SEMESTER I
CORE COURSE I: INVERTEBRATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231CC1	4	1	-	1	4	6	90	25	75	100

Pre-requisite

Students need to know the classification of invertebrates based on their morphology and Anatomy.

Learning Objectives:

1. To distinguish the characteristic features and function, evolutionary position, economic importance, and interaction with the environment of invertebrates.
2. To develop the skill of identification of invertebrates and to promote employability in museum, consultancy firms and educational institutions.

Course Outcome

COs	On completion of this course, students will;	CL
CO 1	understand the basic concepts of invertebrate animals and recall its structure and functions.	**K1**
CO 2	illustrate and examine the systemic and functional morphology of various groups of invertebrates.	**K2**
CO 3	differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

UNIT	Contents	No. of Hours
I	**Protozoa:** Introduction to Classification, taxonomy, and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study: *Paramecium* (Morphology and Reproduction) and *Plasmodium* (Lifecycle)- Parasitic protozoans (*Entamoeba, Trypanasoma&Leishmania*) - Economic importance Nutrition in protozoa - Host-parasitic interactions in *Entamoeba* and *Plasmodium*- Locomotion in protozoa **Porifera:** General characters and classification up to Classes. Type study: Sycon- Canal system in sponges. Reproduction in sponges. Skeleton in sponges.	18
II	**Coelenterata :** General characters and classification up to classes – Type study: *Obelia* (Morphology and lifecycle)- Corals and coral reefs - Economic importance of corals and coral reefs - Polymorphism in Hydrozoa. **Platyhelminthes:** General characters and classification of up to classes. Type study: *Fasciola hepatica* (Morphology and lifecycle)-. Parasitic adaptations. Host-parasitic interactions of Helminthine parasites	18
III	.**Aschelminthes** : General characters and classification of up to classes - Type study: *Ascaris lumbricoides* (Morphology and	18

	lifecycle), Nematode Parasites and diseases - *Wuchereriabancrofti*, *Enterobius vermicularis*, *Ancylostoma duodenale*. Parasitic adaptations. **Annelida:** General characters and classification up to Classes. Type study: *Nereis* (Morphology), Metamerism- Modes of life in Annelids. Reproduction in polychaetas .	
IV	**Arthropoda:** General characters and classification of Phylum Arthropoda up to Classes. Type study: *Penaeus indicus* (Morphology and reproduction). Affinities of *Peripatus* – Larval forms in Crustacea. Economic importance of Insects. Insect pests of Agricultural Importance- Pest of rice: Rice stem borer (*Scirpophagaincertulas*) – Pest of Sugarcane: The shoot borer (*Chilo infuscatellus*) – Pest of coconut: The rhinoceros beetle (*Oryctes rhinoceros*). Principles of Integrated Pest Management.	18
V	**Mollusca:** General characters and classification of Phylum Mollusca up to Classes. Type study: *Pila globosa*. Foot and torsion in Mollusca. Economic importance- Cephalopods. **Echinodermata:** General characters and classification of Phylum Echinodermata up to Classes. Type study: *Asterias.* Water Vascular system in Echinodermata – Larval forms of Echinoderms.	18

Self-study	Nutrition in Protozoa; Corals and coral reefs; Nereis; *Penaeus indicus* – Morphology; Economic importance- Cephalopods

Text Books

1. Ekambaranatha Ayyar, and T. N. Ananthakrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd.
2. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3. Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrtes 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut.
4. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai.
5. Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA : Thomson-Brooks/Cole.

References Books

1. Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Miffin and ELBS, London.
2. Bhamrah, H.S. and KavithaJunea, 2002. A text book of Invertebrates. Alilnol Publications Private Limited, 4374/4B.Ansari Road, Dayaganj, New Delhi.
3. Hyman L.H, 1955. The invertebrates – Vol. I to Vol. VII – McGraw Hill Book Co.
4. Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.
5. Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams.
6. Srivastava, M.D.L and Srivastava, 1969. A text book of Invertebrate Zoology, U.S- Central Book Depot, Allahabad.
7. Verma, A. Invertebrates: Protozoa to Echinodermata. Narosa Publishing House Private Limited.35-36 Greams Road, Thousand Lights, Chennai.

