CH. CHARAN SINGH UNIVERSITY, MEERUT

A.C. meeting date:

E.C. meeting date:

Minutes of the Meeting of Board of Studies in Entomology

As per the letter no. Committee Cell (BoS-M.Sc. Ag. Ento.)/ 7397, dated 06-10-2025, a meeting of the **Board of Studies in the subject of Entomology (Only University Campus)** in Faculty of Agriculture of the University was held on **09.10.2025** at 11:00 a.m. through hybrid mode (online and offline) in the Department of Plant Protection to finalize the syllabus for M.Sc. Ag. (Entomology) as per Choice Based Credit System (CBCS) and according to ICAR-BSMA Committee- 2020. Following Committee members were present in the meeting: Link for online meeting is: https://meet.google.com/pua-xktk-trj

1. Prof. Shailendra Sharma, Dean, Faculty of Agriculture and Convener-I, C.C.S. University, Meerut.
2. Prof. D.V. Singh, SVP University of Agri. & Technology, Meerut (External Subject Expert).
3. Prof. Mukesh Kumar Dhillon, Head, Division of Entomology, IARI-PUSA, New Delhi (External Subject Expert).
4. Prof. Anuj Bhatnagar, Principal Scientist, Division of Plant Protection, CPRIC, Modipuram (External Subject Expert).
5. Prof. Harikesh Singh, Principal, Ganna Utpadak (PG) College, Bareilly (External Subject Expert).
6. Dr. Ajay Kumar, Department of Plant Protection, C.C.S. University, Meerut (Special Invitee)

The Board went critically through the course contents of two year (four semesters) M.Sc. Ag. (Entomology) degree programme, under CBCS involving core courses, core elective courses and two open electives.

The Board unanimously approved the syllabus whose signed copy by the Board members is enclosed herewith. The syllabus may be made effective from the academic session 2025-26.

The rest of the conditions/ rules shall be same as are applicable in Choice Based Credit System of the Faculty of Agriculture/ other faculties of Ch. Charan Singh University, Meerut.

(Ajay Kumar)
Member

(D.V. Singh)
External Expert

(Mukesh Kumar Dhillon)
External Expert

(Anuj Bhatnagar)
External Expert

(Harikesh Singh)
External Expert

(Shailendra Sharma)
Dean, Faculty of Agriculture

For the kind perusal and approval:

(Hon'ble Vice Chancellor)

CH. CHARAN SINGH UNIVERSITY, MEERUT

(NAAC A++ Accredited)

PROGRAMME SYLLABUS

For

M. Sc. (Ag.) ENTOMOLOGY

Course outline and its distribution as per the recommendation of

{ICAR – Broad Subject Matter Area (BSMA) Committee}

Effective from

ACADEMIC SESSION 2025-2026

FACULTY OF AGRICULTURE

DEPARTMENT OF PLANT PROTECTION

ABOUT THE DEPARTMENT

The Department of Plant Protection was established in 1998 under the self-financed scheme (SFS) of the UP-State Government and the University to meet the long-standing demand of students, farmers, pesticide companies, bio-control laboratories, and government and private organizations. The study of plant protection aims at developing strategies, and means for overall improvement in crop production by minimizing crop losses due to insect-pests, diseases, weeds, nematodes, rodents, etc. The department has modern laboratories, which are well equipped for under-taking isolation, purification, identification and maintenance of cultures, mass rearing of natural enemies, mass production of bio-pesticides. Major equipments in the Department are BOD incubator, hot air oven, autoclave, Laminar air flow, GEL documentation system, deep freezer, high quality research microscopes, high quality inverted phase contrast microscopes, double distillation unit, bio-safety cabinets, PCR machines, electronic balances, horizontal electrophoresis unit, deep freezer, refrigerated centrifuge, pH meter, sprayers, etc. The department has its own departmental library, which consists of more than 1000 books of different titles, and journals A separate computer laboratory with online internet facility was also set-up in the department to cater the teaching and research needs of the postgraduate students. The department is having active academic collaboration with several national Institutes /laboratories in India like– Central Potato Research Institute (ICAR-CPRI), Shimla; National Research Centre for Integrated Pest Management (ICAR-NCIPM) New Delhi; National Bureau of Plant Genetic Resources (ICARNBPGR) New Delhi; National Research Centre on Litchi (ICAR-NRCL), Muzaffarpur (Bihar); Indian Institute of Wheat & Barley Research (ICAR-IIWBR), Karnal; Indian Institute of Pulses Research (ICAR-IIPR), Kanpur; Indian Institute of Sugarcane Research, Lucknow (ICARIISR); ICAR- Central Institute for Subtropical Horticulture, Lucknow, Uttar Pradesh (ICARCISH) and Indian Institute of Farming Systems Research (ICAR-IIFSR), Modipuram, Meerut, etc. where the students have an opportunity to undertake their thesis work in collaboration of the department. The students of the department have shown good performance in ARS, ICAR-NET and have obtained various scholarships from various agencies. Several students of the department are presently occupying important positions in both public and private sector organizations; including universities, colleges, and research institutes, state agriculture departments, krishi vigyan kendra (KVKs), FCI, DPPQS, private pesticides companies, etc.

Course Structure of M.Sc. Ag. (Entomology) degree programme:

M.Sc. Ag. (Entomology) is a two years (four semesters) full time CBCS course, including the thesis work. In each semester, there will be one open elective/ minor course of 4 credits each. A minimum of 108 credits are required to be earned for successful completion of the Master's degree programme. Each student has to undertake a thesis work on any aspect related to the course of study and submit the same at the end of fourth semester to Department. The students are also facilitated to receive training during their master's research work in different research institutes, laboratories and other Universities. Minimum 30 credits are required for master's research/ thesis. There shall be an advisory board consisting up to 3 members (major and minor) for guiding students for master's research from the department and minor can be from outside of the department/university.

Major Courses/ Core Compulsory: These are main (major) courses of the subject which every student has to study who has taken admission in PG (First and Second Year).

Supporting Courses/ Core Elective: The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Information Technology in Agriculture, etc.) or necessary for building his/ her overall competence.

Minor Courses/ Open Elective: From the subjects closely related to a student's major subject

Examination and Evaluation: The examination and evaluation patterns in each course will be according to the University norms as provided for CBCS system in this regard. Each theory paper will carry 80 marks (40+40 marks of internal and external evaluation). In each semester, there shall be one joint external practical examination carrying 80 marks based on all the four compulsory core courses (20+20+20+20 marks). The M.Sc. (Ag.) thesis shall be of 300 marks (200+100 marks for thesis evaluation and viva – voce examination, respectively).

Internal assessment in each course will be based on:

Quizzes- Two: each for 5 marks.	= 10 marks
Tests- Two: each for 10 marks.	= 20 marks
Seminar/Term paper: 10 marks in each paper	= 10 marks

Pass Percentage: Theory- A minimum of 30% marks separately in internal and external assessment of each course, Practical- 30%. Overall- An aggregate of 40% marks in all the courses (including practical) is required for passing (Entomology / M.Sc. Ag.)

