ST. MARY'S COLLEGE (AUTONOMOUS)

(Re-accredited with A+ Grade by NAAC)

Thoothukudi – 628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

B.Sc. Zoology

School of Biological Sciences

Outcome Based Curriculum

(w.e.f. 2024)

Preamble

Zoology is a vital stream of science, it gives an insight into the essence of life. It helps for the betterment of human race through various fields. It unravels the magic of co-existence and ecological balance by creating awareness of conservation of biodiversity. After completing the graduate degree the candidates have tremendous opportunities for higher studies and lots of job opportunities both in public and private sectors.

Vision: To prepare young women face the challenges of life through education, an ideal weapon for empowerment.

Mission: To impart knowledge and skills in Zoology through specialization in recently emerging technologies and thereby to produce quality graduates capable of contributing to the development of knowledge based society.

Programme Outcome:

PO. No.	**After completion of the Undergraduate programme, the students of St. Mary's College will be able to**
PO-1	acquire an in-depth domain knowledge and a comprehensive knowledge of various disciplines to become skilled professionals
PO-2	enrich their communicative skills, and enhance their creative, numerical, analytical and problem solving skills
PO-3	gain potential skills to excel indigital literacy, team management, scientific reasoning, research and self-directed life-long learning to emerge as entrepreneurs
PO-4	be aware of the environment with a social responsibility for the well-being of humanity and the planet at large
PO-5	be an empowered, economically independent woman with a global perspective to emerge holistically in the egalitarian society

Programme Specific Outcome:

PSO. No.	After completion of the B.Sc Zoology Degree programme, the graduates will be able to
PSO-1	exhibit an extensive comprehension of zoological principles, structure, functions, interactions integrating knowledge from various basic and applied fields to analyse and solve complex biological challenges
PSO-2	communicate scientific findings across various courses, employing creative, numerical, analytical, and problem-solving skills to interpret and convey related concepts effectively
PSO-3	acquire proficiency in utilizing digital tools for data analysis, scientific attitude, entrepreneurial skills to drive innovation in research and exhibit leadership qualities within the academic and scientific community
PSO-4	cultivate a deep sense of environmental consciousness and uphold social responsibility by integrating ethical considerations into their research and conservation efforts
PSO-5	emerge as empowered, economically independent individuals with a holistic perspective and actively contributing to the human welfare and society

St. Mary'College(Autonomous)Thoothukudi

Department of Zoology

UG Course Structure (2024- 2027)

Semester – I

Part	Components	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
						CIA	ESE	Total
I	Tamil / French	24ULTA11 / 24ULFA11		6	3	40	60	100
II	General English	24UGEN11		6	3	40	60	100
III	Core I	24UZOC11	Invertebrata	6	5	40	60	100
	Core Practical I	24UZOCR1	Invertebrata	2	2	40	60	100
	Generic Elective I	24UCHE12	Chemistry for Biological Sciences I	4	4	40	60	100
	Elective Practical I	24UCHER1	Chemistry Practical I	2	1	40	60	100
IV	Skill Enhancement Course I	24UZOSE1	Ornamental Fish Farming and Management	2	2	20	30	50
	Ability Enhancement Course I	24UZOA11	Value Education	2	2	20	30	50
Total				**30**	**22**			

Semester – II

Part	Components	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
						CIA	ESE	Total
I	Tamil / French	24ULTA21 / 24ULFA21		6	3	40	60	100
II	General English	24UGEN21		6	3	40	60	100
III	Core II	24UZOC21	Chordata	6	5	40	60	100
	Core Practical II	24UZOCR2	Chordata	2	2	40	60	100
	Generic Elective II	24UCHE22	Chemistry for Biological Sciences II	4	4	40	60	100
	Elective Practical II	24UCHER2	Chemistry Practical II	2	1	40	60	100
IV	Skill Enhancement Course II	24UZOSE2	Apiculture	2	2	20	30	50
	Ability Enhancement Course II	24UZOA21	Environmental Studies	2	2	20	30	50
Total				**30**	**22**			

