

AC 27/2/13
Item no. 4.43

UNIVERSITY OF MUMBAI



Syllabus for Sem III and Sem IV
Program: M.Sc.
Course: Zoology-Biotechnology-
Entomology

(Credit based semester and Grading System with
effect from the academic year 2013–2014)

UNIVERSITY OF MUMBAI
M.Sc. in Zoology: SEMESTER III and IV

Credit Based Semester and Grading System
to be implemented from the Academic Year 2013-2014.

PREAMBLE

BOS in Zoology during its meeting constituted a pyramid committee, to revise the syllabi in Zoology, with Dr. M. K. Pejaver as the Chairperson and Senior Teachers from affiliated Colleges as Jt. Chairperson, one each for UG and PG programmes. The class-wise syllabus committees were constituted in accordance with inclusive policy of the BOS with an aim to provide faculty at large hands on training and exposure to work on syllabus committees which will go a long way in taking our subject ahead in future when these experienced staff members would shape the subject after a decade. With the introduction of Credit Based Semester and Grading System and continuous evaluation consisting of components of internal assessment and external assessment by the esteemed University, the syllabus in Zoology was revised for M.Sc. Sem I and II to be implemented with effect from 2012-13, after approval by concerned authorities of the University.

Vide University Circular No. APD/Misc.-01/407/of 2011 dated 12/12/2011, contents of letter from K. P. Singh, Joint Secretary, UGC No. D.O.F1-1/2009-(CPP-II) dated 29/11/2011 were notified to the faculty in Zoology. As per the letter an expert committee was constituted by the UGC to look into the issue of discontinuation of dissection of live animals in the laboratory experiments in Zoology/ Life Sciences at UG and PG levels. The guidelines prepared by the expert committee and approved by UGC were notified with a viewpoint to ensure compliance of the guidelines.

A special meeting of Heads of Zoology Departments of all the Colleges affiliated to the University was convened on 17th August 2012 for deliberation on recommendation of expert committee appointed by the UGC regarding the discontinuation of dissection of live animals in laboratory experiments in Zoology / Life Sciences at UG and PG level.

In accordance with the deliberations in the above meeting, draft syllabus for M.Sc. SEMESTER-III and IV in Zoology, suitably revised, to be implemented in the Credit Based Semester and Grading System was prepared by the committee under the guidance of pyramid committee. The draft was circulated

among the heads and senior teachers of the Department of Zoology of various colleges for approval and suggestions.

In meeting of the BOS held on 12th December, the draft was approved and it was resolved to implement the revised syllabus of Zoology at M.Sc. SEMESTER-III and IV and make it effective from the Academic Year 2013-2014 after approval from concerned authorities of the University.

Chairman
Board of Studies in Zoology
University of Mumbai.

M.Sc.
Semester III and Semester IV
Zoology - Biotechnology and Entomology
Credit Based Semester and Grading System.
To Be Implemented from the Academic Year 2013-2014.

Semester –III

Theory				
Course	Unit	TOPIC	Credits	L / Week
PSZOBT301	I	The implications of recombinant DNA technology of commercial products and microbial synthesis	4	1
	II	Large scale culture & production from recombinant microorganisms & genetically engineered animal cells		1
	III	Medical Biotechnology		1
	IV	Environmental Biotechnology I		1
PSZOBT302	I	Genome management and analysis	4	1
	II	Manipulation of gene expression in prokaryotes		1
	III	Bioinformatics		1
	IV	Animal biotechnology and Human therapies		1
PSZOENT303	I	Insect classification.	4	1
	II	Insect morphology.		1
	III	Insect anatomy and physiology.		1
	IV	Insect development and endocrinology		1
PSZOENT304	I	Insect pests of crops.	4	1
	II	Medical & industrial entomology.		1
	III	Insect control and toxicology		1
	IV	Insect ecology and genetics		1
			16	16
Practicals				
PSZOBT3P1		Practicals based on PSZOBT 301	2	4
PSZOBT3P2		Practicals based on PSZOBT 302	2	4
PSZOENT3P3		Practicals based on PSZOENT303	2	4
PSZOENT3P4		Practicals based on PSZOENT304	2	4
Total			08	16
TOTAL			24	32