Attendance Criterion: As per the norms decided by the statutory body

Maximum marks: 2000

(Ajay Kumar) (D.V. Singh) (M.K. Dhillon) (Anuj Bhatnagar) (Harikesh Singh) (Shailendra Sharma)

Percentage range for Division: First = 60% (6 = CGPA <= 10)
Percentage range for Division: Second = 45% (4.5 = CGPA < 6)
Percentage range for Division: Third = 40% (4 = CGPA < 4.5)

Marks Range for Grades:

Marks Range (Out of 100)	Grade	Grade Points
0-29	F/F	0
30-39	D	4
40-49	D^{+}	5
50-54	D^{++}	5.5
55-59	C	6
60-64	C^{+}	6.5
65-69	C^{++}	7
70-74	B	7.5
75-79	B^{+}	8
80-84	B^{++}	8.5
85-89	A	9
90-94	A^{+}	9.5
95-100	A^{++}	10

CBCS Regulations and grade card shall be as per Ordinances of the university in this regards.

Eligibility for Admission to M.Sc. Ag. (Entomology) CBCS Programme: Bachelor's degree in Agriculture/ Horticulture/ Forestry with 50% marks.

Intake (Number of Seats): 30

(Ajay Kumar) (D.V. Singh) (M.K. Dhillon) (Anuj Bhatnagar) (Harikesh Singh) (Shailendra Sharma)

Program: M.Sc. Ag.
Program (Specific): M.Sc. (Ag.) Entomology (CBCS)
Program Code: CPDD06

Program Outcomes

After successful completion of the M.Sc. (Ag.) Entomology program, students will be able to explore new opportunities in agriculture sector. They may also be expected to plan and execute independent research, formulate course curriculum in various sub-disciplines of Entomology, make plan/project for the development and advancement of Agricultural Entomological industry for the welfare of mankind in general.

PO1: To get opportunities in higher education. Students will be developed on the professional front. Program also provides opportunities for career advancement in teaching, research, and industries.

PO2: Entomologists commonly work with Plant Breeders, Farmers, Agronomists, Horticulturists, Pathologists etc. in the fields, farms and gardens wherever plants grow.

PO3: 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.

PO4: Addressing the farmer's problems with regard to insect pests of regional and national significance and their management.

PO5: To address environmental issues in relation to use of agro-chemicals in insect pest management by adopting bio-intensive and integrated approaches.

PO6: Students will be able to establish Agricultural entomology and applied entomology as a business and guide people to adopt Economic Entomology at large. Develop suitable package of practices for the prevention of post harvest losses. They may also be able to deliver recent Agricultural technologies to the stakeholders

(Ajay Kumar) (D.V. Singh) (M.K. Dhillon) (Anuj Bhatnagar) (Harikesh Singh) (Shailendra Sharma)

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Student will gain expertise in the field of Entomology.

PSO2: Students will be trained for entrepreneurship programme in agro-chemical and bio-pesticides industry.

PSO3: Expertise in the identification, ecology, life history of insect pests and basic principles and strategies in the management of insect pests.

PSO4: The knowledge acquired and skills 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.

PSO5: Analyse the complex insect pest problems of agriculture, horticulture and storage grains and address issues through use of modern tools and techniques in plant protection.

PSO-6: Interdisciplinary research work is also being carried out, with the different departments like Plant Pathology, Biochemistry, Molecular biology, Soil science, Horticulture, Agronomy etc.

PSO7: Aspirants of Entomology, comprises with the basic knowledge and technologies used in Apiculture, Nematology, Sericulture, Biological control Toxicology, Economic Entomology etc.

PSO8: This program has a strong theoretical and practical focus with an emphasis on applications, directly related to employment of the students. This program will be of great help to generate the employability and skills in the students for their better future.

(Ajay Kumar) (D.V. Singh) (M.K. Dhillon) (Anuj Bhatnagar) (Harikesh Singh) (Shailendra Sharma)

STRUCTURE OF THE PROGRAMME

Semester-wise titles of the papers in M.Sc. (Ag.) Entomology as per Choice Based Credit System and according to ICAR-BSMA Committee- 2020 w.e.f. 2025-26

Course Type	Course Title	Course Code	Credits L+P+T	Maximum Marks			
				Int.	Ext.	Practical	Total
Semester: First							
Core Compulsory/ Major Course	Insect Morphology	CJ-1525	4+1+0	40	40	20	100
	Insect Taxonomy	CJ-1526	4+1+0	40	40	20	100
	Concepts of Integrated Pest Management	CJ-1527	4+1+0	40	40	20	100
Core Elective/ Supporting Course	Statistical Methods for Applied Science	CJ-1528	4+1+0	40	40	20	100
Practical-I	Based on courses I-IV	CJ-525	1+1+1+1				
Open Elective/ Minor Course	Hindi/ English/ Urdu/ Sanskrit		4+0+0				100
	Total of Credits/ marks		**24**				**500**
Semester: Second							
Core Compulsory/ Major Course	Insect Anatomy and Physiology	CJ-2525	4+1+0	40	40	20	100
	Pests of Field Crops	CJ-2526	4+1+0	40	40	20	100
	Biological Control of Insect Pests and Weeds	CJ-2527	4+1+0	40	40	20	100
	Insect Ecology	CJ-2528	4+1+0	40	40	20	100
Practical-II	Based on courses V-VIII	CJ-625	1+1+1+1				
Open Elective/ Minor Course	Insect Vectors of Plant Pathogens	CO-6626	4+0+0				100
	Total of Credits/ marks		**24**				**500**
Semester: Third							
Core Compulsory/ Major Course	Toxicology of Insecticides	CJ-3525	4+1+0	40	40	20	100
	Post Harvest Entomology	CJ-3526	4+1+0	40	40	20	100
	Pests of Horticultural and Plantation Crops	CJ-3527	4+1+0	40	40	20	100
Core Elective/ Supporting Course	Information Technology in Agriculture	CJ-3528	4+1+0	40	40	20	100
Practical-III	Based on courses IX-XII	CJ-725	1+1+1+1				
Open Elective/ Minor Course	Sericulture	CO-7626	4+0+0				100
	Total of Credits/ marks		**24**				**500**
Semester: Fourth							
Core Compulsory/ Major Course	Master's Seminar	CJ-4525	0+1+0	100			100
	Master's Research	CJ-4526	0+30+0	150	150		300
Common Course	Basic Concepts in Laboratory Techniques	CJ-4527	0+4+0			100	100
	Total		**35**				**500**
	Grand Total of Credits/ marks		**110**				**2000**

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Compulsory Core Courses (Major Course)

DETAILED COURSES OF STUDY FOR M.Sc. (Ag.) ENTOMOLOGY
FIRST SEMESTER

Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **First**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-1525**	Course Title: **Insect Morphology**	

Aim of the course:
To acquaint the students with the external morphology of the insect's body and the functioning of various body parts.

Course Outcomes:
CO1- To study the anatomy of different systems.
CO2- Identify and describe the different body regions, sclerites, appendages and their modifications in insects and metamorphosis in insects. Interpret the need for specific modifications.
CO3- Create permanent slides and develops insect collection.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	**External Morphology:** Insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation. **Head:** Origin, structure and modification; mouthparts, antennae, their types and functioning; tentorium and neck sclerites. **Thorax:** Areas and sutures of tergum, sternum and pleuron, pterothorax; wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; legs: structure and modifications. **Abdomen:** Segmentation and appendages; genitalia and their modifications; embryonic and postembryonic development	25
II	Insect sense organs (mechano-photo and chemo- receptors); organogenesis at pupal stage; insect defense; chaetotaxy; morphological traits in relation to forensic entomology.	15
III	Types of immature stages in insect orders, morphology of egg, nymph/ larva and pupa, identification of different immature stages of crop pests and stored product insects. Comparative study of life history strategies in hemi-metabola and holometabola, immature stages as ecological and evolutionary adaptations, significance of immature stages for pest management.	20
	Practical: • Preparation of permanent mounts of different body parts and their appendages of taxonomic importance including male and female genitalia; • Dissection of genitalia. Types of immature stages in insects; their collection, rearing and preservation; • Identification of immature insects to orders and families, in endopterygote orders, viz., Diptera, Lepidoptera, Hymenoptera and Coleoptera using key	

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Teaching methods:

- Classroom lectures
- Power point presentations
- Exposure/ field visits
- Laboratory experiments
- Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected to have a complete understanding of the comparative morphology of the external features of insects that can be utilized in taxonomy, ecology and applied entomology.