Semester III

Part	Components	Course Code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil / French	24ULTA31 / 24ULFA31		6	3	40	60	100
II	General English	24UGEN31		6	3	40	60	100
III	Core III	24UZOC31	Developmental Zoology	5	5	40	60	100
	Core Practical III	24UBOCR3	Developmental Zoology	2	2	40	60	100
	Generic Elective III	24UBOE31	Basics of Botany I	4	3	40	60	100
	Generic Elective Practical III	24UBOER3	Basics of Botany Practical I	2	1	40	60	100
	NME I	24UZON31	Basic Biotechnology	2	2	20	30	50
IV	Skill Enhancement Course III	24UZOSE3	Value Added Fishery Products	2	2	20	30	50
	Ability Enhancement Course III	24UYMA31	Yoga & Meditation	1	1	--	50	50
	Self Study/ MOOC / Internship (Compulsory)	24UZOSS1	Wildlife Management and Conservation		+2			
Total				**30**	**22+2**			

Semester IV

Part	Components	Course Code	Course Title	Contact Hours/ Week	Credits	Max. Marks		
						CIA	ESE	Total
I	Tamil / French	24ULTA41 / 24ULFA41		6	3	40	60	100
II	General English	24UGEN41		6	3	40	60	100
III	Core IV	24UZOC41	Biochemistry and Bioinstrumentation	5	5	40	60	100
	Core Practical IV	24UZOCR4	Biochemistry and Bioinstrumentation	2	2	40	60	100
	Generic Elective IV	24UBOE41	Basics of Botany II	4	3	40	60	100
	Generic Elective Practical IV	24UBOER4	Basics of Botany Practical II	2	1	40	60	100
	NME II	24UZON41	Applied Biotechnology	2	2	20	30	50
IV	Skill Enhancement Course IV	24UZOSE4	Medical Laboratory Techniques	2	2	20	30	50
	Ability Enhancement IV Course (Entrepreneurial Based)	24UZOA41	Biocomposting for Entrepreneurship	1	1	--	50	50
	NCC / NSS / Sports				1			
	CDP				+1			
Total				**30**	**23+1**			

Semester V

Part	Components	Course Code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core V	24UZOC51	Cell Biology	4	4	40	60	100
	Core VI	24UZOC52	Genetics	4	4	40	60	100
	Core VII	24UZOC53	Animal Physiology	4	4	40	60	100
	Core VIII	24UZOC54	Animal Biotechnology	4	4	40	60	100
	Core Practical V	24UZOCR5	Cell Biology, Genetics	4	2	40	60	100
	Core Practical VI	24UZOCR6	Animal Physiology, Animal Biotechnology	4	2	40	60	100
	Discipline Specific Elective I	24UZOE51/ 24UZOE52	**Commercial Aquaculture/** Animal Behaviour	4	4	40	60	100
IV	Skill Enhancement Course V	24UZOSE5	Sericulture	2	1	20	30	50
	Self Study / Online Course / Internship (Optional)	24UZOSS2	Dairy Farming		+2		50	50
Total				**30**	**25+2**			

Semester VI

Part	Components	Course Code	Course Title	Contact Hours/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core IX	24UZOC61	Marine Biology	5	5	40	60	100
	Core X	24UZOC62	Immunology and Microbiology	5	5	40	60	100
	Core XI	24UZOC63	Biostatistics and Bioinformatics	5	5	40	60	100
	Core Practical VII	24UZOCR7	Marine Biology	2	1	40	60	100
	Core Practical VIII	24UZOCR8	Immunology and Microbiology, Biostatistics and Bioinformatics	4	2	40	60	100
	Core XII (Project)	24UZOP61	Project and Viva Voce	5	4	40	60	100
	Discipline Specific Elective II	24UZOE61/ 24UZOE62	**Ecology and Biodiversity/** Evolutionary Biology	4	4	40	60	100
Total				**30**	**26**			

SEMESTER I			
Core I: Invertebrata			
Course Code: 24UZOC11	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 5**

Objectives:

- To understand the basic concepts of lower animals and observe the structure and functions.
- To examine the systemic and functional morphology of various group of invertebrates.

Course outcome

CO. No.	Upon completion of this course, students will be able to	CL
CO-1	describe the basic concepts of invertebrate animals and recall itsstructure and functions.	**K1**
CO-2	differentiate and classify the animal's mode of life in various taxaand interpret the related concepts of biodiversity.	**K2**
CO-3	illustrate and demonstrate the systemic and functional morphologyof various groups of invertebrates using digital tools.	**K3**
CO-4	appraize the biological knowledge on environmental consciousness of lower animals.	**K4**
CO-5	evaluvate the scientific issues in invertebrates within the larger social context to become an empowered woman	**K5**

Unit I Protozoa and Porifera (18Hrs)

Protozoa: Introduction to classification, taxonomy and nomenclature. General characters and classification of phylum Protozoa up to classes. Type study: *Paramecium* - Parasitic protozoans *Entamoeba* and *Trypanasoma* – General topics – nutrition, and locomotion in protozoa.