Web Resources

1. https://www.nationalgeographic.com/animals/invertebrates/
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://bit.ly/3lJdUX0
5. https://greatbarrierreef.org/

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	1	3	3	1	3
CO 2	3	2	2	2	2	1	3
CO 3	3	3	1	2	3	2	3
TOTAL	9	8	4	7	8	4	9
AVERAGE	3	2.6	1.3	2.3	2.6	1.3	3

3 – Strong, 2 – Medium, 1 - Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	2	2	3
CO3	2	2	3	2	2
Total	8	8	7	7	7
Average	2.6	2.6	2.3	2.3	2.3

SEMESTER I
CORE COURSE I: INVERTEBRATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU231CC1	**4**	**1**	**-**	**1**	**4**	**6**	**90**	**25**	**75**	**100**

Pre-requisite

Students need to know the classification of invertebrates based on their morphology and Anatomy.

Learning Objectives:

1. To distinguish the characteristic features and function, evolutionary position, economic importance, and interaction with the environment of invertebrates.
2. To develop the skill of identification of invertebrates and to promote employability in museum, consultancy firms and educational institutions.

Course Outcome

COs	On completion of this course, students will;	CL
CO 1	understand the basic concepts of invertebrate animals and recall its structure and functions.	**K1**
CO 2	illustrate and examine the systemic and functional morphology of various groups of invertebrates.	**K2**
CO 3	differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	**K3**

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UNIT	Contents	No. of Hours
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II	**Coelenterata :** General characters and classification up to classes – Type study: *Obelia* (Morphology and lifecycle)- Corals and coral reefs - Economic importance of corals and coral reefs - Polymorphism in Hydrozoa. **Platyhelminthes:** General characters and classification of up to classes. Type study: *Fasciola hepatica* (Morphology and lifecycle)-. Parasitic adaptations. Host-parasitic interactions of Helminthine parasites	18
III	.**Aschelminthes** : General characters and classification of up to classes - Type study: *Ascaris lumbricoides* (Morphology and lifecycle), Nematode Parasites and diseases - *Wuchereriabancrofti, Enterobius vermicularis, Ancylostoma duodenale*. Parasitic adaptations. **Annelida:** General characters and classification up to Classes. Type study: *Nereis* (Morphology), Metamerism- Modes of life in Annelids. Reproduction in polychaetas.	18
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V	**Mollusca:** General characters and classification of Phylum Mollusca up to Classes. Type study: *Pila globosa*. Foot and torsion in Mollusca. Economic importance- Cephalopods.	18

	Echinodermata: General characters and classification of Phylum Echinodermata up to Classes. Type study: *Asterias.* Water Vascular system in Echinodermata – Larval forms of Echinoderms.	

Self-study	Nutrition in Protozoa; Corals and coral reefs; Nereis; *Penaeus indicus* – Morphology; Economic importance- Cephalopods

Text Books

6. Ekambaranatha Ayyar, and T. N. Ananthakrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd.
7. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
8. Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrtes 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut.
9. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai.
10. Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA : Thomson-Brooks/Cole.

References Books

8. Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Miffin and ELBS, London.
9. Bhamrah, H.S. and KavithaJunea, 2002. A text book of Invertebrates. Alilnol Publications Private Limited, 4374/4B.Ansari Road, Dayaganj, New Delhi.
10. Hyman L.H, 1955. The invertebrates – Vol. I to Vol. VII – McGraw Hill Book Co.
11. Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.
12. Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams.
13. Srivastava, M.D.L and Srivastava, 1969. A text book of Invertebrate Zoology, U.S- Central Book Depot, Allahabad.
14. Verma, A. Invertebrates: Protozoa to Echinodermata. Narosa Publishing House Private Limited.35-36 Greams Road, Thousand Lights, Chennai.

