

# **FACULTY OF AGRICULTURE**

## **SYLLABUS**

For

**M.Sc. Ag. (Entomology)**

**(Semester: I–IV)**

**Session: 2020-21**

**KHALSA COLLEGE AMRITSAR-143001**

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-I

| Sr. No. | Course Code                    | Subject  | Periods per week |           | Marks      |            | Internal Assesment* | Grand Total    |
|---------|--------------------------------|--|------------------|-----------|------------|------------|---------------------|----------------|
|         |                                |  | Th.              | Pract.    | Th.        | Pract.     |                     |                |
| 1       | ENT-511                        | Insect Morphology and Systematics                              | 4                | 3         | 75         | 37         | 38                  | 150            |
| 2       | ENT-512                        | Insect Anatomy and Physiology                                  | 4                | 6         | 75         | 37         | 38                  | 150            |
| 3       | ENT-513                        | Classification of Insects                                      | 4                | 3         | 75         | 37         | 38                  | 150            |
| 4       | TWC-514                        | Technical Writing and Communication Skills                     | 2                | 0         | 50         | -          | -                   | <b>50 (NC)</b> |
| 5       | PPL-410/<br>SSC-410<br>(Minor) | Principles of Plant Pathology/Soil Chemistry and Bio Chemistry | 4                | 6         | 75         | 37         | 38                  | 150            |
| 6       | STA-415                        | Statistical Methods for Research Workers                       | 4                | 3         | 75         | 37         | 38                  | 150            |
| 7       |                                | Research Work (Synopsis)                                       | -                | 2         | -          | -          | -                   | --             |
|         | <b>Total</b>                   |  | <b>22</b>        | <b>23</b> | <b>375</b> | <b>185</b> | <b>190</b>          | <b>750</b>     |

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

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-II

| Sr. No       | Course Code                    | Subject   | Periods per week |           | Marks      |            | Internal Assesment* | Grand Total |
|--------------|--------------------------------|---|------------------|-----------|------------|------------|---------------------|-------------|
|              |                                |   | Th.              | Pract.    | Th.        | Pract.     |                     |             |
| 1            | ENT-521                        | Insect Ecology  | 4                | 3         | 75         | 37         | 38                  | 150         |
| 2            | ENT-522                        | Toxicology of Insecticides  | 4                | 6         | 75         | 37         | 38                  | 150         |
| 3            | ENT-523                        | Plant Resistance to Insects                                       | 4                | 3         | 75         | 37         | 38                  | 150         |
| 4            | TPP-524/<br>IBC-524            | Techniques in Plant Protection/<br>Insect Biochemistry            | 4                | 3         | 75         | 37         | 38                  | 150         |
| 5            | PPL-420/<br>BCH-420<br>(Minor) | Principles of Plant Disease Management/<br>Pesticide Formulations | 4                | 6         | 75         | 37         | 38                  | 150         |
| 6            | STA-425                        | Experimental Designs for Research Worker                          | 4                | 3         | 75         | 37         | 38                  | 150         |
| 7            |                                | Research Work (Synopsis)  | -                | 2         | -          | -          | -                   | --          |
| <b>Total</b> |                                |   | <b>24</b>        | <b>26</b> | <b>450</b> | <b>222</b> | <b>228</b>          | <b>900</b>  |

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

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-III

| Sr. No. | Course Code                    | Subject   | Periods per week |           | Marks      |            | Internal Assesment* | Grand Total |
|---------|--------------------------------|---|------------------|-----------|------------|------------|---------------------|-------------|
|         |                                |   | Th.              | Prac      | Th.        | Prac       |                     |             |
| 1       | ENT-531                        | Biological Control of Insect Pests                            | 4                | 3         | 75         | 37         | 38                  | 150         |
| 2       | ENT-532                        | Integrated Pest Management                                    | 4                | 6         | 75         | 37         | 38                  | 150         |
| 3       | PPL-430/<br>BOT-430<br>(Minor) | Fungal Diseases of Plants/ Physiology of Growth & Development | 4                | 3         | 75         | 37         | 38                  | 150         |
| 4       |                                | Credit seminar  | -                | 3         | 100        | --         | --                  | 100         |
| 5       |                                | Research Work (Thesis)  | -                | 4         | --         | --         | --                  | S/US        |
|         | <b>Total</b>                   |   | <b>12</b>        | <b>19</b> | <b>325</b> | <b>111</b> | <b>114</b>          | <b>550</b>  |