Semester –IV

Theory				
Course	Unit	TOPIC	Credits	L / Week
PSZOBT401	I	Microbial synthesis of commercial products	4	1
	II	Large scale culture & production for industrial biotechnology		1
	III	Agricultural Biotechnology		1
	IV	Environmental Biotechnology II		1
PSZOBT402	I	Genome management	4	1
	II	Manipulation of gene expression in eukaryotes		1
	III	The human genome project		1
	IV	Regulations and patents in biotechnology		1
PSZOENT403	I	Insect classification	4	1
	II	Insect morphology.		1
	III	Insect anatomy and physiology		1
	IV	Insect development and endocrinology		1
PSZOENT404	I	Insect pests of crops and forest	4	1
	II	Veterinary & industrial entomology		1
	III	Insect control and toxicology		1
	IV	Insect ecology and genetics		1
Total			16	16
Practicals				
PSZOBT4P1		Practicals based on PSZOBT4P1	2	4
PSZOBT4P2		Practicals based on PSZOBT4P1	2	4
PSZOENT4P3		Practicals based on PSZOENT403	2	4
PSZOENT4P4		Practicals based on PSZOENT404	2	4
Total			08	16
TOTAL			24	32

M. Sc.
ZOOLOGY
SEMESTER III
THEORY
PSZOBT301

ZOOLOGY – BIOTECHNOLOGY ENTEMOLOGY

PSZOBT301: Basics of Industrial & Environmental Biotechnology I

Unit I: The implications of recombinant DNA technology of commercial products and microbial synthesis **15**

- 1.1. The implications of recombinant DNA technology
 - 1.1.1 *General account on applications of biotechnology
 - 1.1.2 *Commercialization of biotechnology & biotech companies
 - 1.1.3 Prospects of novel food technology
 - 1.1.4 Economics of microbial biotechnology
 - 1.1.5 Areas of significant public concern: Antibiotic resistance marker gene, transfer of allergies, pollen transfer from GM plants, social, moral & ethical issues associated with GMOs.
- 1.2 Amino acids & their commercial use – production strain, process of L-glutamate, L-aspartate, L-phenylalanine, L-tryptophan.

Unit II: Large scale culture & production from recombinant microorganisms & genetically engineered animal cells **15**

- 2.1. Large scale culture & production from recombinant microorganisms:
 - 2.1.1 Batch fermentation
 - 2.1.2 Fed batch fermentation
 - 2.1.3 Continuous fermentation
 - 2.1.4 *Maximizing the efficiency of fermentation process
 - 2.1.5 Harvesting, disrupting & downstream processing
- 2.2. Large scale culture & production from genetically engineered animal cell cultures:
 - 2.2.1 Design of bioreactors for large scale animal cell culture-Batch, Fed batch
 - 2.2.2 Mammalian cell lines & their characteristics
 - 2.2.3 Media for the cultivation of mammalian cells
 - 2.2.4 *Commercial products produced with mammalian cell culture

Unit III: Medical Biotechnology

15

- 3.1. Sub-unit vaccines
 - 3.1.1 *Sub-unit Vaccine production against viruses-Herpes simplex, Bovine foot & mouth disease virus
 - 3.1.2 Peptide vaccines-synthetic drugs (engineered proteins)
 - 3.1.3 Genetic immunization-DNA vaccines, Antisense DNA, Therapeutic ribozymes
 - 3.1.4 *Live recombinant vaccines
 - 3.1.5 *Attenuated vaccines against Cholera, Salmonella sp.
 - 3.1.6 Vector vaccines-Vaccine directed against viruses-Rabies virus G-protein, Hepatitis B surface antigen
 - 3.1.7 Anti-idiotypic vaccine for cancer treatment
- 3.2. Monoclonal antibodies (mAbs) & therapeutic applications:
 - 3.2.1 mAbs for prevention of rejection of transplanted organs
 - 3.2.2 Treatment of bacterial blood infection
 - 3.2.3 Human monoclonal antibodies
 - 3.2.4 Hybrid human-mouse monoclonal antibodies
 - 3.2.5 HIV therapeutic agents
 - 3.2.6 Anti-tumour antibodies

Unit IV: Environmental Biotechnology I

15

- 4.1. Biomass utilization
 - 4.1.1 Microorganisms in lignocellulose degradation
 - 4.1.2 Isolation of prokaryotic & eukaryotic cellulase gene
 - 4.1.3 Manipulation of cellulase gene
 - 4.1.4 Production of single cell proteins by using biomass as raw material
 - 4.1.5 Commercial production of fructose and alcohol from biomass
 - 4.1.6 Improvements of fructose and alcohol production
 - 4.1.7 Fuel ethanol from biomass
- 4.2. Bioremediation of xenobiotic compounds
 - 4.2.1 Characteristics of xenobiotics in the environment
 - 4.2.2 Characteristics of aerobic microorganisms for degradation of organic pollutants
 - 4.2.3 Genetic engineering of biodegradative pathways-Manipulation by transfer of plasmid, manipulation by gene alteration
 - 4.2.4*Degradation of xenobiotic compounds-petroleum products, n-alkanes, alkenes, cycloaliphatic compounds, aromatic hydrocarbons, polyaromatic hydrocarbons, chlorinated organic compounds (aliphatic & aromatic)