Web Resources

1. https://www.nationalgeographic.com/animals/invertebrates/
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4. https://bit.ly/3lJdUX0
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MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	1	3	3	1	3
CO 2	3	2	2	2	2	1	3
CO 3	3	3	1	2	3	2	3
TOTAL	9	8	4	7	8	4	9
AVERAGE	3	2.6	1.3	2.3	2.6	1.3	3

3 – Strong, 2 – Medium, 1 - Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	2	2	3
CO3	2	2	3	2	2
Total	8	8	7	7	7
Average	2.6	2.6	2.3	2.3	2.3

CORE LAB COURSE I: INVERTEBRATA

Course Code	L	T	P	S	Credits	Inst.Hours	Totalhours	Marks		
								CIA	External	Total
ZU231CP1	**-**	**-**	**2**	**-**	**-**	**2**	**30**	**25**	**75**	**100**

Pre-requisite:

Studentsshouldbeawareofinvertebrateanimalsandtheirlivingenvironments

Learning objectives:

1.To enable students to identify different groups of invertebrate animals by observing their external characteristics and understand their adaptations to various environments and modes of life.

2. To develop students' practical skills in invertebrate anatomy throughdissection, internal organ display, and mounting of mouth parts and scales, enhancing their understanding of invertebrate structures and functions.

Course outcome

On completion of this course, students will be able to		
CO1	Identify and label the external features of different groups of Invertebrate animals.	**K1 & K2**
CO2	illustrate and examine the circulatory system, nervous system, and reproductive system of invertebrate animals.	**K4 & K2**
CO3	Differentiate and compare the structure, function, and mode of life Of various groups of animals.	**K3**
CO4	To compare and distinguish the dissected internal organs of lower animals.	**K4 & K5**
CO5	Prepare and develop them outing procedure of economically Import ant invertebrates.	**K5 & K6**

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5** -Evaluate; **K6** –Create

UNIT	Details	No.of Hours
I	**Major Dissection:** Cockroach: Nervous system, Reproductive system.	6
II	**Minor Dissection:** Cockroach: Digestive system.	6
III	**Mounting:** Cockroach: Mouthparts- Mosquito. HoneyBee/Housefly/ Prawn: Appendages	6
IV	. Record/Observation Note **(Submission Is Mandatory)**	6
V	**Spotters :** (i). Protozoa: *Amoeba, Paramecium, Paramecium* Binary fission and Conjugation, *Entamoeba histolytica, Plasmodium vivax*(ii).Porifera:Sycon, Gemmule(iii).Coelenterate: Obelia– Colony&Medusa, Aurelia, Physalia, Gorgonia, (iv). Platyhelminthes: Planaria, *Fasciola hepatica,* Fasciola larval forms – Miracidium, Redia, Cercaria, *Taenia Solium,* (v). Nemathelminths: Ascaris (Male & Female), vi). Annelida: Nereis, Chaetopteurs, Hirudinaria, Trochophore larva (vii).Arthropoda:Cancer,Palaemon,Scorpion,Scolopendra,Sacculina,Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, (viii). Mollusca:Chiton,Pila,Unio,Pteredo,Murex,Sepia,Loligo,Octopus,(ix). Echinodermata: Asterias, Ophiothrix, Cucumaria, Antedon, Bipinnarialarva.	6
	Total	**30**

Textbooks

1. Ekambaranatha Ayyar, and T.N. Ananthakrishnan, 2000. A Manual of Zoology. Vol1 (Invertebrata).PartII–Viswanathan Pvt. Ltd, 842pp
2. Jordan,E.L. and Verma P.S, 1995. Invertebrate Zoology, 12thedn. S. Chand& Co.
3. KotpalR.L.2019.ModernTextBookofZoology,Invertebrates9thEd.,Rastogi Publications,Gangotri, Shivaji Road, Meerut, 1004 pp.
4. Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai .400 pp.
5. Ruppert andBarnes,R.D.2006.InvertebrateZoology,VIIIEdition.HoltSaundersInternationalEdition, Belmont, CA: Thomson-Brooks/Cole,928pp

References Books

1. Barrington,E.J.W.,2012,Invertebratestructureandfunction.Boston–Houghton.Miffinand ELBS, London.
2. HymanL.H, 1955. Theinvertebrates– Vol.Ito Vol.VII – McGrawHill Book Co.
3. Kotpal,1992.Protozoa,Porifera,Coelenterata,Annelida,Arthropoda,Mollusca,Echinodermata,R.L-Rastogi Publication.
4. Parker,J.andHaswell,1978. Atextbook ofZoologyVol. I -Williams andWilliams.
5. Srivastava,M.D.LandSrivastava,1969.AtextbookofInvertebrateZoology,U.S-CentralBook Depot, Allahabad.