Porifera: General characters and classification up to classes. Type study: Sycon- Canal system in sponges. Reproduction in sponges.

Unitt II Coelenterata and Platyhelminthes (18Hrs)

Coelenterata : General characters and classification up to classes – Type study: *Obelia* - Corals and coral reefs - Economic importance of coralsand coral reefs - Polymorphism in Hydrozoa.

Platyhelminthes: General characters and classification up to classes. Type study: *Fasciola hepatica* - parasitic adaptations of platyhelminthes.

Unit III Aschelminthes and Annelida (18Hrs)

Aschelminthes : General characters and classification of up to classes -Type study:*Ascaris lumbricoides.* Nematode parasites and diseases - *Wuchereria bancrofti* and *Ancylostoma duodenale*.

Annelida: General characters and classification up to classes. Type study: E a r t h w o r m - Biological significance of earthworm.

Unit IV Arthropoda (18Hrs)

Arthropoda: General characters and classification of phylum Arthropoda up to classes. Type study: *Penaeus indicus*. Larval forms in Crustacea. Economic importance of Insects – lac insect and silk worm. Pest of rice: Rice stem borer (*Scirpophaga incertulas*) – Pest of coconut: Rhinoceros beetle (*Oryctes rhinoceros*).

Unit V Mollusca and Echinodermata (18Hrs)

Mollusca: General characters and classification of Phylum Mollusca up to classes.Type study: *Pila globosa*. General topic – Cephalopods are advanced Molluscs.

Echinodermata: General characters and classification of Phylum Echinodermata upto classes. Type study: *Asterias* - Water vascular system - Larval forms of Echinoderms.

Text Books

1. Ekambaranatha Iyer, *A Manual of Zoology*, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd, 2000.
2. Jordan, E.L. and P.S, Verma, *Invertebrate Zoology*, 12th edn. S. Chand& Co,1995.
3. Kotpal, R. L, *Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata*,1992.

Books for Reference

1. Ruppert and R.D. Barnes, *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition, 2006.

Web Resources

1. https://www.nationalgeographic.com/animals/invertebrates/
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://greatbarrierreef.org/

PSO Relation Matrix

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	3	3	**3**	3	**3**	3	2
CO-2	1	**1**	1	1	1	2	2	2	**1**	2
CO-3	1	2	2	3	**2**	1	1	**2**	2	2
CO-4	2	2	2	3	3	3	3	3	3	3
CO-5	2	2	2	2	3	2	2	**2**	3	**3**
Ave.	1.8	2.0	2.0	2.4	2.4	2.2	2.2	2.4	2.6	2.4

Mapping	**<40%**	**≥ 40% and < 70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

PRACTICALS

Course Code: 24UZOCR1

Hrs/Week: 2 **Credits: 2**

I. **Major Dissection :** Cockroach:, Nervous system, Reproductive system.

II. **Minor Dissection:** Cockroach: Digestive system

III. **Mounting :** Cockroach: Mouth parts - Prawn: Appendages

IV. Record / Observation Note (SUBMISSION IS MANDATORY)

V. **Spotters :(i) Protozoa:** Amoeba, Paramecium, *Entamoeba histolytica*, **(ii) Porifera:** *Sycon, Gemmule* **(iii) Coelenterata:** *Obelia* – Colony, *Physalia,* **(iv) Platyhelminthes:** *Planaria, Fasciola hepatica, Fasciola* larval forms – Miracidium, Redia, Cercaria, *Taenia solium* **(v) Nemathelminthes:** *Ascaris* (Male & Female),**vi) Annelida:** *Nereis, Hirudinaria, Trochophore* larva **(vii) Arthropoda:** Crab, *Palaemon, Scorpion, Limulus, Peripatus*, Larvae -

Nauplius, Mysis, Zoea **(viii) Mollusca:** *Chiton, Pila, Murex, Sepia, Loligo, Octopus,* **(ix) Echinodermata:** *Asterias, Cucumaria, Antedon, Bipinnaria* larva.