Suggested Readings:

1. Chapman, R.F. (2006). The Insects: Structure and function. 4th edition, Cambridge University Press, Cambridge, U.K.
2. David, B.V. and Ananthkrishnan, T.N. (2004). General and Applied Entomology. Tata-McGraw Hill, New Delhi.
3. Duntson, P.A. (2004). The Insects: Structure, Function and Biodiversity. Kalyani Publishers, New Delhi.
4. P.J. Gullan and P.S. Cranston. (2010). The Insects: An outline of Entomology. 4th edition, John wiley & Sons, Ltd., Publication, West Sussex, U.K.
5. Richards, O.W. and Davies, R.G. (1977). Imm's General Text Book of Entomology. 10th Ed. Volume I. Structure, Physiology and Development. Chapman & Hall, New York.
6. Snodgrass, R.E. (1993). Principles of Insect Morphology. Cornell University Press, Ithaca.
7. Chu, H. F. 1992. How to Know Immature Insects. William Brown Publication, Iowa.
8. Evans, J. W. 2004. Outlines of Agricultural Entomology. Asiatic Publ., New Delhi.
9. Gillott, C. 1995. Entomology, 2nd Ed. Plenum Press, New York, London.
10. Gullan, P. J. and Cranston, P. S. 2000. The Insects, An Outline of Entomology, 2nd Ed. Blackwell Science, UK.
11. Peterson, A. 1962. Larvae of Insects. Ohio University Press, Ohio.
12. Tembhore, D. B. 2000. Modern Entomology, Himalaya Publishing House, Mumbai.
13. Stehr, F. W. 1998. Immature Insects. Vols. I, II. Kendall Hunt Publication, Iowa.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **First**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-1526**	Course Title: **Insect Taxonomy**	

Aim of the course:
To sensitize the students on the theory and practice of classifying organisms (with special reference to animals) and the rules governing the same. 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 with an emphasis on the practical aspects.

Course Outcomes:
CO1- 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.
CO2- Easily identifies the different orders of insect.
CO3- Understand basic information about insect taxonomy and its classification.
CO4- Prepare the develop identification key for important orders.
CO5- Analyse diagnostic features of Non-insect orders, Exopterygote orders and Endopterygote orders.
CO6- Evaluating the insect species diversity in various ecosystems.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	History of insect classification; principles of systematics and its importance. Identification, purpose, methods character matrix, taxonomic keys. Descriptions- subjects of descriptions, characters, nature of characters, analogy *v/s* homology, parallel *v/s* convergent evolution, intraspecific variation in characters, polythetic and polymorphic taxa, sexual dimorphism. Brief evolutionary history of insects- introduction to phylogeny of insects and Classification of Superclass Hexapoda – Classes – Ellipura (Collembola, Protura), Diplura and Insecta- and the Orders contained. International Code of Zoological Nomenclature, Phylocode, its brief explanation and uses. Process of speciation and interbreeding allopatric species. Molecular systemnatics, karyological and biochemical approaches in taxonomy. Insect labeling protocols and procedures.	25
II	Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them. Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera – Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera.	20

(Ajay Kumar) (D.V. Singh) (M.K. Dhillon) (Anuj Bhatnagar) (Harikesh Singh) (Shailendra Sharma)

III	Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them (Continued). Division Neoptera – Subdivision Endopterygota, Section Neuropteroid- Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuroptera and Coleoptera, Section Panorpoid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.	15
	Practical: • Study of Orders of insects and their identification using taxonomic keys; • Keying out families of insects of different major Orders: Odonata, Orthoptera, Mantodea, Isoptera, Hemiptera, Thysanoptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera; • Field visits to collect insects of different orders.	

Teaching methods:

- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Exposure/ field visits
- ❖ Laboratory experiments
- ❖ Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- ❖ Students are expected to know the evolution of arthropods, especially insects and other hexapods, and their hierarchical classification.
- ❖ Acquire working skills for collecting, mounting, and preserving insects.
- ❖ Understand the basic concepts of taxonomic hierarchy, identification, taxonomic characters, variations, taxonomic keys and preparation of taxonomic papers.
- ❖ Identify insects of economic importance up to family levels, taking up the insect orders of agriculture and veterinary importance.

Suggested Readings:

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, P.J. and Cranston, P.S. 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.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **First**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-1527**	Course Title: **Concepts of Integrated Pest Management**	

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

Course Outcomes:
CO1- The concept and philosophy, ecological principles, economic threshold etc are understood for consideration of economic management strategy.
CO2- 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.
CO3- Explain concepts of IPM, ETL, EIL, role of sampling and capable of identifying and implementing various components of IPM.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	History, origin, definition and evolution of various terminologies. Importance of resistance, principles, classification, components, types and mechanisms of resistance. National and international level crop protection organizations; insecticide regulatory bodies; synthetic insecticide, bio-pesticide and pheromone registration procedures; label claim of pesticides – the pros and cons.	10
II	Concept and philosophy, ecological principles, economic threshold concept and economic consideration. Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects.	10
III	Tools of pest management and their integration- legislative, quarantine regulations, cultural, physical and mechanical methods; semiochemicals, biotechnological and bio-rational approaches in IPM. Pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting; case studies of successful IPM programmes. ITK-s in IPM, area-wide IPM and IPM for organic farming; components of ecological engineering with successful examples	20
IV	Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessment direct losses, indirect losses, potential losses, avoidable losses, unavoidable losses; global and Indian scenario of crop losses. Computation of EIL and ETL.	20

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	Practical: • Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessment direct losses, indirect losses, potential losses, avoidable losses, unavoidable losses; • Computation of EIL and ETL; crop modeling; designing and implementing IPM system.	

Teaching methods:

- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Demonstration
- ❖ Laboratory experiments
- ❖ Field visits.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- ❖ Students are expected to have significant knowledge of IPM concepts, estimation of losses due to insect pests, computation of ETL, EIL and should be able take management decisions.

Suggested Readings:

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

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Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **First**
Subject: **ENTOMOLOGY**	Subject Code: **CPDD06**	
Course Code: **CJ-1528**	Course Title: **Statistical Methods for Applied Sciences**	

Aim of the course: This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Course Outcomes:

CO1- Understand basic statistical concepts, including averages, variability, and data visualization.
CO2- Use probability, random variables, and exploratory data analysis to study agricultural data.
CO3- Apply correlation, regression, and estimation methods to examine relationships and make predictions.
CO4- Use sampling distributions, chi-square, t-test, F-test, and ANOVA for hypothesis testing and data analysis.
CO5- Understand and apply common probability distributions and their uses in research.