Web Resources

1. https://www.nationalgeographic.com/animals/invertebrates/
2. https://bit.ly/3kABzKa
3. https://www.nio.org/
4. https://bit.ly/3lJdUX0

SEMESTERI

ELECTIVECOURSEI-ALLIED ZOOLOGYI

Course Code	L	T	P	S	Credits	Inst.Hours	Total Hours	Marks		
								CIA	External	Total
ZU231EC1	3	1	-	-	3	4	60	25	75	100

Pre-requisite:

Students shouldbecommonawareoflivingorganismsandtheirbasicmorphologicaldifferentiationsfrom biological studies.

Learning Objectives

1. To acquire basic knowledge of diversity and organization of Protozoa, Coelenterate, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata. (Knowledge)
2. To comprehend the taxonomic position and diversity among Protochor data,
   Pisces, Amphibia, Reptilia, Aves and Mammalia. (Skill)

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	relate the characteristic features invertebrates and chordates.	**K1 & K2**
CO2	classify invertebrates up to class level and chordates up to order level.	**K2 & K4**
CO3	identify the structural and functional organization of some invertebrates and chordates.	**K3 & K4**
CO4	survey the adaptations and habits of animals to their habitat.	**K4 & K5**
CO5	Assess the taxonomic position of invertebrate and chordate animals.	**K5 & K6**

K1-Remember; **K2**- Understand; **K3**-Apply;**K4** -Analyze; **K5**- Evaluate; **K6**–Create

Unit	Contents	Hours
Unit I	Diversity of Invertebrates–I: Principles of taxonomy . Criteria for classification– Symmetry and Coelom–Binomial nomenclature .Classification of Protozo, Coelenterate , Helminthes and Annelida up to classes with two examples.	**12**
Unit II	Diversity of Invertebrates–II: Classification of Arthropoda, Mollusca and Echinodermata up to class level with examples.	**12**
Unit III	Diversity of Chordates– I: Classification of Prochordata, Pisces and Amphibia up to ordersgiv Ing two examples.	**12**
Unit IV	Diversity of Chordates–II: Classification of Reptilia Aves and Mammaliaup to orders giving two examples.	**12**
Unit V	Animal organization, Structure and organization of (i) Earthworm (ii) Rabbit/Rat(iii) Prawn/Fish	**12**

Textbook

1. Ekamberanatha Ayyar M. (1990). A Manual of Zoology, Volume I. Invertebrate Part Iand Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
2. Hickman, C, Keen, S, Larson, A, Eisenhour, D and Roberts, L. 2021. Animal Diversity (9th Edition).

Reference Books

1. Ekambaranatha Iyer M. and Anantakrishnan T. N. (1990): *A manual of Zoology*. Vol. I. Invertebrata (Part 1 &2). S. Vishwanathan Pvt. Ltd.
2. Ekambaranatha Iyer M. and Anantakrishnan T. N. (1990): *A manual of Zoology*. Vol. II. Chordata S. Vishwanathan Pvt. Ltd.
3. Jordan E. L. and Verma P.S. (1976): *Chordate Zoology*. S. Chand & Co. Jordan E. L.and Verma P.S. (1976): Invertebrate Zoology. S. Chand & Co.
4. Kotpal R. L. (1993): *Protozoa- Echinodermata* (all volumes). Rastogi Publ. Pough H(2004): *Vertebrate life*, VIII Edition, Pearson International.
5. Ruppert and Barnes, R.D. (2006): Invertebrate Zoology, VIII Edition. Holt Saunders International Edition

Web Resources

1. https://blogs.ubc.ca/mrpletsch/2019/09/10/unit-1-1-principals-of-taxonomy/
2. https://byjus.com/biology/animal-kingdom-basis-classification/
3. https://www.britannica.com/animal/arthropod/Classification
4. https://www.geeksforgeeks.org/phylum-chordata/
5. https://www.brainkart.com/article/Phylum-Chordata-and-Diversity-and-General-Characters-of-Chordates_587/
6. https://youtu.be/19dPFqd-H_o
7. https://youtu.be/QRYVvRRmJRU
8. https://www.biologydiscussion.com/invertebrate-zoology/phylum-
9. arthropoda/study-notes-on-prawn/33417

SEMESTER I

ELECTIVE LABCOURSE-LABONALLIEDZOOLOGYI

Course Code	L	T	P	S	Credits	Inst.Hours	Total Hours	Marks		
								CIA	External	Total
ZU231EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:

Students should be aware of surrounding living invertebrates and vertebratesand their basic structural differentiations and their habitats.