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

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-IV

| Sr. No. | Course Code | Subject                   | Periods per week |           | Marks      |           | Internal Assessment* | Grand Total |
|---------|-------------|---------------------------|------------------|-----------|------------|-----------|----------------------|-------------|
|         |             |                           | Th.              | Pract.    | Th.        | Pract.    |                      |             |
| 1       | ENT-541     | Commercial Entomology     | 4                | 3         | 50         | 25        | 25                   | 100         |
| 2.      | ENT-542     | Storage Entomology        | 4                | 3         | 50         | 25        | 25                   | 100         |
| 3       |             | Research Work<br>(Thesis) |                  | 4         |            |           |                      | S/US        |
|         |             | <b>Total</b>              | <b>08</b>        | <b>10</b> | <b>100</b> | <b>50</b> | <b>50</b>            | <b>200</b>  |

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

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-I

**ENT-511**

**Insect Morphology and Systematics**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+3**

#### **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 15 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 (15).

#### **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.

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-I

ENT-512

Insect Anatomy and Physiology

Time: 3 Hours

Max. Marks: 150

Theory: 75

Practical: 37

Internal assessment: 38

Periods per week: 04+6

#### 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 15 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 (15).

#### 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.

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-I

**ENT-513**

**Time: 3 Hours**

**Classification of Insects**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+3**

#### **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 15 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 (15).

#### **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 alongwith the habits and habitats of insects belonging to economically important families of Apterygota and Endopterygota orders of Class Insecta.

**Section-D:** Distinguishing morphological characters alongwith 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 upto family level. Field visits to collect insects of different orders.



# M.Sc. Ag. (ENTOMOLOGY)

## SEMESTER-I

**TWC-514**                      **Technical Writing and Communication Skills**

**Time:-3 hours**

**Max. Marks: 50**  
**Theory Marks: 37**  
**Internal Assessment: 13**  
Periods per week: 02+0

### **Instructions for the Paper Setters:**

- 1) The question paper will consist of seven skill-oriented questions.
- 2) The first 6 Questions carry 5 marks each. There will be internal choice wherever possible  
(6x5=30 Marks).
- 3) There will be one essay type question out of two parts of the course. The student has to attempt any one of the two in about 150 words  
(1x7=7 Marks)

### **Course Contents:**

1. **Technical Writing**-Various forms of technical writing-theses, technical papers, reviews, electronic communication etc; qualities of technical writing; parts of research communications- title page, content page, authorship, preface, introduction, review of literature, materials and methods, experimental results, documentation; photographs and drawings with suitable captions; pagination; citations; writing of abstracts; précis; synopsis; editing and proof reading.

2. **Communication Skills**-defining communication; types of communication- verbal and non-verbal; assertive communication; using language for effective communication; paraphrasing; vocabulary building- word roots, prefixes.

### **Recommended Books:**

1. *Oxford Guide to Effective Writing and Speaking* by John Seely.
2. *The Written Word* by Vandana R Singh, Oxford University Press

# M.Sc. Ag. (ENTOMOLOGY)

## SEMESTER-I

**PPL-410**

**Principles of Plant Pathology**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+6**

### **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 15 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 (15).

### **Theory:**

**Section-A:** Importance, terminology and concepts of plant diseases. History and growth of plant pathology. Biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens.

**Section-B:** Role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection. Symptomatology, disease development. Role of enzymes, toxins, growth regulators.

**Section-C:** Defense strategies, oxidative burst, phenolics, phytoalexins, PR proteins and elicitors. Altered plant metabolism as affected by plant pathogens. Disease management strategies

**Section-D:** Genetics of resistance, 'R' genes, mechanism of genetic variation in pathogens, molecular basis for resistance, marker-assisted selection and genetic engineering for disease resistance.

### **Practicals:**

Growth, reproduction, survival and dispersal of important plant pathogens and their symptomatology

Study of Biotic and abiotic causes of plant diseases and its management

Serological and molecular techniques for detection of plant pathogens.

Molecular techniques to study variability in different plant pathogens

Various disease management strategies

Evaluation of fungicides and bactericides.

Screening techniques for measuring resistance of host plant

Demonstration of gene transfer techniques- direct and indirect methods.

## M.Sc. Ag. (ENTOMOLOGY)

### SEMESTER-I

SSC-410

Soil Chemistry and Bio Chemistry (Minor)

Time: 3 Hours

Max. Marks: 150

Theory: 75

Practical: 37

Internal assessment: 38

Periods per week: 04+06

#### 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.
5. In all nine questions should be asked, of which first question of 15 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
3. 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 (15).