Credit: **4+1**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	Frequency distribution, Box-plot, Measures of central tendency (Mean, Mode, Median), Measures of dispersion (range, variance, mean & standard deviation), Graphical representations of data by histogram, frequency polygon, frequency curve and cumulative frequency curves).	10
II	Exploratory data analysis, Theory of probability, Random variable and mathematical expectation.	10
III	Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination, Fitting of quadratic models.	10
IV	Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions. Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.	10
V	Discrete and continuous probability distributions, Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications.	10
VI	Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the randomness of a sequence. Median test.	10

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	Practical: • Exploratory data analysis, fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; • Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F; • Confidence interval estimation and Correlation and regression analysis, fitting of Linear and Quadratic Model; • Non-parametric tests. ANOVA: One way, Two Way, SRS.	

Teaching methods:

- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Exposure/ field visits
- ❖ Laboratory experiments
- ❖ Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- ❖ Understand basic statistical measures, including averages, variability, and data visualization.
- ❖ Apply probability concepts and exploratory data analysis to study agricultural data.
- ❖ Analyze relationships between variables using correlation, regression, and estimation techniques.
- ❖ Use probability distributions and non-parametric tests to handle different types of data in agricultural research.

Suggested Readings:

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.

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SECOND SEMESTER

Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **Second**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-2525**	Course Title: **Insect Anatomy and Physiology**	

Aim of the course:
To impart knowledge about the anatomy and physiology of insect body systems; nutritional physiology; and their applications in entomology.

Course Outcomes:
CO1- Capable of identifying structure, modification and physiology of digestive and excretory system.
CO2- Describe Respiratory and Circulatory, Anatomy & Physiology and their role in thermoregulation.
CO3- Capable of identifying various components of Nervous system and describe ion channels and Nerve physiology can explain various sense organs and their function.
CO4- Explain importance of Ecdysone and JH. Identify various Reproductive methods and physiology of reproduction.
CO5- Understand the Embryological growth in insects and development of various systems can explain role of various nutrients on the growth and symbionts impact on insects.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	Scope and importance of insect physiology; physiology of integument, moulting, chemistry of cuticle, biosysthesis of chitin; growth, hormonal control, metamorphosis and diapause; pheromone secretion, transmission, perception and reception.	20
II	Physiology and mechanism of digestion, circulation, respiration, excretion, reproduction, secretion (exocrine and endocrine glands) and nerve impulse transmission in insects.	20
III	Importance of insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology; artificial diets.	20
	Practical: • Determination of chitin in insect cuticle; • Examination and count of insect haemocytes; preparation and evaluation of various diets; • Consumption, utilization and digestion of natural and artificial diets.	

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Teaching methods:

- Classroom lectures
- Power point presentations
- Laboratory experiments
- Demonstration
- Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected to have a thorough understanding of insect growth and development, physiology of exoskeleton, endoskeleton and different organ systems; action and role of hormones, pheromones, physiology of nutrition and its application.

Suggested Readings:

1. Chapman, R.F. (2006). *The Insects: Structure and function*. 4th edition, Cambridge University Press, Cambridge, U.K.
2. David, B.V. and Ananthkrishnan, T.N. (2004). General and Applied Entomology. Tata-McGraw Hill, New Delhi.
3. Duntson, P.A. (2004). *The Insects: Structure, Function and Biodiversity*. Kalyani Publishers, New Delhi.
4. Gullan PJ and Cranston PS. 2000. *The Insects*: *An Outline of Entomology*, 2nd Ed. Blackwell Science, UK.
5. Kerkut, G.A. and Gilbert, L.I. (1985). *Comprehensive Insect Physiology, Biochemistry and Pharmacology*. Vols. I-XIII. Pergamon Press, New York.
6. Patnaik BD. 2002. *Physiology of Insects*. Dominant Publishers, New Delhi.
7. Richards, O.W. and Davies, R.G. (1977). *Imm's General Text Book of Entomology*. 10th Ed. Volume I. *Structure, Physiology and Development*. Chapman & Hall, New York.
8. Simpson SJ. 2007. *Advances in Insect Physiology*, Vol. 33, Academic Press (Elsevier), London, UK.
9. Patnaik, B.D. (2002). *Physiology of Insects*. Dominant, New Delhi.
10. Wigglesworth, V.B. (1984). *Insects Physiology*. 8th Ed. Chapman & Hall, New York.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **Second**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-2526**	Course Title: **Pests of Field Crops**	

Aim of the course:
To familiarize the students about nature of damage and seasonal incidence of pestiferous insects that causes loss to major field crops and their effective management by different methods.

Course Outcomes:
CO1- To familiarize the students about nature of damage and seasonal incidence of insect pests that causes loss to major field and their effective management by different methods.
CO2- Understand the ecological behavior of major insect pest of field crops.
CO3- Examine the typical damaging symptoms caused by pest on field crops.
CO4- Estimate the economic losses caused by the pest attack.
CO5- Plan for recent eco-friendly management practices for insect pest of field crops.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
	Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors. Insect pest scenario in relation to climate change.	
I	Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs, etc.). Insect pests of cereals and millets and their management.	20
II	Insect pests of pulses, tobacco, oilseeds and their management.	20
III	Insect pests of fibre crops, forage crops, sugarcane and their management.	20
	Practical: • Field visits, collection and identification of important pests and their natural enemies; • Detection and estimation of infestation and losses in different crops; • Study of life history of important insect pests.	

Teaching methods:
- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Laboratory experiments
- ❖ Demonstration
- ❖ Exposure/ field visits.

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Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected to acquire knowledge of insect pests of field crops, their nature of damage, life history traits and effective management.

Suggested Readings:

1. David, BV and Ramamurthy, VV. 2001. *Elements of Economic Entomology.* Popular Book Depot, Chennai.
2. Dunston, A.P. (2007). *The Insects: Beneficial and Harmful Aspects.* Kalyani Publishers, New Delhi.
3. Dhaliwal, G.S. and Arora, R. (2002). *Principles of Insect-pests Management.* First edition, Kalyani Publishers, New Delhi.
4. Dhaliwal, G.S., Singh, R. and Chhillar, B.S. (2006). *Essentials of Agricultural Entomology.* Kalyani Publishers, New Delhi.
5. Evans JW. 2005. *Insect Pests and their Control.* Asiatic Publ., New Delhi.
6. Nair MRGK. 1986. *Insect and Mites of Crops in India.* ICAR, New Delhi.
7. Prakash I and Mathur RP. 1987. *Management of Rodent Pests.* ICAR, New Delhi.
8. Srivastava, K.P. (2004). *A Text book of Applied Entomology.* 2nd Ed., Volume-I and II, Kalyani Publishers, New Delhi.
9. Saxena RC and Srivastava RC. 2007. *Entomology at a Glance.* Agrotech Publ. Academy, Udaipur.
10. Singh, A. (2003). *Field Problems of Important Crops.* 2nd Eds., Publishing by Punjab Agricultural University, Ludhiana, India.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **Second**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-2527**	Course Title: **Biological Control of Insect Pests and Weeds**	

Aim of the course: 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.

Course Outcomes:

CO1- Understand key characteristics of important natural enemies and observe symptoms caused by entomopathogens.

CO2- Explain about bacteria, viruses, fungi, protozoans and rickettsiae and their symptoms of infections, mass production and field release.

CO3- Use the bio-control knowledge for sustainable pest management.

CO4- Solve the pest outbreak problems through entomopathogenic organisms and natural enemies as an eco-friendly approach.