Learning Objectives

1. To understand the structure and label the various parts of the dissected organisms.
2. Enable the students to understand, identify and classify the various fauna surrounding them.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	compare and distinguish the dissected internal organs of animals.	**K1 & K2**
CO2	prepare and develop the mounting procedure of important invertebrate and chordate anatomical parts.	**K2 & K3**
CO3	identify and label the external features of different groups of invertebrates.	**K3 & K4**
CO4	analyze the ecological roles and significance of the organisms within their ecosystems.	**K4 & K5**
CO5	evaluate evolutionary relationships and broader biological concepts among the spotted organisms.	**K5 & K6**

K1-Remember;**K2**- Understand;**K3**-Apply;**K4** -Analyse; **K5**- Evaluate;**K6**–Create

S.No	**Details**
1.	**DISSECTION:** 1. Cockroach - digestive system 2. Cockroach - nervous system 3. Fish-digestive system
2.	**MOUNTING:** 1. Mouth parts- Cockroach 2.Mouth parts - Mosquito 3. Scales -Placoid, Cycloid and Ctenoid 4. Prawn appendages
3.	**SPOTTERS-** *Paramecium, Plasmodium*, Scypha, *Leucosolenia*, Corals. *Taenia solium* – entire, *Ascaris* male and female. Earthworm, Prawn, Scorpion, Pila, Starfish Amphioxus, Shark, Frog, Calotes, Pigeon feather

Text Books

1. Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, S. Viswanathan, Chennai.

2. Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books &Allied Ltd; 3rd Revised edition.

3. Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications.

4. Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand.

5. Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.

References Books

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science.

2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.

3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

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

5. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut

Web Resources

1. https://nbb.gov.in/
2. http://www.agshoney.com/training.htm
3. https://icar.org.in/
4. http://www.csrtimys.res.in/
5. http://csb.gov.in/
6. https://iinrg.icar.gov.in/
7. https://www.nationalgeographic.com/animals/invertebrate

SEMESTERI

NONMAJORELECTIVE NMEI

ORNAMENTALFISHFARMING&MANAGEMENT

Course Code	L	T	P	S	Credits	Inst.Hours	TotalHours	Marks		
								CIA	External	Total
ZU231NM1	1	-	-	1	2	2	30	25	75	100

Pre-requisite

Students were ableto create effective entrepreneurs by enhancing their innovative thinking and To fulfill the need of the society.

Learning Objectives

1. To identify various ornamental fish species, their habitat requirements, and the keyfactors influencing their health and well-being in captivity.
2. To gain skills on the techniques of ornamental fish breeding, rearing, disease controland economics of ornamental fish farming.

Course Outcome:

On the successful completion of the course, student will be able to**:**		
CO1	The students will bibelot identify, culture, maintain and market the Commercially important ornamental fishes.	**K1**
CO2	Identify different species of ornamental fish commonly Sedin the aquarium trade.	**K2**
CO3	Interpret the significance of water quality parameters on the health of ornamental fish	**K3**
CO4	Design suitable aquarium for a specificspeciesofor namenal fish, following appropriate feeding strategies, and implementing water quality testing and corrective measures in a practical setup.	**K4 & K5**
CO5	the knowledge and skills gained on the different aspects of ornamental fish keeping will enable the students to develop entrepreneur ship potential and helping self-employment.	**K5 & K6**

K1-Remember; **K2**- Understand; **K3**-Apply;**K4** -Analyze; **K5**- Evaluate; **K6**–Create

Units	Contents	No.of Hours
I	Introduction to ornamental fish keeping. Scope and importance of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential. Commercially important ornamental fishes - Indigenous and exotic varieties.	**6**

