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**ENTOMOLOGY**

Course Contents

**ENT 501 INSECT MORPHOLOGY 2(1+1)**

**Theory**

Principles, utility and relevance: Intetument- structure, outgrowths, colouration, appendages and function.

Head-Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites.

Thorax- sclerites, sutures, ridges, areas of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus. Legs: structure and modifications.

Abdomen-Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis.

**Practical**

 Preparation of permanent and temporary mounts/ slides, integumentry outgrowth. General morpholpgy of grass hopper. Head- sclerites, sutures, areas, types, tentorium, types of antenna, mouth parts and their modifications, grasshopper, honeybee, red cotton bug, housefly. Thorax sclerites, wings- types and venation, wing coupling. Legs- types. Abdomen- genitalia, post embryonic development.

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| **ENT 502** |  **INSECT ANATOMY, PHYSIOLOGY AND** | **3(2+1)** |
|  | **NUTRITION** |  |

**Theory**

Scope and importance of insect anatomy and physiology.

Anatomy and physiology of digestive, circulatory, respiratory, excretory, nervous, endocrine and reproductive systems.

Metabolism of carbohydrates, lipids nitrogenous compounds.

Insect nutrition-importance of insect nutrition of phytophagous insect, stored grain insect and beneficial insect. Role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents of insect nutrition.

Extra and intra cellular micro-orgnisms and their role in physiology. Sensory organs and insect behaviours.

**Practical**

Dissection of insects to study comparative modification in different systems of grasshopper ,bugs,flies,bees.Experiment to study gas exchange, specific gravity and voloume of hemolymph excretory efficiency and excretory products and digestibility. Formulation and preparation of artificial diets for rearing insects.

**ENT 504 CLASSIFICATION OF INSECTS 3(2+1)**

**Theory**

Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Superclass Hexapoda – Classes - Diplura and Insecta- Orders contained.

Distinguishing characters, 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 (Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders Psocoptera, Thysanoptera and Hemiptera

Distinguishing characters, 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.

**Practical**

Study of Orders of insects and their identification.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.

**ENT 505 INSECT ECOLOGY 2(1+1)**

**Theory**

Basic concepts-Population and enviornment. Population regulation-natural control and current theories. Characteristics of population. Biotic potential and environmental resistance. Stable age distribution. Population dynamics. Dispersal and migration. Diapause hibernation and aestivation. Effect of environmental factor on distribution and abundance of insect. Food chain and ecological succession. Ecological indicator.

**Practical**

Measurement of microenvironment. Concept of life table and construction of life tables. modeling, estimates of population density, sampling methods and plans, estimation of dispersal and migration.

**ENT 507 BIOLOGICAL CONTROL OF CROP PESTS AND WEEDS 3(2+1)**

**Theory**

The philosophy, scope, history, and importance of biological control. important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation. Theoretical and empirical basis of biological control.

Parasitism and predatism. Important parasitic and predatory groups of insects and insect pathogens. Ecological basis of biological control. Introduction, culture, establishment and management of natural enemy population. Biological control of weeds. Role of natural enemies in integrated pest management. Microbial pesticide.

**Practical**

Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weeds. Rearing 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.

**ENT 508 TOXICOLOGY OF INSECTICIDES 3( 2+1)**

**Theory**

History and principles of toxicology. Classification of insecticides and based on mode of entry, mode of action and chemical nature. Structure activity relationship. Metabolism and toxicity, synergism, antagonism systemic and selective insecticides.

Insect resistance to insecticides; insecticide residue-their significance .Analysis of environmental implications. Diagnosis and treatment of insecticide poisoning. Plant products .Development of new insecticides, formulations, mixtures. Application techniques. Insecticide Act, safe use of insecticides

**Practical**

Insecticide formulations and mixtures standerd concentration of insecticide. bioassay techniques. evaluation of insecticide toxicity and joint action. Compatibility of pesticide, Phytotoxicity Toxicity to beneficial insects. Pesticide appliances.

**ENT 509 PLANT RESISTANCE TO INSECTS 2(1+1**)

**Theory**

History and importance of resistance, principles, classification, components, types and mechanisms of resistance.

Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects.

Factors affecting plant resistance including biotypes and measures to combat them.

Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; 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; bioassay of plant extracts of susceptible/resistant varieties; demonstration of antibiosis, tolerance and antixenosis.

**ENT 510 PRINCIPLES OF INTEGRATED PEST MANAGEMENT 2 (1+1 )**

**Theory**

The concept and History of pest management. Tools of pest management. Ecological and socio-economic aspects, costs/benefit and risk/benefit ratio. Cultural, biological, chemical, genetic, legal and other control tactics and their integration for the pest management. sampling and measuring the economic level of damage, economic injury level, economic threshold. Analysis and modeling for the pest management and case histories. Pest management in major crops. Integration of IPM option in integrated farming system and sustainable agriculture.