CO5- Describe about role of non insect predators and weed killers in biocontrol programmes.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation. History of insect pathology, infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes.	15
II	Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa, etc., their mode of action. Biological control of weeds using insects. Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens.	15
III	Mass production of quality bio-control agents- techniques, formulations, economics, field release/ application and evaluation. Development of insectaries, their maintenance.	15
IV	Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.	15
	Practical: • Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers; • Visits to bio-control laboratories to learn rearing and mass production of egg, egg-larval, larval, larval-pupal and pupal parasitoids, common predators, microbes and their laboratory hosts, phytophagous natural enemies of weeds; • Field collection of parasitoids and predators. Hands-on training in culturing, identification of common insect pathogens.	

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Teaching methods:

- Classroom lectures
- Power point presentations
- Laboratory experiments
- Demonstration
- Exposure/ field visits and industry visits.
- Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected to have a good understanding of the role of natural enemies in managing pest populations below those causing economic damage.
- Learn the techniques for mass production of quality bio-agents and their optimal use in IPM.

Suggested Readings:

1. Burges, H.D. and Hussey, N.W. (Eds). (1971). *Microbial Control of Insects and Mites*. Academic Press, London.
2. De, Bach P. (1964). *Biological Control of Insect Pests and Weeds*. Chapman & 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. (19900. *Acarine Biocontrol Agents – An Illustrated Key and Manual.* Chapman and Hall, New York.
5. Huffaker, C.B. and Messenger, P.S. (1976). *Theory and Practices of Biological Control.* Academic Press, London.
6. Ignacimuthu, S.S. and Jayaraj, S. (2003). *Biological Control of Insect Pests*. Phoenix Publishers, New Delhi.
7. Srivastava, K.P. (2004). A Text book of Applied Entomology. 2nd Eds., Volume-I, Kalyani Publishers, New Delhi.
8. Dhaliwal, G.S. and Arora, R. (2001). Integrated Pest Management: Concepts and Approaches. Kalyani Publishers, New Delhi.
9. Roy Van Driesche. (2009). Control of Pests and Weeds by Natural Enemies. Wiley Blackwell U.K.
10. Saxena AB. (2003). *Biological Control of Insect Pests*. Anmol Publ., New Delhi.
11. Van Driesche and Bellows TS. Jr. (1996). *Biological Control*. Chapman and Hall, New York.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **Second**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-2528**	Course Title: **Insect Ecology**	

Aim of the course:

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 Outcomes:

CO1- Acquired the knowledge to understand the concepts of ecology, basic principles of distribution and abundance of organisms and their causes.

CO2- Describe the role of ecology in population dynamics of insects and describe the link between ecology and pest management.

CO3- Understand the biotic and abiotic factors that drive terrestrial arthropod species richness and abundance.

CO4- Estimate pest intensity through damage assessment and implement pest management.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	History and definition. Basic Concepts. Organisation of the Biological world. Plato's. Natural Balance *vs.* Ecological Dynamics as the modern view. Abundance and diversity of insects, Estimates and Causal factors. Study of abundance and distribution and relation between the two. Basic principles of abiotic factors and their generalised action on insects. Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance, and biocoenosis, Systems approach to ecology.	14
II	Basic concepts of abundance- Model *vs.* Real world. Population growth basic models– Exponential *vs.* Logistic models. Discrete *vs.* Continuous growth models. Concepts of Carrying capacity, Environmental Resistance and Optimal yield. Vital Statistics- Life Tables and their application to insect biology. Survivorship curves. Case studies of insect life tables. Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) – aestivation, hibernation.	14
III	Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain- web and ecological succession. Interspecific interactions- Basic factors governing the interspecific interactions- Classification of interspecific interactions– The argument of cost-benefit ratios. Competition- Lotka-Volterra model, Concept of niche ecological homologues, competitive exclusion. Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies.	16

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IV	Community ecology- Concept of guild, Organization of communities- Hutchinson Ratio, May's d/w, Relation between the two and their association with Dyar's Law and Przibram's law. Relative distribution of organisms, Concept of diversity- the Wallacian view. Assessment of diversity. Diversity- stability debate, relevance to pest management. Pest management as applied ecology. Climate change and insect pest/ natural enemy population; ecological engineering.	16
	Practical: • Types of distributions of organisms; • Methods of sampling insects, estimation of densities of insects and understanding the distribution parameters- Measures of central tendencies; • Assessment of prey-predator densities from natural systems and understanding the correlation between the two; • Problem solving in ecology. Field visits to understand different ecosystems and to study insect occurrence in these systems.	

Teaching methods:

- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Laboratory experiments
- ❖ Demonstration, Exposure/ field visits.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- ❖ The students are expected to be well versed with the basic concepts of ecology, ecological succession, population ecology, community ecology, nutritional ecology and different insect-ecosystem interactions.
- ❖ Quantification of insect diversity and abundance, life table analyses, predator- prey and host-parasitoid relations, functional and numerical responses, niche breadth and overlap.

Suggested Readings:

1. Begon M, Townsend CR and Harper JL. 2006. *Ecology: From Individuals to Ecosystems*. 4th Ed. Blackwell Publishing, USA/ UK/ Australia.
2. Chapman JL and Reiss MJ. 2006. *Ecology: Principles and Applications*. 2nd Ed. Cambridge Univ. Press, Cambridge.
3. Fowler J, Cohen L and Jarvis P. 1998. Practical Statistics for Field Biology. 2nd Ed. John Wiley & Sons, Chichester, West Sussex PO19 8SQ, England.
4. Gupta RK. 2004. *Advances in Insect Biodiversity*. Agrobios, Jodhpur.
5. Krebs CJ. 1998. *Ecological Methodology*. 2nd Ed. Benjamin-Cummings Publ. Co., New York.
6. Magurran AE. 1988. *Ecological Diversity and its Measurement.* Princeton Univ. Press, Princeton.
7. Price PW. 1997. *Insect Ecology*. 3rd Ed. John Wiley, New York.
8. Schowalter Timothy D. 2011. *Insect Ecology – An Ecosystem Approach*. 3rd Ed. Academic Press, London, UK/ CA, USA.
9. Speight MR, Hunta MD and Watt AD. 2006. *Ecology of Insects: Concepts and Application*. Elsevier Science Publ., The Netherlands.

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THIRD SEMESTER

Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Third**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-3525**	Course Title: **Toxicology of Insecticides**	

Aim of the course:
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.

Course Outcomes:
CO1- 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.
CO2- Safety measures during handling of pesticides and their usages.
CO3- Familiarity with different types of pesticide classifications and their chemistry.
CO4- Knowledge on enforcement of insecticide act, registration of insecticides, development of toxicology data and ethics in animal use.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:
Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0	

Units	Topics	No. of Lectures (60 Hrs.)
I	Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.	06
II	Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature; categorization of insecticides on the basis of toxicity – criteria for bees, beneficial insects and other insects in general; structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds/ new insecticide molecules; nanopesticides; drawbacks of insecticide abuse.	18
III	Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides-synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity. Bioassay definition, objectives, criteria, factors, problems and solutions.	14
IV	Insecticide metabolism; insect-pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.	10
V	Insecticide residues, their significance and environmental implications; procedures of insecticide residue analysis. Insecticide Act, registration procedures, label claim, and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.	12
	Practical: • Insecticide formulations and mixtures; • Pesticide appliances; • Working out doses and concentrations of pesticides.	

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Teaching methods:

- Classroom lectures
- Power point presentations
- Laboratory experiments
- Demonstration
- Exposure/ field visits and industry visits
- Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected understand the concept of toxicity, bio-efficacy, insecticide formulations, modes of action of insecticides, estimation of insecticide residues and have significant know-how about the functioning of various types of spray equipments.