Book for Reference:

1. Boradale, L.A. and E.A. Potts, *Invertebrates: A Manual for the use of Students*, Asia Publishing Home, 1961.

SEMESTER I			
Skill Enhancement Course I: Ornamental Fish Farming and Management			
Course Code: 24UZOSE1	**Hrs / Week: 2**	**Hrs / Semester: 30**	**Credits: 2**

Objectives

- To enable the identification, culture and maintenance of commercially important ornamental fishes and to generate technically skilled manpower for entrepreneurship development
- To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	CL
CO - 1	find the commercially important ornamental fishes	**K1**
CO - 2	interpret competencies to become an entrepreneur in ornamental fish culture	**K2**
CO - 3	apply the knowledge and skills in aquarium management	**K3**
CO - 4	analyse the taxonomy, biology and different breeding techniques employed for varieties of ornamental fish	**K4**
CO - 5	evaluate the National and International export process and income generation	**K5**

Unit I **Benefits of Ornamental fish rearing** **(6Hrs)**

Introduction to ornamental fish keeping.

Scope and importance of ornamental fish culture.

Commercially important ornamental fishes - Indigenous (Zebra fish, Gourami) and exotic varieties (Sword tail, Platy).

Unit II **Aquarium Fabrication** **(6Hrs)**

Aquarium design and construction: Accessories - aerators, filters and lighting. Maintenance of water quality – temperature, water hardness, ammonia, pH, O_2, CO_2. Importance of aquarium plants

Unit III **Fish Feeding and Nutrition** **(6Hrs)**

Biology: Egg layers–Gold fish and Angel fish, Live bearers–Guppy and Molly. Food and feeding in ornamental fishes - Formulated feed – classification, ingredients, quality, preparation - Live feed – brine shrimp, earthworm, advantages of live feed

Unit IV **Fish diseases** **(6Hrs)**

Causative organism, symptoms, prevention, and control measures.- Protozoan (velvet disease), bacterial (Columnaris), Fungal (Saprolegniasis), parasitic (ectoparasites-Argulosis), viral (Carp pox) disease.

Unit V **Fish Transport** **(6Hrs)**

Conditioning, packing, transport and quarantine methods.

Economics, trade regulations, domestic and export marketing strategies.

Practical **(6Hrs)**

1) Identification of locally available ornamental fishes - Egg layers and live bearers.
2) Identification of locally available live feed organisms.
3) Preparation of artificial feed

Text Book

1. Jayashree K.V., N. Tharadevi and N. Arumugam. *Ornamental Fish Farming and Management*. Biosciences Book Publishers, Saras Publication, Nagercoil, Tamilnadu, India. 2023.

Books for Reference:

1. Swain SK, N. Sarangi. and S. Ayyappan. *Ornamental Fish Farming*. ICAR, New Delhi. 2010
2. Living Jewels – *A Handbook on Freshwater Ornamental Fish*, MPEDA, Kochi.1990.

3. Dey V.K.A. *A Handbook on Aquafarming Ornamental Fishes*. MPEDA, Kochi. 1997.
4. Ahilan, B, N. Felix and Santhanam R. *Text Book of Aquariculture*. Daya Publishing House, New Delhi. 2008.

Web links:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=297
2. https://www.ofish.org/
3. https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/
4. https://99businessideas.com/ornamental-fish-farming/

PSO Relation Matrix

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	2	3	2	2	3	2	3	3	3
CO-2	3	2	3	2	3	3	2	3	2	3
CO-3	3	2	3	3	3	2	2	2	2	3
CO-4	3	1	2	2	3	3	2	3	2	2
CO-5	2	2	3	3	3	3	3	1	2	3
Ave.	2.8	1.8	2.8	2.4	2.8	2.8	2.2	2.4	2.2	2.8

Mapping	**<40%**	**≥ 40% and < 70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

SEMESTER II			
Core II: Chordata			
Course Code: 24UZOC21	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 5**

Objectives:

- To understand the basic characters of chordates, systematic position, origin and ancestrory of chordates
- To impart information on the basic concepts of vertebrates

Course Outcome

CO. No	**Upon completion of this course, students will be able to**	CL
CO - 1	recall the structures, functions and distinct features of phylum Chordata.	**K1**
CO - 2	distinguish the characteristic features of each subphylum and class.	**K2**
CO - 3	apply scientific methods to generate insights for addressing the various organs of chordates using digital tools.	**K3**
CO - 4	appraize the knowledge on environmental consciousness of some important fishes, amphibians, reptiles, birds and mammals.	**K4**
CO - 5	evaluvate the conservation and management strategies of the chordate fauna to gain career opportunities	**K5**

Unit I General Characters and Classification of Phylum Chordata (18 Hours)

Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and systematic position of Hemichordata (*Balanoglossus*), Urochordata (*Ascidia*), Cephalochordata (*Amphioxus*).