#### Theory

**Section-A:** Soil colloids–nature, properties, origin of charges and their significance; Cation and anion exchange phenomena and their importance; Introduction to ionic adsorption and fixation;

**Section-B:** Soil reaction and buffering; Distribution, characterization, genesis and amelioration of acid, acid sulphate, saline, saline-sodic, sodic and calcareous soils; Plant reaction and tolerance to soil salinity, sodicity and acidity;

**Section-C:** Chemical and electro chemical properties of submerged soils; Organic matter and characterization of clay –organic matter interaction ;

**Section-D:** Biochemical decomposition of organic manures and farm wastes, composting and vermicomposting .Biochemistry of humus formation and biogas production .

**Practical:  
Hours**

**Time: 3**

Determination of the effect of dilution and salinity on soil pH; Active and potential acidity; Cation and anion exchange capacity and exchangeable cations; Soluble salts in soils; Lime and gypsum requirements. Nutrient adsorption and fixation capacities of soils; Estimation of biochemical constituents of organic residues- cellulose, hemi-cellulose, lignin and C: N ratio. Preparation of enriched compost, biofertilizers and vermiculture

**SEMESTER-I**

**STA-415: Statistical Methods for Research Workers**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+3**

**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 15 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 (15).

**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.

**SEMESTER-II**

**ENT-521**

**Insect Ecology**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+3**

**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 15 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 (15).

**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 (rm), 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.

**SEMESTER-II**

**ENT-522**

**Toxicology of Insecticides**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+6**

**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 15 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 (15).

**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.

**SEMESTER-II**

**ENT-523**

**Plant Resistance to Insects**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+3**

**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 15 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 (15).

**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.

**SEMESTER-II**

**TPP-524                      TECHNIQUES IN PLANT PROTECTION**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal Assessment: 38**

**Periods per Week 4+3**

**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 15 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 (15).

**Theory:**

**UNIT I**

Pest control equipments, principles, operation, maintenance, selection, application of pesticides and biocontrol agents, seed dressing, soaking, root-dip treatment, dusting, spraying, application through irrigation water.

**UNIT II**

Soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests through seed, bulbs, corms, cuttings and cut flowers.

**UNIT III**

Protein isolation from the pest and host plant and its quantification using spectrophotometer and molecular weight determination using SDS/PAGE. Use of tissue culture techniques in plant protection.

**UNIT IV**

Use of light, transmission and scanning electron microscopy. Computer application for predicting/forecasting pest attack and identification.

**Practical:**

Study of plant protection equipments with respect to principle, parts, working, uses and maintenance

Study of seed dressing techniques by using traditional methods and seed dresser

Symptomatic diagnosis and other techniques to detect pest/pathogen infestations

Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Sterilization techniques, Callus induction from various explants, micropropagation

Protein estimation using spectrophotometer

SDS-PAGE for molecular weight determination

Principle and Use of light, transmission and scanning electron microscopy

Use of computer applications in pest forecasting and identification



**SEMESTER-II**  
**INSECT BIOCHEMISTRY**

**IBC-524**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal Assessment: 38**

**Periods per Week 4+3**

**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 15 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 (15).

**Theory:**

**UNIT I**

Metabolic specializations in insects in relation to carbohydrates, lipids, amino acids and proteins; role of trehalose and glycogen in energy production.

**UNIT II**

Insect lipids and their metabolism during flight, diapause and reproduction; biochemistry of tyrosine, tryptophan and proline metabolism in insects.

**UNIT III**

Biosynthesis, mode of action and metabolism of insect juvenile hormones and ecdysones; pheromone biosynthesis and regulation of release;

**UNIT IV**

Insect neuropeptides and special emphasis on PTTH, adipokinetic hormone, proctolin and bursicon; insect specific proteins.

**Practicals**

Estimation of carbohydrates, lipids, amino acids and protein, JH, ecdysone etc. in insect haemolymph. To study pheromone biosynthesis and regulation of neuropeptides, adipokinetic hormone, proctolin and bursicon.

**SEMESTER-II**

**PPL-420**

**Principles of Plant Disease Management**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+6**

**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. In all nine questions should be asked, of which first question of 15 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 (15).

**Theory:**

**Section-A:** Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals. Integrated control measures of plant diseases.

**Section-B:** Disease resistance and molecular approach for disease management. Foliage, seed and soil application of chemicals. Role of stickers, spreaders and other adjuvants. History of fungicides, bactericides, antibiotics, antivirals.