II	Biology of egg layers and live bearers. Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture. Breeding, hatchery and nursery management of egg layers (e.g. Goldfish) and live	**6**
III	Aquarium design and construction; Accessories - aerators, filters and lighting. Aquarium plants and their propagation. Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.	6
IV	Conditioning, packing, transport, and quarantine methods. Economics, trade regulations, domestic and export marketing strategies.	6
V	Practical 1) Identification of locally available ornamental fishes - Egg layers and live bearers. 2) Identification of locally available live feed organisms.	6

Self-Study	Scope and importance of ornamental fish culture, Food and feeding in ornamental fishes, Aquarium construction; Accessories - aerators, filters and lighting, Export marketing strategies

Text books

1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, NewDelhi.
2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi.
3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi.
4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya PublishingHouse, New Delhi.

References:

1. Tarit Kumar Banrjee (2016). *Applied Zoology*. London: New Central Agency (P) Ltd.
2. Supriti Sarkar, Gautam Kundu, Korak Kanti Chaki (2016). *Introduction to Economic Zoology* London: New Central Agency (P) Ltd.
3. Nagendra S. Pawar. (2008). *Applied Zoology*. New Delhi: Adhyayan Publishers.
4. Sukumar De. (2005). *Outlines of Dairy Technology*. New Delhi: Oxford University Press.
5. Williamson. G and Payne. J. A. (1978). *An introduction to Animal Husbandry in the Tropics*. London: Longman Group Limited.

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/

SEMESTERI

FOUNDATION COURSE- INTRODUCTION TO ZOOLOGY

Course Code	L	T	P	S	Credits	Inst.Hours	Totalhours	Marks		
								CIA	External	Total
ZU231FC1	1	1	-	-	2	2	30	25	75	100

Pre-requisite:

Students should know the basic concepts of biology such as systemic classification, Grades in organization, parts of the cell, role of environment, culture of different organisms.

Learning objectives

1. To provide the knowledge of fundamental principles in zoology that willbe a foundation for their later advanced courses in more specific biological subjects.
2. Familiarize with animal classification schemes and diagnostic characteristics as well as developing an understanding of and ability to apply basic zoological principles.

Course Outcomes

COS	On the successful completion of the course, student will be able to**:**	**Cognitive level**
CO1	describe the basic concepts of taxonomy, organization, structure and role of cell, environmental issues, importance of culturing organisms.	**K1**
CO2	apply classification principles and identify animals, its organ system on the basis of its function, environmental problems, benefits of culturing organisms.	**K2**
CO3	enhance leadership qualities, team spirit, participate in learning activities and communicate effectively among the peer.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply

Unit	Content	Hours
I	**Systematic and binomial system of nomenclature**: meaning of the terms taxonomy, Systematic, classification and nomenclature, Need of classification. **Systematics:** Kingdom Protista- Salient features, examples; Kingdom Animalia-**Introduction to different Phyla**: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminths, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and Chordata	6
II	**Physiology and Biochemistry**: Introduction to organ systems- Digestive,Respiratory system, Endocrine and Circulatory system, Urinogenital system, Nervous system, Reproductive system.	6

III	**General structure Cell**: Ultrastructure of prokaryotic and eukaryotic cell. Different cell organelles- endoplasmic reticulum, Golgi bodies, mitochondria, lysosome, nucleus, nucleolus. Modern concept of gene: DNA as genetic material, structure of DNA as given by Watson and Cricks model and RNA.	6
IV	**Environmental Biology:** Principal layers of atmosphere- Exosphere, Thermosphere, Mesosphere, Stratosphere, Troposphere. Lithosphere Hydrosphere, Environmental issues- Global warming, green house effects, acid rain.	6
V	**Applied Zoology**: Aquaculture - Pisciculture, Prawn culture and Pearl culture, Sericulture, Apiculture.	6

Self-Study	Need of classification, Organization - organ systems, Differentiation of Prokaryotic and Eukaryotic cell, Outline of layers of atmosphere**.**

Text books

1. Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd.
2. Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6thEdn., Pathfinder Publication.
3. Verma P.S. and Agarwal V.K. (2016). Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand, and Company Ltd.
4. Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co.Ltd., New Delhi Publishing.
5. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R., Applied Zoology, 2020, Saras Publication, Nagercoil.