Suggested Readings:

1. IUPAC (1986). Pesticide Science and Biotechnology. Sixth edition. Black Well Publication, Australia.
2. Chattopadhyay, S.B. (1985). *Principles and Procedures of Plant Protection*. Oxford & IBH, New Delhi.
3. Gupta, H.C.L. (1999). *Insecticides: Toxicology and Uses*. 2nd Ed., Agrotech Publ., Udaipur.
4. Ishaaya, I. and Degheele. (1998). *Insecticides with Novel Modes of Action*. Narosa Publ. House, New Delhi.
5. Matsumura, F. (1985). *Toxicology of Insecticides*. Plenum Press, New York.
6. Parmar, B.S; Tomar, S.S (2004). *Pesticides Formulation: Theory and Practical*. 1st Ed., CBS. Publishers and Distributors, New Delhi.
7. Perry, A.S., Yamamoto, I., Ishaaya, I. and Perry, R. (1998). *Insecticides in Agriculture and Environment*. Narosa Publ. House, New Delhi.
8. Prakash A and Rao J. 1997. *Botanical Pesticides in Agriculture.* Lewis Publication, New York.
9. Dodia, D.A. Petel, I.S. and Petal, G.M. 2008. *Botanical Pesticides for Pest Management*. Scientific Publisher (India), Jodhpur.
10. Ishaaya, I. and Degheele, D. 1998. *Insecticides with Novel Modes of Action: Mechanism and Application*. Norosa Publishing House, New Delhi.
11. Mathews G.A. 2002. *Pesticide Application Methods*. 4th Ed. Intercept. UK
12. Roy, N.K. 2006. *Chemistry of Pesticides*. Asia Printograph Shahdara Delhi.
13. Krieger, R. I. 2001. *Handbook of Pesticide Toxicology*. Vol-II. Academic Press. Orlando Florida.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Third**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-3526**	Course Title: **Post Harvest Entomology**	

Aim of the course:
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.

Course Outcomes:
CO1- Analyze the complex insect pest problems of agriculture, horticulture and storage grains and address issues through use of modern tools and techniques in plant protection.
CO2- Exposure to handle the agri-horticultural produce for contamination free trading, treatment protocols, and other sanitary and phytosanitary regulations.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	Introduction, history of storage entomology, concepts of storage entomology and significance of insect pests. Post-harvest losses *in toto vis-à-vis* total production of food grains in India. Scientific and socio-economic factors responsible for grain losses.	10
II	Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature & extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains.	15
III	Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains & commodities. Stored grain deterioration process, physical and biochemical changes and consequences. Grain storage-types of storage structures i.e., traditional, improved and modern storage structures in current usage. Ideal seeds and commodities' storage conditions	15
IV	Important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Role of bird pests and their management. Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods. Curative measures- Non-chemical control measures- ecological, mechanical, physical, cultural, biological and engineering. Chemical control- prophylactic and curative- Characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants.	20

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	Practical: • Collection, identification and familiarization with the stored grains/ seed insect pests and nature of damage caused by them; • Detection of hidden insect infestation in stored food grains; • Determination of moisture content in stored food grains; • Familiarization of storage structures, demonstration of preventive and curative measures including fumigation techniques; • Field visits to save grain campaign, central warehouse and FCI warehouses and institutions engaged in research or practice of grain storage like IGSMRI, Hapur, etc.

Teaching methods:

- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Laboratory experiments
- ❖ Demonstration
- ❖ Exposure/ field visits and industry visits
- ❖ Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- ❖ Students are expected to acquire knowledge of pestiferous insects, mites, rats and birds affecting stored produce, their nature of damage, life history traits and effective management.
- ❖ Detection of insect infestation and familiarization with different storage structures.
- ❖ Learning preventive and curative measures to manage infestation in storage houses.

Suggested Readings:

1. Hall, D.W. (1970). *Handling and Storage of Food Grains in Tropical and Subtropical Areas*. FAO. Agricultural Development Paper No. 90 and FAO, Plant Production and Protection Series No. 19, FAO, Rome.
2. Jayas, D.V., White, N.D.G. and Muir, W.E. (1995). *Stored Grain Ecosystem*. Marcel, New York.
3. Khader, V. (2004). *Textbook on Food Storage and Preservation*. Kalyani Publishers, New Delhi.
4. Khera, B.P. (1994). *Store Grain Pests and Their Management*. Kalyani Publishers, New Delhi.
5. Subramanyam, B. and Hagstrum, D.W. (1995). *Integrated Management of Insects in Stored Products*. Marcel Dekker, New York.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Third**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-3527**	Course Title: **Pests of Horticultural and Plantation Crops**	

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

Course Outcomes:
CO1- Acquiring thorough knowledge and skill in the management of insect pest devastating agricultural and horticultural crops.
CO2- Exposure to handle the agri-horticultural produce for contamination free trading, treatment protocols, and other sanitary and phytosanitary regulations.
CO3-Examine the typical damaging symptoms caused by pest on horticultural and plantation crops.
CO4-Plan for recent eco-friendly management practices for insect pest of horticultural and plantation crops.

Credit: **04**	Core: **Compulsory/ Major Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practicals-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
	Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of various crops.	
I	Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, *ber*, citrus, *aonla*, pineapple, apple, peach and other temperate fruits	10
II	Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, French beans, brinjal, okra, all gourds, drumstick, leafy vegetables, etc.	15
III	Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa, etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, etc.	15
IV	Ornamental, medicinal and aromatic plants and pests in polyhouses/ protected cultivation.	20
	Practical: • Collection and identification of important pests and their natural enemies on different crops; • Study of life history of important insect pests and non-insect pests.	

Teaching methods:
- ❖ Classroom lectures
- ❖ Power point presentations
- ❖ Laboratory experiments
- ❖ Demonstration
- ❖ Exposure/ field visits

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Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected to acquire knowledge of insect pests of horticultural, medicinal and plantation crops, their nature of damage, life history traits and effective management.

Suggested Readings:

1. Atwal, A.S. and Dhaliwal, G.S. (2002). *Agricultural Pests of South Asia and their Management*. Kalyani Publishers, New Delhi.
2. Butani, D.K. and Jotwani, M.G. (1984). *Insects and Vegetables*. Periodical Expert Book Agency, New Delhi.
3. Dhaliwal, G.S., Singh, R. and Chhillar, B.S. (2006). *Essentials of Agricultural Entomology*. Kalyani Publishers, New Delhi.
4. Dhaliwal, G.S. and Arora, R. (2002). *Principles of Insect-pests Management*. 1st Ed., Kalyani Publishers, New Delhi.
5. Srivastava, K.P. (2004). A Text book of Applied Entomology. 2nd Ed., Volume-I and II, Kalyani Publishers, New Delhi.
6. Srivastava RP. 1997. *Mango Insect Pest Management*. International Book Distr., Dehra Dun.
7. Verma, L.R., Verma, A.K. and Goutham, D.C. (2004). *Pest Management in Horticulture Crops: Principles and Practices*. Asiatech Publ., New Delhi.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Third**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD07**
Course Code: **CJ-3528**	Course Title: **Information Technology in Agriculture**	

Aim of the course: This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office. Also to understand Internet and WWW, use of IT application and different IT tools in Agriculture.

Course Outcomes:

CO1- Apply fundamental computer concepts, MS Office tools, databases, and ICT applications for data management, analysis, and agricultural decision-making.

CO2- Utilize modern IT tools such as computer models, automated systems, geospatial technologies, and smartphone applications to enhance crop planning, resource management, and postharvest operations.