**Section-C:** Concepts of pathogen, immobilization, chemical protection and chemotherapy. Nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals.

**Section-D:** Recent trends in the development of fungi-toxicants, antibiotics and antiviral agents and relationships between their structures and activity. Environmental hazards, residual effects and safety measures.

**Practical:** In vitro and in vivo evaluation of chemicals against plant pathogens. Foliage, seed and soil application of chemicals. Role of stickers, spreaders and other adjuvants. ED and MIC values. Study of structural details of sprayers and dusters. Environmental hazards, residual effects and safety measures.

**SEMESTER-II**

**BCH-420**

**Pesticide Formulations (Minor)**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+6**

**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 15 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 (15).

**Theory:**

**Section-A:** General aspects: definition, objectives, process, product spectrum, classification, formulation codes etc. Solid and liquid formulations including the latest developments: preparation, properties, specifications, use etc.

**Section-B:** Formulants: carriers/ diluents, surfactants, synergists, safeners, encapsulants, antioxidants, stabilizers etc. highlighting chemistry, classification, properties, use etc., formulant-toxicant interactions, pesticide mixtures.

**Section-C:** Machinery and equipment, packaging and labeling. Packaging standards, requirement, materials, disposal, decontamination etc. Labeling: content, specifications, needs for low literacy regions, etc.

**Section-D:** Application: principles, distribution and coverage, recent developments. Precautions in use of pesticides. Bio-efficacy: basic considerations and applied aspects, physico-chemical basis, pesticide antidotes.

**Practical:**

Equipment used in formulation research, Determination of acidity of a pesticide, Determination of alkalinity of a pesticide, Preparation of controlled release formulation, Release of active ingredient from CR formulation in soil and water, Preparation of toxicant based creams, Study of solid carriers: Determination of (i) Surface acidity by volumetric method, (ii) Surface area, study of solid carriers, (iii) Sorptivity and (iv) Particle size. Preparation of dust, wettable powder and granules, Determination of wettability and suspensibility of wettable powder, Study of liquid carriers (i) Flash point and specific gravity, Study of liquid carriers (ii) Determination of viscosity. Study of surfactants: Micelle formation, Preparation of liquid formulations, Determination of emulsion stability of an emulsifiable concentrate, Application technology: Sprayers.

**SEMESTER-II**

**STA-425:**

**Experimental Designs for Research Workers**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment: 38**

**Periods per week: 04+3**

**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 15 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 (15).

**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.

**SEMESTER-III**

**ENT-531**

**Biological Control of Insect Pests**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment=38**

**Periods per week: 04+3**

**Instructions for the Paper Setters:**

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3. In all nine questions should be asked, of which first question of 15 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 (15).

**Theory**

**Unit- I**

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, Reduvid bugs) of insects.

**Unit- II**

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.

**Unit-III**

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

**Unit-IV**

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.
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.

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## SEMESTER-III

ENT-532

Integrated Pest Management

Time: 3 Hours

Max. Marks: 150

Theory: 75

Practical: 37

Internal Assessment=30

Periods per week : 04+6

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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 (15).

### 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.

**SEMESTER-III**

**Fungal Diseases of Plants**

**PPL-430**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment =38**

**Periods per week: 04+3**

**Instructions for the Paper Setters:**

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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 (15).

**Theory:**

**Section-A**

Nomenclature, classification and general characterization of fungi

**Section-B**

**Description of important phytopathogenic genera and Study of diseases with emphasis on their distribution, symptomatology, etiology, epidemiology and control:** *Plasmodiophora, Spongospora, Synchytrium, Physoderma, Pythium, Phytophthora, Peronospora, Sclerospora, Pseudoperonospora, Plasmopara, Peronosclerospora, Albugo.*

**Section-C**

**Description of important phytopathogenic genera and Study of diseases with emphasis on their distribution, symptomatology, etiology, epidemiology and control:** *Protomyces, Taphrina, Erysiphe, Podospaera, Claviceps, Venturia, Puccinia, Uromyces, Hemilia, Ustilago, Tolyposporium, Urocystis, Tilletia, Sphacelotheca, Alternaria, Cercospora, Colletotrichum, Fusarium, Ascochyta, Rhizocotonia.*

**Section-D**

Post harvest diseases in transit and storage and their management:

**Vegetables-** Potato, Tomato, Cucurbits, Onion, Chilli, Brinjal, Beans

**Fruits-** Guava, Grapes, Mango, Citrus, Papaya, Pear, Banana, Apple

**Practical:**

Characteristics of important phytopathogenic genera and of fungi and their identification.  
Macro and microscopic diagnosis of representative diseases of various crops.

