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UNIVERSITY OF MUMBAI



**Syllabus for T.Y.B.Sc.
Applied Component
Semester V and Semester VI
Program: B.Sc.
Course: Economic Entomology**

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

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PREAMBLE

Applied component was introduced for T.Y. B.Sc. class in the academic year 1979-80 with a view to enhance essential for employability. Thereafter the syllabus of T.Y.B.Sc. Applied Component in Zoology has been revised many times. However during the last revision of syllabi, emphasis on entrepreneurial potential and skills has been enhanced by incorporating applied topics having commercial propositions. The BOS also experimented by introducing flexibility in terms of selecting any four out of eight units included in the syllabus during the last revision. The experiment has been successful and appreciated. It is continued in this revised syllabus also.

From the academic year 2010-2011, the University has introduced Credit Based Semester and Grading System with continuous evaluation involving Internal and External Assessment. The revised syllabi in the Applied Component subjects in Zoology are modularized offering opportunity to learners to study any four out of a total of eight units in each course.

The jurisdiction of our esteemed University extends from Colaba in South Mumbai to Banda in Sindhudurga. The diversity of the colleges affiliated to the University in terms of infrastructure, expertise and opportunity has been an important consideration while drafting the syllabus. The syllabus offers freedom to select any four units out of eight in each paper in the semester according to the requirements of the College. This also satisfies the purpose of choice based syllabus.

Thus the revolutionary initiative of the BOS in Zoology, with an inherent flexibility, aimed at providing need based training catering to the needs of rural as well as urban niches has been continued with this revision of syllabi also. However this flexibility is, at present, available for only Applied Component subjects.

T.Y.B.Sc.
Applied Component
Economic Entomology

Credit based Semester and Grading System.
 To Be Implemented from the Academic Year 2013-2014.

Semester V

Theory (Any four units to be opted)				
Course	Unit	TOPIC	Credits	L / Week
USACEENT501	I	Morphology and Development.	2	4
	II	Apiculture.		
	III	Anatomy of Insects		
	IV	Sericulture		
	V	Insect Classification		
	VI	Lac Culture.		
	VII	Insects and their Environment.		
	VIII	Generalized Management for Entomology.		
Practicals				
USACEENT5P1		Practicals based on Course USACEENT501	2	4

Semester VI

Theory (Any four units to be opted)				
Course	Unit	TOPIC	Credits	L / Week
USACEENT601	I	Damage Caused by Insects	2	4
	II	Control of Household Pests		
	III	Social Life of Insects.		
	IV	Important Insecticides.		
	V	Insecticide Formulations.		
	VI	Other Methods of Insect Control.		
	VII	Integrated Pest Management.		
	VIII	Forensic Entomology.		
Practicals				
USACEENT6P1		Practicals based on Course USACEENT601	2	4

Semester V
Theory
Morphology and Industrial Entomology

Course code: USACEENT501

2 Credits

(Any four units to be opted)

Unit I

General morphology and development of insects:

- i) External morphology of Head, Thorax and Abdomen.
- ii) Appendages of head, thorax and abdomen including antennae, legs, mouth parts and wings.
- iii) Types of Metamorphosis. Types of larvae and pupae.

Unit II

Apiculture:

- i) Details including management and economics.
- ii) Different types of bees *Apis dorsata*, *Apis mellifera*, *Apis florea* & *Apis indica*. Stingless bees.
- iii) The Apiculture business: structure of artificial bee hive, method of cultivation, tools used, management of apiary. Disease of bees and their natural enemies.
- iv) Products: honey, wax, royal jelly, venom, propolis & economics of bee keeping.

Unit III

General anatomy of insects:

Brief outline of ...

- i) Digestive system, Respiratory system
- ii) Circulatory system, Reproductive systems of male and female.
- iii) Excretory system, Nervous system, Endocrine system.