Unit II Prochordates, Agnatha and Pisces (18 Hours)

Characteristics of subphylum vertebrata, Classification of Vertebrata up to class level, Agnatha *Petromyzon* – External morphology and life cycle – Pisces - General characters and classification up to sub classes – Type study - *Scoliodon sorrakowah* - digestive system, respiratory system, circulatory system, urinogenital system and reproductive

system – General topics: Parental care – Migration of fishes.

Unit III Amphibia (18 Hours)

General characters and classification up to classes. Type study - *Rana hexadactyla* - External morphology, skin, digestive system, respiratory system, circulatory system, nervous system and urinogenital system - parental care in Amphibia.

Unit IV Reptilia (18 Hours)

General characters and classification up to classes - Type study – *Calotes versicolor* - External morphology, digestive system and circulatory system only. General topic – Identification of poisonousand non-poisonous snakes – Poison apparatus, fangs, biting mechanism, snake venom and first aid.

Unit V Aves and Mammalia (18 Hours)

Aves: General characters and classification up to classes – Type study - *Columba livia* - External morphology, digestive system, respiratory system. Osteology – synsacrum. General topic - Flight adaptations of birds and migrationin birds.

Mammalia: General characters and classification up to classes - Type study – Rabbit. Dentition, digestive system, respiratory system, circulatory system, urinogenital system. - General topics– Adaptations of aquatic mammals.

Text Books

1. Ayyar, E.K. and T.N. Ananthakrishnan. *Manual of Zoology* Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p, 1992.
2. Jordan, E.K. and P.S. Verma. *Chordate Zoology and Elements of Animal Physiology*, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp, 1995.
3. Nigam, H.C. *Zoology of Chordates*, Vishal Publications, Jalandhar - 144008, 942, 1983.
4. Ganguly, Sinha, Bharati Goswami and Adhikari. *Biology of Animals* Vol.II - New Central Book Agency (p) Ltd, 2004.
5. Kotpal. R.L. A, *Modern Text Book of Zoology Vertebrates*- Rastogi Publications. 2009.

Books for Reference

1. Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub. Co. 2017.
2. Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts. *Integrated Principles of Zoology*, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp, 1984.
3. Newman, H.H. *The Phylum Chordata*, Satish Book Enterprise, Agra – 282 003, 477 pp, 1981.
4. Parker and Haswell. *Text Book of Zoology*, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp, 1964.
5. Pough H. *Vertebrate Life*, VIII Edition, Pearson International, 2018
6. Waterman, Allyn J. *et al.*, *Chordate Structure and Function*, Mac Millan &Co., New York, 587 pp, 1971.

Web Resources

1. http://tolweb.org/Chordata/2499
2. https://www.nhm.ac.uk/
3. https://bit.ly/3Av1Ejg
4. https://bit.ly/3kqTfYz
5. https://biologyeducare.com/aves/
6. https://www.vedantu.com/biology/mammalia

PSO Relation Matrix

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO-1	2	1	1	1	2	2	1	2	2	2
CO-2	3	1	2	2	3	3	1	2	3	3
CO-3	1	1	3	2	2	1	1	3	2	2
CO-4	3	3	2	2	2	3	3	2	2	2
CO-5	1	1	1	2	2	1	1	1	2	2
Ave.	2.0	1.4	1.8	1.8	2.1	2.0	1.4	2.0	2.2	2.2

Mapping	<40%	≥ 40% and < 70%	≥ 70%
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

PRACTICAL

Hours/Week: 2 **Course Code: 24UZOCR2** **Credits: 2**

I. **Dissections**:(Virtual) Frog – Brain

II. Fish: External features, Digestive system.

III. **Mounting**: Fish: Placoid scale

IV. **Specimen and Slides**: **(i) Hemichordata:** Balanoglossus, Tornaria larva **(ii). Protochordata:** Amphioxus **(iii). Cyclostomata:** Petromyzon, Ammocoetus larva **(iv). Pisces:** Shark, Anabus, Cybium, Hippocampus, Echieneis, Labeo, Catla, Anguilla. **(v). Amphibia:** Ichthyophis, *Amblystoma*, Hyla, Rachophous, Bufo, Rana, Axolotal larva **(vi). Reptilia:** Draco, Chemaeleon, Naja, Typhlops, **(vii). Aves:** Archaeopteryx, *Columba*, Corvus, *Pavo*; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down **(viii). Mammalia:** Ornithorhynchus, Pteropus, Hedgehog.