***marked topics are to be taken for seminar**

PSZOBT302

PSZOBT302: GENETIC ENGINEERING TECHNIQUES AND ITS APPLICATIONS

Unit I: Genome management and analysis

15

1.1 The Basic tools of genetic engineering

- 1.1.1 Chemical Synthesis of DNA-Oligonucleotide synthesis by Phosphoramidite method, Synthesis of genes
- 1.1.2 *DNA Sequencing -- Maxam-Gilbert method, Sanger's dideoxynucleotide method, By using bacteriophage M13 By Primer walking
- 1.1.3 Polymerase chain reaction and its advantages

1.2 Cloning Vectors

- 1.2.1 *General purpose plasmid vectors (pUC19, pBR322)(Bacterial Vectors)
- 1.2.2 Bacteriophage and cosmid vectors
- 1.2.3 Yeast artificial chromosomes (YACs)

1.3 Analysis of genome/proteome

- 1.3.1 DNA fingerprinting/physical mapping/pulsed field gel electrophoresis
- 1.3.2 Analysis of the proteome
- 1.3.3 Analysis of mRNA transcripts

Unit II: Manipulation of gene expression in prokaryotes

15

2.1 Promoters of gene expression in prokaryotes

- 2.1.1 Prokaryotic gene expression
- 2.1.2 Isolation of functional promoters
- 2.1.3 Promoter selection with E.coli plasmid pBR316
- 2.1.4 *Promoter selection with plasmid pKO1
- 2.1.5 Gene expression from strong and regulatable promoters

2.2 Expression of cloned genes in prokaryotes

- 2.2.1 Increasing protein production and secretion
- 2.2.2 *Inclusion bodies and fusion proteins
- 2.2.3 Unidirectional tandem gene arrays
- 2.2.4 Translation expression vectors
- 2.2.5 Increasing protein stability

Unit III: Bioinformatics

15

- 3.1 Uses and application of computers in biological sciences

- 3.2 *DNA profiling: cDNA and EST's (expressed sequence tags)
- 3.3 Basic research with DNA microarrays and its application in healthcare.
- 3.4 Biomedical genome research and pharmaco genomics
- 3.5 *Random amplified polymorphic DNA (RAPD)
- 3.6 Human genomic variation-SNP's (single nucleotide polymorphisms,SNP's and disease; QTL (quantitative trait loci) and its relation to SNP's
- 3.7 Satellite DNA and its types

Unit IV: Animal biotechnology and Human therapies **15** **4.1**

Animal Biotechnology

- 4.1.1 *Transgenic animals and their applications:
Mice as model system for human diseases and as test case model,Cows, pigs, sheep, goats as biopharmaceuticals
Transgenic insects and birds
- 4.1.2 Recombinant DNA technology to prevent animal diseases
- 4.1.3 Conservation biology-Embryo transfer
- 4.1.4 Regulation of transgenic animals and patenting genetically engineered animals

4.2 Human therapies

- 4.2.1 Tissue engineering: Skin, liver, pancreas
- 4.2.2 *Xenotransplantation
- 4.2.3 Antibody engineering
- 4.2.4 Cell adhesion based therapies: Integrins, Inflammation, Cancer and metastasis
- 4.2.5 Targeted gene replacement for correcting a mutated gene
- 4.2.6 Site directed mutagenesis

***marked topics are to be taken for seminar**

Course PSZOENT303

General Entomology.

Unit – I : INSECT CLASSIFICATION. **15 L**

1.1. Extinct insects, Origin and evolution of insects.

1.2. General characters of various orders and classification of some economically important orders up to families.

i) Apterygota – Thysanura, Collembola.

ii) Pterygota – Odonata, Orthoptera, Hemiptera, Coleoptera.

iii) Insect preservation techniques.

Unit – II : INSECT MORPHOLOGY. 15L

2.1 Integument - Structure and Chemistry.

2.2 Head - Segmentation, Endoskeleton and Antennae.

2.3 Mouth Parts* - Types, Structure and Mechanism of feeding.

Unit – III : INSECT ANATOMY AND PHYSIOLOGY. 15L

3.1. Digestive System - Structure and modification of gut, digestive enzymes and physiology of digestion.

3.2. Respiratory System* - Aerial and aquatic respiration. Mechanism of gaseous exchange.

3.3. Excretory System - Principal and accessory organs of excretion.

Unit – IV : INSECT DEVELOPMENT AND ENDOCRINOLOGY : 15L

4.1. Development.*

4.1.1 Types of eggs and cleavage.

4.1.2 Early embryonic development.

4.1.3 Types of larvae and pupae.

4.2. Endocrinology.

Histology of Neuro – endocrine glands and mechanism of secretion.