Unit IV

- i) Sericulture techniques – Details including management and economics.
- ii) Different types of silk moths. Life cycle of Mulberry silk moth.
- iii) The Sericulture business: cultivation of mulberry, laboratory setup, rearing of worms (procuring eggs, incubation, hatching and maintenance of larvae), overall management, diseases of silk worms.
- iv) Process of obtaining silk from cocoons and variations with reference to other silk moths; Uses of silk and economics of sericulture.

Unit V

- i) Insect classification.
- ii) Broad characteristics and few examples of:
 - a) Thysanura, Orthoptera, Isoptera
 - b) Hemiptera, Lepidoptera, Diptera
 - c) Hymenoptera, Coleoptera, Odonata

Unit VI

Lac culture:

- i) The lac insect, hosts, culture techniques.

- ii) Natural enemies of lac insects. Processing of raw lac to fine lac and uses of lac.
- iii) Management and economics of lac culture business.

Unit VII

Insects in relation to their environment:

- i) Effect of temperature, light, humidity.
- ii) Mimicry; diapause.
- iii) Communication in insects [Tactile, chemical, visual (light and dance) and by sound].

Unit VIII

Generalized management topics:

Brief idea about ...

- i) Awareness of - Labour laws, Taxation, Regulatory authorities / organizations such as: Local self Government., Government Agencies, FDA.
- ii) Fund Raising - Financial institutions & funding agencies (loans and subsidies) Financial management – [Costing, budgeting, fund flow, auditing, feasibility report]
- iii) Marketing, Cooperative and self-help group, MAVM (MahilaAarthikVikasMahamandal), KVIC(Khadi and Village Industry Corporation).

SEMESTER-V PRACTICAL

Course code: USACEENT5P1

Credits – 2

Mountings:

1. Head sclerites, thoracic segments, abdominal segments of cockroach.-
2. Types of antennae. Filiform, Moniliform, Aristate, Capitae, Clavate, Clubbed, Plumose, Pilose, Pectinate, Bipectinate, Setaceous and Genuiculate, Lamellate, Serrate. (Any two mountings and rest for study with photo/permanent slides). (Preferably pests)
3. Halter and wing of house fly.

Study of wing types: membranous, hemitegmina, tegmina, hemielytra, elytra with photos or permanent slides.

4. Types of legs- Typical, Cursorial, Fossorial, Saltatory, Natatorial and Scansorial (Mountings of any two and rest for study with photo/permanent slides).
5. Abdominal appendages- Styles, cerci of cockroach.
Study of abdominal gills using photos/ permanent slides.).
6. Cornea (Cockroach or Housefly)
7. Mouth parts of Cockroach
8. Malpighian tubules (cockroach)
9. Haemocytes from cockroach.

Dissections:

1. Digestive system - Cockroach
2. Nervous system – Cockroach.

Study:

1. Any one sound producing organ (Photo / specimen).
2. Insect types: *Lepisma*, cricket, winged termite, giant water bug, any one type of butterfly and moth, *Sarcophaga*, potter wasp, long horn beetle or water beetle, damselfly. – use Photo/specimen.
3. Types of larvae and pupae, Types of metamorphosis.
4. Life cycle of bee, silk moth.
5. Products – lac, bee wax, silk.
6. Equipments used in apiculture, sericulture, lac culture.
7. Examples of mimicry, camouflage and concealment. (Specimens or photos)
8. Collection, preservation and display of 5 insect types of 5 different insect orders. (Collection and preservation of insects other than pests be discouraged)
9. Field visit / Assignment / Play and ponder.
Give actual handling of bees/ silk moth / lac insect or visit to any one of these units.

Semester VI
Theory
Pest Control and Forensic Entomology
Course code: USACEENT601 **Credits -2**
(Any four units to be opted)

Unit I

Damage caused by insects:

- i) To plants and stored grains- Grasshoppers, bugs, caterpillars, scale insects, leaf hoppers, rice weevil, *Bruchus*, meal moth, *Tenebrio*, *Trogoderma*.
- ii) To animals - bird louse, *Hypoderma*, screw worms. *Gastrophilus*.
- iii) To man- flea, *Anopheles*, *Culex*, *Aedes*, *Glossina*, *Phlebotomus*.