Credit: **4+1**	Core: **Core Elective/ Supporting Course**
Maximum Marks: **80+20**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 4-1-0

Units	Topics	No. of Lectures (60 Hrs.)
I	Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions.	15
II	Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications.	15
III	Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.	15
IV	Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.	15
	Practical: • Study of operating systems – definition, types, and basic operations, Use of MS Word for document creation and editing. • Preparation of data presentation using MS PowerPoint, Graph creation, data interpretation, and statistical analysis using MS Excel. • Use of smartphone applications for farm advisory, market prices, and postharvest management, Application of geospatial technology in generating agricultural information.	

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Teaching methods:

- Classroom lectures
- Power point presentations
- Exposure/ field visits
- Laboratory experiments
- Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Apply computer and ICT tools – including MS Office, databases, e-Agriculture, geospatial technologies, and decision support systems – for data management, analysis, and farm decision-making.
- Utilize modern IT applications – such as computer models, automated systems, and smartphone apps – to optimize crop water and nutrient management, market linkages, and postharvest operations.

Suggested Readings:

1. Vanitha G. 2011. Agro-informatics
2. Niederst J. 2001. *Web Design in a Nutshell*. O'Reilly Media.
3. Tanenbaum A.S. 2003. Computer Networks. *Prentice* Hall of India.
4. Gear C.W. 1974. *Computer Organization and Programming*. McGraw Hill.
5. Hayes J.P. 1988. *Computer Architecture and Organisation*. McGraw Hill.
6. http://www.agrimoon.com
7. http://www.agriinfo.in
8. http://www.eagri.org
9. http://www.agriglance.com
10. http://agritech.tnau.ac.in

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FOURTH SEMESTER

Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Fourth**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD07**
Course Code: **CJ-4525**	Course Title: **Master's Seminar**	

Aim of the course: The objective of this course is to enhance the student's ability to critically analyze, interpret, and communicate scientific knowledge through seminar presentations.

Course Outcomes:

CO1- Identify and select a suitable seminar topic based on recent advancements in their academic discipline.

CO2- Conduct a thorough literature survey and compile relevant information.

CO3- Prepare a structured seminar report using standard academic writing formats.

CO4- Deliver effective oral presentations using audio-visual tools.

Credit: **01**	Core: **Compulsory/ Major Course**
Maximum Marks: **100**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 4-0-0

Units	Topics	No. of Lectures (60 Hrs.)
I	Selection of seminar topic (current/recent research in discipline), Objectives, scope, and importance of seminar in Agriculture education.	10
II	Literature collection and organization from primary and secondary sources, Critical review of relevant research papers, reports, and case studies.	12
III	Preparation of seminar report: structure, format, referencing styles (APA/MLA/ICAR style) & scientific writing skills: coherence, clarity, flow of ideas.	12
IV	Designing effective seminar presentations: PowerPoint skills, charts, graphs, tables, images, and presentation ethics.	12
V	Evaluation of seminar based on content, presentation skills, and discussion handling, submission of written seminar report.	14

Teaching methods:

- Class discussions.
- PowerPoint-based presentations.
- Group discussions and peer feedback
- Mock seminars for practice and improvement

Learning Outcome:

- ❖ Identify, review, and analyze relevant literature to select and frame a suitable seminar topic.
- ❖ Prepare and present a well-structured seminar report and oral presentation using scientific writing and communication skills.
- ❖ Demonstrate confidence and critical thinking by effectively engaging in academic discussion and defending their seminar work.

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Suggested Readings:

1. Wayne Booth, Gregory Colomb, Joseph Williams (2008). *The Craft of Research.* University of Chicago Press.
2. Michael Alley (2013). *The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid.* Springer.
3. C.R. Kothari (2009). *Research Methodology: Methods and Techniques.* 2nd Edition, New Age International Publishers, New Delhi.
4. Zeigler, Bernard P. (2000). *Presentation Skills for Scientists and Engineers.* Morgan & Claypool Publishers.
5. Relevant recent research articles, reviews, reports, and seminar proceedings.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Fourth**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD07**
Course Code: **CJ-4526**	Course Title: **Master's Research**	

Aim of the course: The objective of this course is to train students in independent research work, including formulation of research problems, planning and execution of experiments, analysis of data, and preparation of a thesis/dissertation.

Course Outcomes:

CO1- Formulate research problems and hypotheses based on a review of literature.
CO2- Plan and conduct experiments/field work/laboratory work systematically.
CO3- Prepare a comprehensive dissertation following academic and ethical standards.

Credit: **30**	Core: **Compulsory/ Major Course**
Maximum Marks: **300**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 0-4-0

Units	Topics
I	Identification of research problem in the chosen discipline, Formulation of objectives, hypotheses, and methodology, Designing experimental layout/field trials/lab experiments.
II	Collection of literature related to the research problem, Standardization of methods, tools, and techniques, Preliminary experiments/trials.
III	Execution of main research experiments (field, laboratory, or bioinformatics-based).
IV	Compilation and statistical analysis of data, Preparation of tables, graphs, and illustrations.
V	Preparation of dissertation (Introduction, Review of Literature, Materials & Methods, Results & Discussion, Summary & Conclusion, References, Appendices).
VI	Evaluation of thesis based on content, data presentation, and major findings, Submission of written thesis report.

Teaching methods:

- Individual guidance by research supervisor
- Laboratory and field-based practical work
- Data analysis using appropriate statistical tools/software
- Regular progress presentations and discussions
- Thesis writing and final defense.

Learning Outcome:

- ❖ Formulate a relevant research problem, objectives, hypotheses, and design appropriate experimental/field/laboratory methodologies.
- ❖ Conduct and Manage Research by reviewing literature, standardizing methods, executing experiments, and maintaining accurate records.
- ❖ Analyze and Interpret Data using statistical tools, graphical representation, and critical discussion with reference to existing studies.
- ❖ Prepare and Communicate Research Findings through a well-structured dissertation, abstracts, and presentations adhering to academic and ethical standards.

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Suggested Readings:

1. C.R. Kothari and Gaurav Garg (2019). *Research Methodology: Methods and Techniques.* New Age International Publishers, New Delhi.
2. John W. Creswell (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.
3. Patrick Dunleavy (2003). *Authoring a Ph.D.: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation*. Palgrave Macmillan.
4. Wayne Booth, Gregory Colomb, Joseph Williams (2008). *The Craft of Research.* University of Chicago Press.
5. Relevant recent theses, dissertations, and peer-reviewed journal articles.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Fourth**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CJ-4527**	Course Title: **Basic Concepts in Laboratory Techniques**	

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

Course Outcomes:

CO1- Demonstrate safe laboratory practices and proper handling of chemicals, glassware, and laboratory equipment.

CO2- Prepare and manage solutions, agro-chemical doses, buffers, and media for laboratory and field applications.

CO3- Apply basic techniques in seed and pollen viability testing, plant tissue culture, and botanical description for taxonomic studies.

Credit: **04**	Core: **Common Course**
Maximum Marks: **100**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 0-4-0

Units	Topics	No. of Lectures (60 Hrs.)
	Practical: • Safety measures while in Lab; • Handling of chemical substances; • Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; • Washing, drying and sterilization of glassware; • Drying of solvents/ chemicals; • Weighing and preparation of solutions of different strengths and their dilution; • Handling techniques of solutions; • Preparation of different agro-chemical doses in field and pot applications; • Preparation of solutions of acids; • Neutralisation of acid and bases; • Preparation of buffers of different strengths and pH values; • Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; • Electric wiring and earthing; • Preparation of media and methods of sterilization; • Seed viability testing, testing of pollen viability; • Tissue culture of crop plants; • Description of flowering plants in botanical terms in relation to taxonomy.	