* Marked topics may be given to students for seminar.

Course PSZOENT304

Applied Entomology, Ecology and Genetics.

Unit – I : INSECT PESTS OF CROPS. 15 L

Study of Insect pests with special reference to their classification upto families, appearance, habit, life history, distribution, host plant damage and control measures

- 1.1** Agricultural Pests of - Rice, Jowar, Cotton and Sugarcane
- 1.2** Vegetable Pests of - Cabbage, Brinjal, Okra
- 1.3** Fruit Pests of - Mango, Citrus, Coconut, Fig waps

Unit – II : MEDICAL & INDUSTRIAL ENTOMOLOGY. 15 L

2.1. Medical Entomology*

- 2.1.1. Study of following insects as vectors of human diseases regarding their classification up to family, appearance, habit, brief life history, distribution, diseases caused and control measures :-
Mosquito, flea, housefly, Tse tse fly sand fly.
- 2.1.2. Forensic entomology.

2.2. Industrial Entomology

- 2.2.1.* Types and life history of honey bees used in Apiculture.
- 2.2.2.* Bee keeping Management & prospects.
- 2.2.3. Life history and cropping of lac insect.
- 2.2.4.* Lac – Utility and scope of lac industry.

Unit – III : INSECT CONTROL AND TOXICOLOGY - 15L

3.1. Basic Principles of Insects Control.

Chemical Control – Classification and evolution of insecticides. Different

types of insecticides. Mode of action.

3.2. Biological Control – Principles, application, success and limitations.

3.2.1. Use of enemies such as predators, parasites and pathogens.

3.2.2. Autocidal Methods – Chemosterilants and radiations for sterilization, Male sterile Theory, Hormones and Pheromones, Attractants and Repellants.

3.3. Insecticide formulations and applications, Insecticide synergists.

Unit – IV : ECOLOGY AND GENETICS

15L

4.1 Ecology

4.1.1. Abiotic Ecological Factors - Photoperiod, Temperature and Humidity.

4.1.2. Biotic factors - Social life in termites, ants and wasps, Foraging and nesting.

4.1.3. High altitude Ecology.

4.1.4. Polymorphism in Aphids.

4.1.5. Swarming in insects with reference to Locust.

4.1.6. Insect Migrations.

4.1.7. Communication, Instinct, Learning and Memory.

4.1.8. Bioluminescence.

4.2. Genetics

Drosophila genetics -Advantages of Drosophila in genetic studies.

* Marked topics may be given to students for seminar.

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PRACTICAL

Semester III

Practicals

Course Code PSZOBT3P1 & PSZOBT3P2

(Based on PSZOBT301 and PSZOBT302)

- 1) Demonstration of aseptic technique: Work place for aseptic handling, packing glassware (flasks, test tubes, pipettes, petridish) for sterilization, aseptic transfer of liquids (pipetting from flask to test tube)

- 2) Preparation of LB agar plate, slant, butt & demonstration of streaking technique using bacterial culture to obtain isolated colonies.
- 3) Determination of viable cell count in the given culture of bacteria by dilution & spreading technique.
- 4) Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis.
- 5) To estimate the number of bacteria in the given culture by nephelometry.

Course PSZOENT3P3

Based on PSZOENT303

- 1) General classification of Insects up to families of the orders mentioned in theory (At least 2 examples, other than the pests to be studied, of each order- Thysanura, Collembola, and Odonata , Orthoptera, Hemiptera, Coleoptera.)
- 2) Dissection of the following insects to study Digestive system.
Cockroach, Grasshopper and House fly.
- 3) Dissection of Tracheal system in Cockroach.
- 4) Dissection of Air Sacs in Honey bee. (Only to be demonstrated.)
- 5) Study of Sclerites of Head of Cockroach.
- 6) Mountings from Cockroach -
Mouth parts, Salivary glands, Spiracles.
- 7) Study of different types of Antennae with reference to functional adaptations.
- 8) Histology of Digestive tract, Malpighian tubules,
- 9) Physiology -
 - i. Detection of presence of Chitin in the integument.
 - ii. Study of Digestive Enzymes in Salivary glands in cockroach/housefly.
 - iii. Study of rate of Respiration in Cockroach.
- 10) Study different types of larvae and pupae of insects.
- 11) Study the Insect preservation techniques through demonstration on few insect types and also photographs/ figures.