**Practical**

Study the flora and fauna in different crop habitats. Calculation of diversity index and economic threshold. Demonstration of IPM technology in field crops.

**ENT 511 INSECT PESTS OF FIELD CROPS 2 (1+1)**

**Theory**

Systematic position, identification, distribution, host-range, nature of damage, life and seasonal history, natural enemies and management strategies of insect pest of cereals crop (Paddy,Wheat,Barley),Millets(Maize,Sorghum,Bajra),Fiber crop (Cotton ,jute, Sunhemp), Oilseed (Groundnut ,Brassica crops,Sesame,Linseed and sunflower),Pulses (Pigeonpea, Chikpea, Pea, Lentil, Mung, Urd) and Sugercane.

**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. Study of life cycle of two insect-pest one each from hemi and holometabolous group.

**ENT 513 STORAGE ENTOMOLOGY 2(1+1)**

**Theory**

Storage losses (seed and food) due to insect , mites ,rodents, birds, moulds. Source of infestation. Biology of major stored grain pest. Significance of temperature and moisture migration in the development of mould and insect population. biochemical changes due to stored commodities due to pest infestation.

Principle of safe grain storage. Storage structures, and warehouse management. Management and safe use of pesticide in stored commodities, Prevention of seeds on long term basis,seed and seed health laws, quarantine laws. Radiation protection of stored grain and seed.

**Practical**

Collection, identification of pest and stored commodities and their damage. Detection of insect infestation in storage losses. estimation of losses in stored food grains; determination of moisture content in stored food grains. Study of different storage structure..

**ENT 518 TECHNIQUES IN PLANT PROTECTION (0+1)**

**Theory**

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

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

Use of light, transmission.Use of tissue culture techniques in plant protection. Forcasting pest attack and identification.

**ENT 519 COMMERCIAL ENTOMOLOGY 2(1+1)**

**Theory**

**Bee keeping**- General colony management during different seasons. Seasonal management. Managing colonies for honey production and pollination. Artificial queen rearing. Pests and diseases of honey bees. Bee poisoning. Production and marketing of quality honey and value added honey products. Establishment and maintenance of apiaries.

**Silkworm**

History, Development and organization of silk industry. Study of different species of silkworms, characteristic features, moriculture, silk and its uses, pests and diseases of silkworms, rearing and management of silkworms. Predator and parasitoid of silkworm and their management.

**Lac insect**

Cultivation of Lac, natural enemies, Lac processing, production technology and their management. Lac based products.

**Practical**

Identification of honey bee species, identification and handling of bee-keeping equipments, bee seasonal management,colony multiplication, queen rearing, control of bee enemies and diseases ,production. Identification of mulberry and non –mulberry silkworms. Rearing of mulberry silkworm, identification of various disease, Predator and parasitoid of silkworm. Identification life stages of different lac insects.Life history of lac insect.Techniques for preparing seed lac,care and maintinance of host of lac insect.Identification of natural enemies of lac insect and maintinance of host of lac insect.

**Course Title- Statistical Methods**

**Code No.:- STAT-551 3(3+0)**

UNIT I

Summarization of data, classification and tabulation of data, Diagrammatic and Graphical Representations, utility and limitations of graphical Representation. Measure of central tendency, definition, merit, demerit, uses and properties of different measure of central tendency, measure of dispersion, moments, skewness and kurtosis.

UNIT II

Probability distribution, discrete probability distribution- Bernouli, poission, normal distribution. Theorem of addition of probability, theorem of multiplication of probability, Definition- (simple and compound events independent and dependents, mutually exclusive, complimentary events.)

UNIT III

Statistical Hypothesis, Null hypothesis, Two type of error, Statistical significance, parametric and nonparametric hypothesis, critical region, level of significance, practical application of simple test of significance viz, ”t” and “F”test.X2test as a goodness of Fit, properties of X2 distribution, conditions for application of X2 test.

UNIT IV

Correlation and its test of significance, line of regression and its test of significance. Correlation, measurement of correlation, limit and range of „ correlation coefficient expressed in term of regression coefficients. Rank correlation and its computations, regression equation.

**Course Title- Experimental Designs**

 **Code No.:- STAT-552 2(2+0)**

UNIT I

Principles of experimental design, precision and accuracy, advantage of replication, experimental technique. Analysis of variance, fundamental principles of analysis of variance. Critical difference, limitations of the analysis of variance.

UNIT II

Statistical analysis and advantage and disadvantage of basic design-completely randomized design, randomized block design, Latin square design.

UNIT III

Factorial concept: simple effects, main effects and interaction, factorial experiments (without confounding), Yates method. Confounding, principles of confounding in a 23 factorial experiments. Split plot design.

UNIT IV

Missing plot technique; Bartlett’s techniques for missing plots, cross-overdesign or switch-over trials, Rotational experiments, progeny selection, compact family block design, uniformity trial, sire index, sampling in field experiments.