government policies and programmes for disaster prone and disaster effected places.

SEMESTER-IV

Masters' Research

***ENT-600**

S/US

Credits hours: 6(0+6)