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Teaching methods:

- Classroom lectures
- Power point presentations
- Exposure/ field visits
- Laboratory experiments
- Hands on training.

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Follow essential laboratory safety protocols for handling chemicals, glassware, and equipment.
- Accurately prepare and dilute solutions, buffers, and agro-chemical doses for laboratory and field use.
- Operate and maintain key laboratory instruments such as microscopes, laminar flow units, and incubators etc.

Suggested Readings:

1. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

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Open Elective/ Minor Course

Programme/ Class: **M.Sc. (Ag.)**	Year: **First**	Semester: **Second**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CO-6626**	Course Title: **Insect Vectors of Plant Pathogens**	

Aim of the course: To teach the students about the different groups of insects that act as vectors of plant pathogens, vector-plant pathogen interaction, and management of vectors for controlling diseases.

Course Outcomes:

CO1- Understand the taxonomy, morphology, feeding behavior, and transmission mechanisms of major insect vectors involved in spreading plant pathogens.

CO2- Apply knowledge of vector–pathogen–host interactions to develop effective strategies for managing insect-transmitted plant diseases.

Credit: **04**	Core: **Open Elective/Minor Course**
Maximum Marks: **50+50**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 4-0-0

Units	Topics	No. of Lectures (60 Hrs.)
I	History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission.	14
II	Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.	12
III	Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips.	10
IV	Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.	10
V	Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.	14

Teaching methods:

- Classroom lectures
- Power point presentations
- Exposure/ field visits
- Laboratory experiments

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning Outcome:

- Students are expected to be well versed with insect vectors of plant pathogens, acquire knowledge on disease transmission and vector management techniques.

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Suggested Readings:

1. Basu AN. 1995. *Bemisia tabaci* (Gennadius) – *Crop Pest and Principal Whitefly Vector of Plant Viruses*. Oxford and IBH, New Delhi.
2. Basu AN. 1995. *Bemisia tabaci* (Gennadius) – *Crop Pest and Principal Whitefly Vector of Plant Viruses*. Oxford and IBH, New Delhi.
3. Harris KF and Maramarosh K. (Eds.). 1980. *Vectors of Plant Pathogens*. Academic Press, London.
4. Maramorosch K and Harris KF. (Eds.). 1979. *Leafhopper Vectors and Plant Disease Agents*. Academic Press, London.
5. Youdeovei A and Service MW. 1983. *Pest and Vector Management in the Tropics*. English Language Books Series, Longman, London.

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Programme/ Class: **M.Sc. (Ag.)**	Year: **Second**	Semester: **Third**
Subject: **ENTOMOLOGY**		Subject Code: **CPDD06**
Course Code: **CO-7626**	Course Title: **Sericulture**	

Aim of the course: To familiarize the students with entrepreneurial opportunities in entomology, sericulture in particular, and providing information on silk worm rearing, production and management.

Course Outcomes:

CO1- Understand the biology, morphology, and rearing techniques of mulberry and non-mulberry silkworms, including their host plants, diseases, and management practices.

CO2- Apply knowledge of silkworm rearing, post-cocoon technology, and sericulture economics to develop entrepreneurial skills and promote sustainable silk production.

Credit: **04**	Core: **Open Elective/Minor Course**
Maximum Marks: **50+50**	Minimum Passing Marks:

Total numbers of Lectures-Practical's-Tutorials (in hours per week): 4-0-0

Units	Topics	No. of Lectures (60 Hrs.)
I	History of Sericulture, importance, organizations involved in sericulture activities, silkworm types, distribution, area and silk production.	06
II	Mulberry species, ecological requirements, cultivation, improved varieties, propagation methods, sapling production, planting and pruning techniques; pest and diseases, management strategies; intercropping, water and weed management. Food plants of eri silkworm, castor cultivation, intercultural operations, nutrient and water management; method of harvest; host plants of Tasar, nursery and cultivation, selection of seed, soaking and heap making, pruning techniques. Food plants of Muga silkworm, Som and Soalu propagation methods; nursery techniques; intercultural operations and weed management.	16
III	Silkworm origin – classification based on voltinism, moultinism, geographical distribution and genetic nature – pure races –multivoltine and bivoltine races – cross breeds – bivoltine hybrids –Races and hybrids of mulberry, eri, tasar and muga silkworm- Morphology and biology of silkworm, sex limited characters; anatomy of digestive and excretory systems of larva; structure and function of silk glands.	14
IV	Rearing house, types, disinfection, room and bed disinfectants; egg incubation methods, Chawki rearing, feeding, cleaning and spacing; rearing of late age worms, feeding, cleaning, spacing and moulting care; mountages, cocoon harvesting and marketing; pests and diseases of silkworms and their management.	12
V	Post cocoon technology, stifling, cocoon cooking, brushing, reeling, re-reeling, bleaching, degumming, dyeing, printing and weaving, different reeling machines; value addition in sericulture; economics of sericulture.	12

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Teaching methods:

- Classroom lectures
- Power point presentations
- Exposure/ field visits
- Laboratory experiments

Home Assignments, Quizzes, and Surprise Class Tests: The continuing evaluation process through Home Assignments, Quizzes, and Surprise Tests will be done by the concerned teacher teaching that course at regular interval of time.

Learning outcome

- Students taking up sericulture are expected to have a thorough knowledge of silkworm morphology, races, biology, and all the practices of rearing for silk production.
- They should be well versed with the pests and diseases of silkworm and their management.
- With practical training it is expected that students develop entrepreneurial skills for sericulture or link up with industries to sell cocoons for silk production or guide farmers engaged in silk worm rearing/ sericulture.

Suggested Readings:

1. Dandin SB and K Giridhar. 2014. *Hand book of Sericulture Technologies*. Central Silk Board, Bangalore, 423p.
2. Govindaiah G, VP, Sharma DD, Rajadurai S and Nishita V Naik. 2005. *A text book on mulberry crop protection.* Central Silk Board, Bangalore. 450 p. Restructured and Revised Syllabi of Post-graduate Programmes Vol. 1.
3. Jolly MS, Sen SK, Sonwalkar TN and Prasad GK. 1980. *Non–mulberry Silks*. FAO Agicultural Services Bulletin 29. Food and Agriculture Organization of the United Nations, Rome, 178 p..
4. Mahadevappa D, Halliyal VG, Shankar DG and Ravindra Bhandiwad. 2000. *Mulberry Silk Reeling Technology*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi. 234 p.
5. Nataraju B, Sathyaprasad K, Manjunath D and Kumar A. 2005. *Silkworm crop protection.* CSB, Bangalore. 412 pp.
6. Rangaswami G, Narasimhanna MN, Kasiviswanathan K, Sastry CR and Jolly MS. 1976. *Food Plants of non-mulberry silkworms. In*: *Mulberry cultivation.* FAO Agricultural Services Bulletin. Vol.1, Chapter-13. Rome, Italy. 96 p.
7. Tribhuvan Singh and Saratchandra B. 2004. *Principles and Techniques of silkworm seed production.* Discovery publishing House, New Delhi, 360 pp.

E-resources

- www.silkwormgenomics.org;
- www.silkboard.com;
- ww.silkgermplasm.com;
- www.csrtimys.res.in

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