Unit II

Control of house-hold pests:

- i) Cockroaches, flies, fleas, ants.
- ii) Silverfish, book lice, cloth moth, carpet damaging insects.
- iii) Powder post beetle, Termites.

Unit III

Social life and other useful activities of insects:

- i) Social life in Bees, Ants and wasps.
- ii) Social life in Termites.
- iii) Insects as pollinators and scavengers.

Unit IV

Important insecticides:

- i) Broad classification of insecticides. Inorganic insecticides (Arsenicals, Lime - sulphur, Mercury compounds, Fluorine compounds) , Fumigants (Para dichlorobenzene, Methyl bromide, Hydrogen cyanide)
- ii) Natural organics – oils, insecticides of plant origin (Pyrethrums, Nicotine, Azadiractin) Synthetic Organics – Chlorinated Hydrocarbons (BHC, Methoxychlor) Organophosphate (Malathion, Parathion, Dicrotophos, Chlorpyrifos) Carbamates (Carbaryl, Propoxur) and Pyrethroids (Allethrin, Cypermethrin).
(Give mode of action and applications of insecticides. Mention important characters of insecticides and precautions to be taken during applications)

Unit V

Insecticide formulations and equipments.

- i) Insecticide Formulations (Dust, Granules, Emulsifiable concentrates, Wettable powders, Aerosols.)
- ii) Techniques of fumigation.
- iii) Equipments used for insecticide applications: - Dusters, Sprayers (Hand operated, Back snap, Foot operated) Precautions and maintenance of the equipments.

Unit VI

- i) Other methods of insect control.
- ii) Advantages and disadvantages of insecticides.
- iii) Biological control by [predators, parasites and microbes (Bacteria, viruses), fungi, Nematodes]
- iv) Use of Hormones and Pheromones.
- v) Sterile male technique.

Unit VII

A) Integrated pest management (IPM).

What is IPM? Need for IPM. Planning of IPM, Different techniques used in IPM, Few examples and advantages of IPM.

Unit VIII

Forensic Entomology:

- i) Brief mention of Common insects of Forensic importance -
Order Diptera- Calliphoridae, Sarcophagidae & Muscidae
Order Coleoptera -Staphylinidae, Histeridae, Silphidae, Dermestidae & Cleridae
- ii) Collection of entomological evidence during a death investigation.
Temperature and climatic records, collection, preservation and handling of insects/maggots from the crime scene.
- iii) Analysis of entomological evidence and estimating PMI(Post Mortem Index) using Maggot age and Insect succession.
- iv)

SEMESTER – VI

PRACTICAL

Course code: USACEENT6P1

Credits – 2

1. Observation of permanent slide or photographs of legs of honey bee.
 2. Mounting of mouth parts of mosquito.
 3. Study of LC50 on suitable insect. Preferably mosquito larvae/rice weevil/flour beetle/ Chironomus larvae.
 4. Study the effect of following insecticides on suitable insects. (Behavioural parameters and mortality)
 - Contact poison.
 - Stomach poison.
 - Fumigant.
- Study of –
5. Damage caused and control of - Grasshopper, plant bug, caterpillar, scale insect. Leaf hopper, Rice weevil, *Bruchus*, Meal moth, Flea, Bird louse, *Anopheles*, *Culex*, *Aedes*, *Glossina*, *Phlebotomus*, *Hypoderma*, Screw worm fly.
 6. Insecticide formulations. (Dust, Granules, Emulsifiable concentrates, sprays, wettable Powders)
 7. Equipments – Sprayers, Dusters as in theory.

8. Castes of termites.
9. Organisms important in Biological control -Braconid or Ichneumonid wasp, Red ant, Wood pecker.
10. Any two insect types breeding in flesh of dead body. One Diptera, one Coleoptera
11. Demo of Household pest control (Use of different equipments such as drills, sprayers, dusters and insecticides).
12. A project based on any applied topic from paper USACEET601, to be assigned to individual student.
13. Digestive and Reproductive system - Housefly.
The assessment will be done during practical USACEENT6P1 through examination of project report, presentation of data and viva-voce.