References

1. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co
2. Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrates 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut.
3. Rastogi, S.C., Cell Biology, 2008, New Age International (P) Limited, Publishers,New Delhi, 2nd Ed.
4. Powar, C.B., Cell Biology, 2013. Himalaya publishing House, Bombay.
5. Goel, K. A. and K.V. Sastry. 1998, A Text Book of Animal Physiology, 6th Revisededition. Rastogi Publications
6. Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book ofHuman Physiology, S. Chand & Co, New Delhi.
7. Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.
8. Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.
9. Concepts of Aquaculture. Santhana Kumar and A. M. Selvaraj. 2012. MeenamPublications, Nagercoil.

Web Resources

1. https://byjus.com/biology/animal-kingdom-animalia-subphylum/
2. https://www.verywellhealth.com/organ-system-1298691
3. https://biologydictionary.net/organ-system/
4. https://www.noaa.gov/jetstream/atmosphere/layers-of-atmosphere

SEMESTER II
CORE COURSE II: CHORDATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232CC1	4	1	1	-	6	6	90	25	75	100

Pre-requisite
Students should know the taxonomical classification of chordates in relation to their functional morphology.

Learning objectives
1. To develop an in-depth knowledge on the structures and distinct features of Phylum Chordata.
2. To identify the animals of each subphylum and class based on their characteristic features.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the name and distinct features of different sub phylum belonging to phylum Chordata.	**K1**
2	explain the structural organization, function and evolutionary aspects of chordates.	**K2**
3	interpret the biological significance and the conservation of chordates.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply

Units	Contents	No. of Hours
I	General Characters and Classification of Phylum Chordata:origin of Chordata, differences between non-chordates and chordates, general characters, affinities and systematic position of Hemichordata (*Balanoglossus*), Urochordata (*Ascidia*), Cephalochordata (*Amphioxus*).	18

II	Agnatha: Characteristics of subphylum vertebrata. General characters and classification up to class level, Agnatha (*Petromyzon*), - Pisces (*Scoliodonsorrakowah*), circulatory system, sense organs. - types of scales and fins - accessory respiratory organs - air bladder - parental care - migration - economic importance.	18
III	Amphibia: General characters and classification up to orders with names of the examples only - Type study – *Ranahexadactyla* - Morphology, Digestive system, respiratorysystemm,Urinogenital system, , Endoskeleton: Skull, typical vertebra, atlas, girdles and limbs.Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.	18
IV	Reptilia: General characters and classification - Type study – (*Calotesversicolor* - Morphology, endoskeleton of*Varanus*). Extinct reptiles.Snakes of South India: Poisonous snakes - *Najanaja*, King cobra and Viper, Non-poisonous snakes - Python, Rat snake (*Ptyas mucosa*) and Wolf snake (*Lycodonaulicus*).Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification	18
V	Aves and Mammalia**:** Aves: general characters and classification – type study - *Columba livia* - exoskeleton - flight adaptations, Migration. **Mammalia:** general characters and classification - type study - Rabbit - nervous system.Adaptations of aquatic mammals, egg laying mammals, marsupials, flying mammals. Dentition in mammals.	18

Self-study	General characters of Chordates, types of scales and fins. Parental care in amphibia, Poisonous snakes and Flight adaptations

Text book

1. N. Arumugam, A. Thangamani, S. Prasanna Kumar, L.M. Narayanan, 2022. Chordate Zoology, Saras Publication, Nagercoil.
2. Kotpal, R. L. 2019. Chordata and Comparative Anatomy.Rastogi publications. Meerut, U.P.

References Books

1. Singh,B.D. A Text Book of Zoology Chordata Paperback – 1. KedarNath Ram, Meerut, Uttar Pradesh.
2. Kotpal, R.L. A, 2009. Modern text book of Zoology Vertebrates, Rastogi publications. Meerut, U.P.
3. Young, J. Z., 2004. The Life of Vertebrates. III Edition. Oxford university press.
4. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan& Co., New York.
5. Hall B.K. and Hallgrimsson B., 2008. Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

Web resources

1. https://byjus.com/biology/phylum-chordata-classification/
2. https://www.uou.ac.in/sites/default/files/slm/BSCZO-201.pdf
3. https://sunyorange.edu/biology/resources/library/prehistoric-life/chordates.html
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBC1201.pdf
5. file:///C:/Users/91944/Desktop/Chordata%20Verma%20college.pdf

SEMESTER II
CORE LAB COURSE: CHORDATA

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
ZU232CP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite

Students should know the taxonomical classification of chordates in relation to their functional morphology.