Course PSZOENT3P4

Based on PSZOENT304

1) Study of Insects specimen of Economic importance

Hieroglyphus, Chilo zonellus, Dysdercus cingulatus, Pyrilla, Earias, Batocera, Papilio demoleus, Rhyncophorus, Fig wasp, Zonabris(Mylabris).

Study of the following insect specimens of medical importance- *Anopheles, Culex, Aedes, Pediculus humans.*

2) Preparation of a report on Apiculture or Lac culture practices in India..

3) Insect Control & Toxicology.

1. Symptomology of following different types of insecticide treatment in Cockroach. -1.Contact poison 2.Stomach poison 3..Fumigant.

ii. Bioassay of insecticides in a suitable insect for -

1. Contact poison.

2. Stomach poison.

3. Fumigant.

iii. Estimation of synergistic ratio using suitable insect model.

4) Ecology

Study of -

1. Entomophagus insects.

2. Symbionts from Termites.

3. Caste system in Termites.

5) Genetics:

Culturing of *Drosophila* to study F1 & F2 generations under controlled conditions.

- 6) Visit to Agricultural fields to study pests.
- 7) Observation in field, of at least one insect type from each order and submission of report.

Note: Minimum animals to be used for experiment

Semester -IV

PSZOBT401: Basics of Industrial & Environmental Biotechnology II

Unit I: Microbial synthesis of commercial products 15

- 1.1. Microbial synthesis of commercial products
 - 1.1.1 Organic acids & their commercial applications – Citric acid, gluconic acid, lactic acid.
 - 1.1.2 Antibiotics – Cloning antibiotic biosynthetic gene by complementation & other methods. Synthesis of novel antibiotics & improving antibiotic production.
*Aminoglycosides & their uses
 - 1.1.3 Polysaccharides:
Bacterial polysaccharides: General properties & their commercial applications- Dextran, Xanthan, Alginate.
Genetic engineering for the large scale production of Xanthan gum & its modification.
*Marine polysaccharides: General properties & their commercial application- Agar & agarose, Chitosan
 - 1.1.4 Polyesters: Polyhydroxyalkanoates (PHA)-Biosynthesis of PHA, Biopol-commercial biodegradable plastic

Unit II: Large scale culture & production for industrial biotechnology 15

- 2.1. Biotransformations
 - 2.1.1 Selection of biocatalyst-screening & use of novel existing biocatalyst
 - 2.1.2 Genetic modification of existing biocatalyst (Indigo biosynthesis)
 - 2.1.3 Biocatalyst immobilization-
Methods of immobilization- Cross linking, supported immobilization, adsorption & ionic binding, covalent coupling, lattice entrapment
 - 2.1.4 Immobilized soluble enzymes & suspended cells
 - 2.1.5 Immobilization of multi-enzyme systems & cells

- 2.1.6 *Immobilized enzyme reactors- Batch reactors, continuous reactors
- 2.1.7 Analytical enzymes-
Enzymes in diagnostic assays: Test strip systems & Biosensors-Electrochemical & optical type

Unit III: Agricultural Biotechnology

15

- 3.1. Agricultural Biotechnology:
 - 3.1.1 *Nitrogen fixation
 - 3.1.2 Nitrogenase-Component of nitrogenase; Genetic engineering of nitrogenase cluster
 - 3.1.3 Hydrogenase-Hydrogen metabolism
 - 3.1.4 Genetic engineering of hydrogenase gene

 - 3.1.5 Nodulation-Competition among nodulation organisms, genetic engineering of nodulation gene
 - 3.1.6 Microbial insecticides-Toxins of *Bacillus thuringiensis*, mode of action & use of thuringiensis toxins, thuringiensis toxin gene isolation, genetic engineering of *Bacillus thuringiensis* strains & cloning of thuringiotoxin gene.
 - 3.1.7 *Developing insect resistant, virus resistant & herbicide resistant plant
 - 3.1.8 Algal products: Fuels from algae, marine natural products & their medical potential-anticancer, antiviral compounds, antibacterial agents.