Instructions for USACEENT501 and USACEENT601

Total four units are to be selected per theory course for formal teaching by the concerned teachers in consultation with the head of the department and having discussed with the students, enabling optimum utilization of the available infrastructure, expertise of the teachers, human resources and opportunities in the local area.

Though it is desirable to encourage the students to undertake assignments / seminars / learning through guest lectures / entrepreneurial skill development / field visits, etc. From the topics which are not formally taught by the teacher/s in order to have an overview of the subject. It is not compulsory to do so and that assignments / seminars / learning through guest lectures / entrepreneurial skill development / field visits, etc. Too also be based on the topics formally taught by the teacher/s. The decision in this matter can be taken with full freedom as may be academically desired.

REFERENCE BOOKS:

- A Text book of insect morphology, physiology and endocrinology – Tembhare D B – S. Chand Publication.
- Principles of insect morphology- Snodgrass R E – Tata McGraw Hill.
- Text book of Entomology—Ross – John Wiley publ.
- General and applied Entomology – David and Ananthakrishnan. Tata McGraw Hill
- Principles of insect physiology – Wigglesworth. – ELBS Publication.
- A General textbook of entomology -- A D Imms. Asia Publication.
- Insect endocrinology and physiology – Tembhare D B – S Chand publication.
- Applied Entomology – Awasthi. Scientific Publication.
- Forensic Entomology-The utility of Arthropods in legal investigations. –Jason H. Byrd and James L. Castner. CRC Press.
- Agricultural insect pests and their control. V.B. Awasthi. Scientific Publication.
- A manual of practical entomology. – M M Trigunayat. Scientific Publication.
- Laboratory manual of entomology – Alaka Prakash . New Age Publishers.
- Applied Entomology – Alaka Prakash and Fennemore. New Age Publishers.

Photographic Atlas of Entomology and guide to insect identification.-Castner. Seline press Florida. Marketed by Scientific Publication.

The Insects - Structure and Function - 4th Edition Edited by R. F. Chapman. Cambridge University Press 1998.

Entomology and Pest Management –Larry P. Pedigo. Pearson Education.

Destructive and Useful Insects.- Metcalf and Flint. McGraw Hill Publication.

Insect Year Book of Agriculture- American Agriculture Department Publication.

Economic Zoology- Shukla, Upaddhaya and Srivastava. S. Chand Publication.

Books in Marathi:

Keetaknirikshakanchasobati:Purushottam Joshi, Continental publication, Pune.

GharopadraviKeetakwaupay:Purushottam Joshi, Continental publication, Pune.

KeetakParichaywaSangraha:Purushottam Joshi, Continental publication, Pune.

PikanvareelKeed – Keetak:Purushottam Joshi, Continental publication, Pune.

Madhmashya – JeevanaaniPalan: R. V. Ranade, Continental publication, Pune.

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 neighbouring colleges.

Annexure I –

Course Code: USACEENT5P1

Group Assignments . (Maximum 5 students in a group)

- 1. Visit Govt. office to find subsidies for different entomology related industries.**
- 2. Collect information on available pesticides.**
- 3. Study the wholesale and retail marketing of the insecticide.**
- 4. Study the production of insecticides in the industry.**
- 5. Study marketing of insecticides by interacting with the salesman/others concerned.**
- 6. Study any one unit of sericulture /culture/apiculture.**
- 7. Survey recent research trends in biological control of insect pests.**
- 8. Study the institutes actively guiding on Biological control.**
- 9. Study the insecticide /formulations available in the market and decide their demand in the market.**
- 10. Obtain from internet/books/journals, taxonomic keys for different insect orders.**
- 11. Species of Bees (solitary & social) and their role as pollinators.**
- 12. Diseases and natural enemies of bees.**
- 13. Bee products and their uses.**
- 14. Types of silk moths (wild & semi domesticated) and their contribution to the National silk production.**
- 15. Diseases and enemies of silk moths.**
- 16. Comparison of the current status of lac industry in Bihar and Maharashtra.**
- 17. Diseases of lac insects and uses of lac in industry.**
- 18. Role of Mahila Aarthik Vikas Mahamandal in insect related small scale enterprise (sericulture, Lac culture).**
- 19. Role of Khadi and Village Industry in encouraging insect related enterprises (Apiculture, Biocontrol).**