Text Books

1. Lal S S. *Practical Zoology Vertebrate*, Rajpal and Sons Publishing, 484 pp, 2009.
2. Verma P.S. *A Manual of Practical Zoology*: Chordates, S. Chand Limited, 627 pp, 2000.

Books for Reference

1. Robert William Hegner. *Practical Zoology*, BiblioLife, 522 pp, 2015.
2. Young, J,Z. *The life of vertebrates*. OxfordUni. London, 1972.

Web Resources

1. https://www.youtube.com/watch?v=b04hc_kOY10
2. https://bit.ly/3CzTEy8
3. http://tolweb.org/Chordata/2499
4. https://www.nhm.ac.uk/
5. https://bit.ly/3Av1Ejg

SEMESTER II			
Skill Enhancement Course II : Apiculture			
Course Code: 24UZOSE2	**Hrs / week :2**	**Hrs / Sem: 30**	**Credits:2**

Objectives:

- To understand the history and different groups of honey bees and their social organizations.
- To develop the entrepreneurial skills and business oriented mindset, which are crucial for managing an apiary as a successful venture.

Course outcome

CO. No.	Upon completion of this course, students will be able to	Cognitive Level
CO-1	recall the distinct features of honey bees for overall development of scientific bee keeping and production of quality honey	K1
CO-2	distinguish the characteristic features of honey bee species and get detailed knowledge of honey bee biology,experts in the scientific practice of bee keeping	K2
CO-3	apply the bee keeping appliances and having knowledge in diseases of honey bees and enemies of honey bee, acquired skill in maintenance of bees colonies and extraction of hive products	K3
CO-4	analyze the value of bee products and support sustainability of bee keeping is vital to the economic well being development of society	K4
CO-5	evaluate the budget and the funding agency for apiary to promote empowerment of women through bee keeping	K5

Unit I **Introduction to Apiculture** **(6Hrs)**

history, classification, honey bee species- *Apis dorsata, Apis mellifera, Apis cerana, Apis florea,* social organization of bee colony

Unit II **Bee-keeping** **(6Hrs)**

bee-keeping-appliances, Newton bee hive-arranging an apiary-location and preparation of an apiary

Unit III **Enemies and Diseases of Honey Bees** **(6Hrs)**

enemies – Moth (Greater wax -moth), wasp and beetles - characteristics and preventive measures, viral disease- sac brood disease, bacterial diseases- septicemia, fungal disease- chalk brood disease, symptoms and control measures

Unit IV **Honey Bee Products** **(6Hrs)**

honey - extraction, chemical composition and nutritive values. uses of royal jelly, propolis, pollen, bee venom and bee wax

Unit V **Economics of Apiculture** **(6Hrs)**

budget for apiculture, funding agencies for apiary, apiculture as an entrepreneurial venture.filling the entrepreneur form,visit to an apiary

Text book

1. Johnson, J. and I.Jeya Chandra, *Apiculture*. Marthandam: Olympic Grafix. Marthandam, 2008.

Books for Reference:

1. Mishra. R.C. *Perspectives in Indian Apiculture*, Anmol Publishers, India New Delhi, 2002.
2. Raja Instus. E. ..*Economics of Bee Keeping Industry.* Rawat Publications, Jaipur and New Delhi , 1994.
3. Delhi Pierre Jean – Prost. *Apiculture*. Oxford & IBH Publishing Co.Pvt. LTD. New Delhi, 1994.
4. Sathe, T V. *Fundamental of Beekeeping*, Daya Publishing House, New Delhi.
5. Shukla & Upadhyay, *Economic Zoology*, 5th edn. Rastogi Publication, Meerut New Delhi, 2014.
6. Vasantharaj David. B. . *Elements of Economic Entomology*. 8th Edition. Brillion Publishing, New Delhi, 2016.

PSO Relation Matrix

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)				
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
CO-1	3	3	3	3	3	3	2	2	3	**3**
CO-2	3	2	3	3	**3**	2	2	1	3	3
CO-3	3	2	**3**	3	3	**3**	**2**	**2**	3	**3**
CO-4	3	2	3	3	3	3	2	2	3	3
CO-5	3	3	2	3	3	2	2	3	3	**3**
Ave.	**3.0**	2.6	2.7	3.0	3.0	**2.3**	**2.6**	**2.0**	3.0	3.0

Mapping	**<40%**	**≥ 40% and < 70%**	**≥ 70%**
Relation	**Low Level**	**Medium Level**	**High Level**
Scale	**1**	**2**	**3**

.