Unit IV: Environmental Biotechnology II

15

- 4.1. Bioabsorption of metals (Recovery from effluents)
 - 4.1.1 *Bioabsorption by fungi, algae, moss & bacteria
 - 4.1.2 Mechanism of bacterial metal resistance & genetic engineering for specific proteins
 - 4.1.3 Bioreactors for bioabsorption-packed bed, fluidized bed, rotating disc, single blanket, sequential reactors
 - 4.1.4 Phytoremediation & its use in biotechnology
- 4.2. Bioleaching of metals
 - 4.2.1 Biochemical mechanism of bioleaching
 - 4.2.2 Extraction from mixtures
 - 4.2.3 Types of bioleaching
 - 4.2.4 Methods for bioleaching-Tank & heap bioleaching
 - 4.2.5 *Microorganisms used for bioleaching

***marked topics are to be taken for seminar**

PSZOB402: Genome management, manipulation, regulations and patents in biotechnology

Unit I: Genome management

15

1.1 The Basic tools of genetic engineering

- 1.1.1 Gene transfer techniques: Protoplast fusion, calcium phosphate, precipitation, electroporation, liposome, ligand mediated, gene gun or biolistic approach, viral mediated
- 1.1.2 Selection and screening of recombinants
- 1.1.3 *Nucleic acid probes and hybridization, Southern blotting and Northern blotting
- 1.1.4 Immunological assays for identification of gene product, Western blot

1.2 Cloning Vectors

- 1.2.1 *Retrovirus and SV40 vectors
- 1.2.2 Special purpose vectors- Expression vectors, Secretion vectors, Shuttle or bi-functional vectors, single stranded phage and phagemids

Unit II: Manipulation of gene expression in eukaryotes

15

- 2.1 Eukaryotic gene expression
- 2.2 *Introduction of DNA into fungi-yeast and filamentous fungi (fungal transformation)
- 2.3 Heterologous proteins production in yeasts
- 2.4 Heterologous proteins production in filamentous fungi
- 2.5 Cultured insect cells expression systems- Baculovirus transfer vector
- 2.6 *Mammalian cell expression systems- Human Papova BK virus shuttle vector

Unit III: The human genome project

15

- 3.1 *The human genome, scope and goals of the project
- 3.2 Genetic linkage maps, chromosome walking, restriction mapping
- 3.3 Polymorphic DNA markers
- 3.4 Restriction fragment length polymorphism (RFLP) and its uses
- 3.5 Physical maps, Sequence tagged sites
- 3.6 Integrating genetic linkage and physical maps
- 3.7 *Mapping human diseases
- 3.8 Positional cloning: Getting closer to a disease causing gene
- 3.9 Testing for exons
- 3.10 Limitations of positional cloning

Unit IV: Regulations and patents in biotechnology

15

- 4.1 Regulating recombinant DNA technology
- 4.2 *Regulatory requirements – safety of genetically engineered foods Chymosin, tryptophan, bovine somatotropin
- 4.3 Regulation environmental release of genetically engineered

- organism(GEO). Ice minus *Pseudomonas syringae*
- 4.4 Regulatory agencies and laws for product regulation
- 4.5 Risk assessment: How much risk?
- 4.6 *Open field tests of GEO

- 4.7 Development of policy for Human gene therapy
- 4.8 Patenting biotechnology inventions
 - a) What constitutes the patent?
 - b) The patent process
 - c) The conditions to be satisfied for an invention to be patentable
:Novelty, Inventiveness, Usefulness
 - d) Patenting in different countries, types of inventions that are not patentable in India
 - e) What is Paris convention? Principal features of Paris convention
 - f) Patenting multicellular organisms
 - g) Patenting and fundamental research

***marked topics are to be taken for seminar**

Course PSZOENT403

General Entomology

UNIT I: Insect classification

15 Lectures

General characters of various orders and classification of some economically important orders upto families.

Diptera, Lepidoptera, Hymenoptera, Mallophaga, Neuroptera, Isoptera, Siphonaptera.

Unit II: Insect morphology

15 Lectures

2.1: Thorax – Structure, Endoskeleton and modification of legs.*

2.2: Wings –. Structure, Coupling apparatus, Mechanism of flight.

2.3: Abdomen—Structure, Genital appendages.

Unit III: Insect Anatomy and Physiology

15 Lectures

3.1: Circulatory system – Structure, Dorsal vessel, pulsatile and phagocytic organs, Chemical composition of Haemolymph, Types and functions of Haemocytes, Mechanism of circulation, Fat bodies.

3.2: Reproduction—Structure of male and female reproductive system. Spermatogenesis and oogenesis, Sperm transfer and spermatophore formation. Vitellogenesis and sperm storage organs.

3.3: Nervous system—Central nervous system, Sympathetic nervous system and nervous integration.

3.4* Sense Organs—Structure and physiology of following sense organs – Ocelli and compound eyes, Mechanoreceptors, Chemoreceptors, Sound producing organs.