20. Damage caused by insects to stored grain, cattle, poultry and man.
21. Feasibility of Biocontrol for household pests (Godrej case study).
22. Comparative study of social life of Bees, Ants and Termites.
23. Insecticide formulations and applications.
24. Maintenance and working of equipments used in insecticide application.
25. Advantages of IPM quoting successful case studies.

Annexure II

Course Code: USACEENT5P1

Play and ponder.

1. Maintain a bee hive.
2. Maintain a stingless bee colony.
3. Behaviour studies.
4. Toxicological studies.
5. Grow larvae/nymphs of insects to study life cycle.
6. Maintain silk moth larvae.
7. Study lac culture.
8. Grow in laboratory, flies/beetles breeding on flesh and note the details of their behavior.
9. Does the scent or colour of a flower attract an insect?
10. Temperature prediction by recording cricket chirps per minute.
11. Effect of sex pheromones on insects.
12. Inter species communication – talking to fireflies.
13. Maintain an ant hill to understand community living.

Annexure III

Course Code: USACEENT5P1

Field visits.

Visit the to an apiculture unit.

Visit the to a sericulture unit.

Visit the to a lac culture unit.

Collect insects from the given area to study diversity.

Collect and study aquatic insects.

Collect different types of mosquitoes.

The topics listed in annexure 1 to 4 are suggestions only, leaving scope for further identifying suitable topics in the relevant areas.

Annexure IV

Course Code: USACEENT6P1

Projects for individual student.

Prepare feasibility report on apiculture unit – small/medium/large scale.

Prepare feasibility report on sericulture unit – small/medium/large scale.

Prepare feasibility report on lac culture unit – small/medium/large scale.

Prepare feasibility report on setting pest control business.

Study of behavior of pest insects.

Collect dead insects to find the infection by fungi, bacteria, viruses and other pathogens.

To compare the toxicity of insecticide using different insect models or stages of insects.

To prepare different types of baits and test their efficacy.

To try different plant extracts/ chemicals for their synergistic activity.

Monitor the life cycle of insects of forensic importance, throughout the year to record seasonal differences.

Modality of Assessment :

Theory Examination Pattern:

A) Internal Assessment - 40%

40 marks.

Theory

40 marks

Sr No	Evaluation type	Marks
1	One Assignments/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

B) External examination - 60 %

Semester End Theory Assessment - 60%

60 marks

- i. Duration - These examinations shall be of two and half hours duration.
- ii. Theory question paper pattern :-
 1. There shall be **five** questions each of **12** marks. On each unit there will be one question & fifth one will be based on all the four units .

2. All questions shall be compulsory with internal choice within the questions. Each question will be of **24** marks with options.
3. Questions may be sub divided into sub questions a, b, c & d only, each carrying **six** marks **OR** a, b, c, d,e & f only each carrying **four** marks and the allocation of marks depends on the weightage of the topic.

Practical Examination Pattern:

(A) Internal Examination:-

There will not be any internal examination/ evaluation for practicals.

(B) External (Semester end practical examination) :-

Sr.No.	Particulars	Marks
1.	Laboratory work	80
2.	Journal	10
3.	Viva	10

Assessment pattern for semester end / External practical examination of 80 marks shall be finalized in the workshop of the subject

Semester end practical examination in applied component shall be conducted by the concerned department of the Institute/ College at the end of each semester and the marks of the candidates are to be sent to the University in the prescribed format.

Semester V:

Practical examination will be held at the college / institution at the end of the semester.

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department ; failing which the student will not be allowed to appear for the practical examination.

Semester VI

Practical examination will be held at the college / institution at the end of the semester. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department ; failing which the student will not be allowed to appear for the practical examination.