**SEMESTER-III**

**BOT-430**

**Physiology of Growth and Development**

**Time: 3 Hours**

**Max. Marks: 150**

**Theory: 75**

**Practical: 37**

**Internal assessment = 38**

**Periods per week: 04+3**

**Instructions for the Paper Setters:**

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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 (15).

**Theory:**

**Section- A**

Concepts of growth, differentiation and pattern formation; growth curves, meristems, growth kinetics, factors affecting growth and general aspects of development, level of differentiation

**Section –B**

Hormones and growth regulators- auxins, gibberellins, cytokinins, ethylene, ABA, other inhibitors, retardants, polyamines, aliphatic alcohols, brassins,

**Section –C**

Hormonal regulation of growth and development, plant movements; photoperiodism, phytochrome, flowering hormones, vernalization, abscission, ageing, senescence;

**Section-D**

Physiology of seed and fruit development; seed germination; seed and bud dormancy. Plant physiology and agriculture. Control of development at genetic level.

**Practical:**

Experiments on growth measurements, hormonal bioassays, plant movements; experiments on quality of light on seed germination, breaking of dormancy. Experiments on photoperiodism. Experiments on hormonal regulation of development.



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**SEMESTER-III**

**CREDIT SEMINAR**

**Total Marks: 100**

**Periods per week: 03**

**SEMESTER-IV**

**ENT-541**

**Commercial Entomology**

**Time: 3 Hours**

**Max. Marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment=25**

**Periods per week: 4+3**

**Instructions for the Paper Setters:**

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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).

**Theory:**

**Unit-I**

Development of apiculture. Classification of bees and distribution of genus Apis. Morphological adaptations. Behaviour and activities of honey bees. Honey bee nutrition.

**Unit-II**

Artificial queen bee rearing and bee breeding. Sex and caste determination. Honey bee ecology. Bee pheromones. Pests and diseases of honey bees. Bee poisoning. Hive products. Planned crop pollination using bees.

**Unit-III**

Silkworm species and their characteristics. Moriculture. Silk seed production. Rearing and management of silkworms. Pests and diseases of silkworms. Silk and its uses. Lac insect's management.

**Unit-VI**

Economic importance of insect-pests of human health and habitation. Biology, damage and management strategies for mosquitoes, house flies, bed bugs, ants, termites, cockroaches and wasps.

**Practical:**

Morphological adaptations in different castes of honey bees. Recording of colony data. Selection and breeding of honey bees. Latest techniques in mass queen bee rearing. Artificial diets and feeding. Production and extraction of hive products. Preparation of beekeeping projects. Recording pollination behaviour and determining pollination requirements. Identification of different species of silkworms. Silkworm rearing equipment. Silkworm rearing and management. Diseases of silkworms. Lac insect and host management. Lac collection and processing. Management of insect-pests of public health importance and human dwellings.

**SEMESTER-IV**

**ENT-542**

**Storage Entomology**

**Time: 3 Hours**

**Max. Marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment 15+5=25**

**Periods per week: 4+3**

**Instructions for the Paper Setters:**

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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).

**Theory:**

**Unit-I**

Introduction, history and concepts of storage entomology. Post-harvest losses. Factors responsible for grain losses. Important pests namely insects, mites, rodents and birds associated with stored grains and agricultural products.

**Unit-II**

Important micro-organisms associated with stored grains and agricultural products. Association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage. Sources of infestation.

**Unit-III**

Type of losses in stored grains and their effect on quality including biochemical changes. Ecology of insect pests of stored commodities. Stored grain deterioration process. Type of storage structures. Ideal storage conditions. Management of rodent and bird pests.

**Unit-IV**

Preventive and curative measures for the management of insect pests of stored grains. Characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management.

**Practical:**

Collection and identification of stored grains insect pests and their nature of damage. Detection of insect infestation in stored food grains and estimation of stored losses. Determination of micro flora of grains. Determination of grain moisture. Familiarization of storage structures. Laboratory culturing of stored grain pests. Demonstration of preventive and curative measures including fumigation techniques. Field visits to grain markets, central and FCI warehouses, IGSMRI and commercial silos.

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**SEMESTER-IV**  
**(ENTOMOLOGY)**

**RESEARCH WORK**

**S/US**

**Periods per week: 04**