Unit IV: Development and Endocrinology

15 Lectures

4.1* Development—Types of Metamorphosis

4.2 Endocrinology

4.2.1 Chemical structure of Hormones, their synthesis and mode of action.

4.2.2 Hormonal Regulation in reproduction. Metamorphosis, diapauses, osmoregulation and intermediately metabolism.

*** Marked topics may be given to students for seminar**

Course PSZOENT404

Applied Entomology, Ecology and Genetics

Unit – I : PESTS OF CROPS AND FOREST.

15 L

Study of Insect pests with special reference to their classification upto families, appearance, habit, life history, distribution, host plant damage and control measures

1.1. Pests of Crops (only Major Pests to be studied).

1.1.1. Stored Grain Pests - *Tenebrio, Trogoderma, Bruchus.*

1.1.2. Pests of Flowering Plants - Mealy Bugs, Aphids White flies, Scale insect.

1.2. Forest Pests (only Major Pests to be studied)

Gall insects, borers, leaf minors, defoliators and teak defoliator.

Unit – II : VETERINARY & INDUSTRIAL ENTOMOLOGY.

15L

2.1. Veterinary Entomology*

Study of following insects as pests of domestic animals with general reference of their classification up to family, habit, brief life history, damage, diseases caused and control measures :-

Horse fly, cattle blood sucking fly,
Flesh fly, *Hypoderma*,
Poultry louse and screw worm fly.

2.2. Industrial Entomology

2.2.1.* Types of silk worm, life history and rearing of silk worms.

2.2.2. Silk worm pathology.

2.2.3. Mulberry and Tussar Silk production.

Unit – III : INSECT CONTROL AND TOXICOLOGY - 15L

3.1. Development of resistance to Insecticides.

3.2. Microbial and Environmental degradation of pesticides. Metabolism of pesticides

3.3. Integrated Pests Managements.

3.4. Dynamics of Environmental Pollution by Insecticides and impact on human health and ecosystem.

Unit – IV : INSECT ECOLOGY AND GENETICS. 15L

4.1 Ecology

4.1.1 Pathogens of Insects.

4.1.2* Mimicry.

4.1.3.* Venomous Insects.

4.1.4. Rare and endangered insects of India.

4.2. Genetics

4.2.1 Sex determination Theory.

4.2.2 Polytene chromosome and puffing pattern.

4.2.3 Research on **Drosophila** Genetics and Mapping of Chromosome.

* Marked topics may be given to students for seminar.

Semester IV
Practical
Course Code PSZOBT4P1 & PSZOBT4P2
Based on PSZOBT401 and PSZOBT402

- 1) Immobilize Yeast cells in calcium alginate & prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column.
- 2) Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided.
- 3) Demonstrate the western blotting technique for the given sample of protein.
- 4) To plot a growth curve for the microorganisms provided.
- 5) Demonstrate the effect of medium on growth curves of given microorganism, using two different media (minimal & enriched).

PSZOENT4P3
Based on PSZOENT403

1. General classification of Insects up to families of the orders mentioned in theory (At least 2 examples, other than the pest, to be studied of each order- Diptera to Siphonoptera .)
2. Dissection of the following insects -
Reproductive system of -Cockroach, Grasshopper, House fly

Nervous system of - Cockroach, Grasshopper.
3. Dissection of Endocrine glands, Stomato-gastric nervous system in Cockroach.
4. Study of Sclerites of Thorax and Abdomen of Cockroach .
5. Mountings of Genitalia from Cockroach .
6. Study of different types of Thoracic Appendages with reference to

functional adaptations.

- 7) Study of Wing morphology and Venation.
- 8) Histology of Testis, Ovary, Brain and Endocrine glands.
- 9) Physiology -
 - a. Study of Heart beats in Cockroach.
 - b. Differential and Total Haemocyte count
 - c. Analysis **Haemolymph** Amino – acids by TLC / Two **Dimensional** Chromatography.

PSZOENT4P4

Based on PSZOENT404

1. Study of Insects specimen of Economic importance.
Idiocerus, Bruchus, Herse convolvuli, Thrips, Aphids, Epilachna, Sitophilus, Tribolium, Tenebrio, Trogoderma, Mealy bugs, Whiteflies, Scale insects, Army worm, Leaf miner, Defoliater.
2. Study of following veterinary pests
Xenopsylla, Ctenocephalides, Sarcophaga, Stomoxys, Tabanus, Oestrous, Hypoderma
3. Preparation of a report on Seri culture practices in India.
4. Insect Control & Toxicology--Computation of LC50 for any suitable insecticide and insect model.
5. Ecology.
Study of -
 - i. Pathogens from suitable insect.
 - ii. Different types of gall insects.
 - iii. Mimicry in insects.

6. Genetics.
 - i) Effect of UV radiations on Drosophila cultures.
 - ii) Study of Chromosomes in Drosophila. (Temporary Preparation of Polytene Chromosomes from Larva.)
7. Visit to Veterinary and Agricultural University/Institutions.
8. Observation in field, of at least one insect type from each order and submission of the report.

Note: Minimum animals to be used for experiment

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N.B :

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees :

- 1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
- 2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows :

- i) Head of the Concerned Department (Convener/Chairperson)
- ii) Two Senior Faculty Members of the concerned Department
- iii) One Faculty of related department from the same College
- iv) One or two members of related department from neighboring colleges.

M.Sc. Zoology – Biotechnology- Entomology

Semester III / IV Practical Examination

Practical

Course Code PSZOBTP1

Q1) Determination of viable cell count in the given culture of bacteria, by dilution & spreading technique. (DAY 1) (25)
MARKS

OR

Q1) Using mini-prep method isolate plasmid DNA from the given strain of bacteria & show the purity of the isolate by performing agarose gel electrophoresis. (DAY 1) (25)
MARKS

Q2) To estimate the Demonstration of aseptic technique: Work place for aseptic handling, packing glassware (flasks, test tubes, pipettes, petridish) for sterilization, aseptic transfer of

liquids (pipetting from flask to test tube. (DAY 2)	(15)
MARKS	
Q3) Viva	(05)
MARKS	
Q4) Journal	(05)
MARKS	

Practical
Course Code PSZOB3P2

Q1) Preparation of LB agar plate, slant, butt & demonstration of streaking technique using bacterial culture to obtain isolated colonies. (DAY 1)	(25)
MARKS	
Q2) Estimate number of bacteria in given culture of nephelometry. (DAY 2)	(15)
MARKS	
Q3) Viva	(05)
MARKS	
Q4) Journal	(05)MARKS

Practical course PSZOENT3P3

Day 1

Duration 5 hours

Marks. 50

	Marks
Q.1. a. Dissection	10
b. Mountings	06
c. Identification of specimens- (5 Specimens)	10
Q.2 Assay /Experiment	14 or 8+6
Q.3. Viva voce	5

Q.4. Journal

5

Day 2

Practical course PSZOENT3P4

Duration 5 hours

Marks 50

	Marks
Q.1.a.Assay/Experiment*	15 or 10+5
b. Identification of specimens (5 Specimens)	10
Q.2. a. Submission of 'Insect observation' report	5
b. Submission of other reports-	10
Q.3. Viva voce-	5
Q.4. Journal	5

* If necessary start the experiment on Day 1.

Practical

Course Code PSZOBT4P1

Q1) Demonstrate the effect of medium on growth curves of given microorganism, using enriched media. (DAY 1) (25) MARKS

OR

Q1) Demonstrate the effect of medium on growth curves of given microorganism, using minimal media. (DAY 1) (25) MARKS

Q2) Immobilize Yeast cells in calcium alginate, prepare beads & keep them overnight in activation medium (DAY 1) (15) MARKS

Q3) Viva (05) MARKS

Q4) Journal

(05) MARKS

Practical
Course Code PSZOB4P2

Q1) Prepare a bioreactor column to demonstrate Invertase activity in the bioreactor column. (DAY 2) (25) MARKS

Q2) Restriction-digest the given DNA sample & demonstrate the separation of fragments by performing agarose gel electrophoresis. Interpret the results by comparing with the standard digests provided. (DAY 2) (15) MARKS

OR

Q2) Demonstrate the western blotting technique for the given sample of protein. (DAY 2) (15) MARKS

Q3) Viva (05) MARKS

Q4) Journal (05) MARKS

Practical course PSZOENT4P3

Day 1

Duration 5 hours

Marks. 50

Marks

Q.1. a. Dissection

10

b. Mountings

06

c. Identification of specimens- (5 Specimens)

10

Q.2 Assay /Experiment	14 or 8+6
Q.3. Viva voce	5
Q.4. Journal	5

Day 2

Practical course PSZOENT4P4

Duration 5 hours

Marks 50

	Marks
Q.1.a.Assay/Experiment*	15 or 10+5
b. Identification of specimens (5 Specimens)	10
Q.2. a. Submission of 'Insect observation' report	5
b. Submission of other reports-	10
Q.3. Viva voce-	5
Q.4. Journal	5

* If necessary start the experiment on Day 1.