Learning Objectives

1. To identify the structures and distinct features of phylum Chordata
2. To distinguish the characteristic features of each subphylum and class

Course Outcomes

On the successful completion of the course, student will be able to:		
1	identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.	**K1**
2	explain the structural organization of various organs and systems in different classes of vertebrates.	**K2**
3	analyze, compare, and distinguish the morphological features and developmental stages of chordates	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Units	Contents	No. of Hours
I	**Dissections**: Frog (Demo): External features, Digestive system, Arterial system, 5th Cranial nerve, 9th and 10th cranial nerves.	6
II	**Mounting**: Fish: Placoid and Ctenoid scales, Frog: hyoid apparatus and brain (Demo).	6
III	**Osteology**: Frog: skull, vertebral column, pectoral girdle, pelvic girdle, Forelimb, hindlimb. Chelonia- anapsid skull. Pigeon – skull, synsacrum.	6
IV	**Specimen and Slides**: Balanoglossus, Tornaria larva, Amphioxus, Petromyzon, Ammocoetus larva.	8

	Pisces: *Torpedo, Channa, Hippocampus, Exocoetus, Echieneis, Catla, Clarius.* Scales: placoid, cycloid, ctenoid Amphibia:Ichthyophis, , Bufo, Axolotl larva Reptilia : Draco, *Chemaeleon, Gecko, Uromastix, Viperarusselli, Naja, Enhydrina, TyphlopsTrionyx, Crocodilus,* Aves: *Psittacul*a, Bubo, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down Mammalia: Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Loris, Hedgehog	
V	**Embryology**: Life cycle of Frog - Placenta in mammals.	4

Text Books

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

Reference Books

1. Robert William Hegner, 2015. *Practical Zoology*, BiblioLife. Macmilla London.
2. Young, J, Z., 1972.*The life of Vertebrates*. Oxford University. London.
3. Kotpal, R.L. A, 2009. Modern text book of Zoology Vertebrates- Rastogi publications.

Meerut, U.P.

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	3	2	3	3	2	2	2	3
CO2	3	1	2	2	2	2	3	2	2	2	1	2
CO3	3	2	1	2	2	1	3	2	1	1	1	2
TOTAL	9	5	5	7	7	5	9	7	5	5	4	7
AVERAGE	3	1.6	1.6	2.3	2.3	1.6	3	2.3	1.6	1.6	1.3	2.3

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE II: ALLIED ZOOLOGY II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232EC1	-	4	-	-	3	4	60	25	75	100

Prerequisite

Students should be known about structure and role of body organs, development, inheritance, immunity against diseases and behavioral aspects of animal.

Learning Objectives

1. To impart knowledge on Physiology, Immunology, Genetics and Animal behavior.
2. To instill interdisciplinary skills for availing employment opportunities.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the internal parts and developmental stages, patterns of inheritance and different types of animal behavior.	**K1**
2.	recognize the major functions of organ and immune systems in the human body and their role and analyze the stages of development in frog.	**K2**
3.	correlate the physiological processes of animals and relationship of organs system, inheritance of characters.	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply

Units	Contents	No. of Hours
I	Physiology: Respiration- Respiratory pigments and transport of gases. Structure and functions of lungs. Mechanism of blood clotting. Types of excretory products – ornithine cycle. Structure of neuron– Conduction of nerve impulse, Mechanism of vision and hearing.	12
II	Developmental Zoology: Structure of sperm and ovum (human).Fertilization (sea urchin), Cleavage: types, blastulation, gastrulation and organogenesis of Frog; Placentation in mammals.	12
III	Immunology: Immunity – types of immunity. innate and acquired - active and passive; Antigens and Antibodies; Immunological organs and cells – responses in humans – innate ad acquired immunity - vaccination schedule.	12
IV	Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked, Y-linked, ABO blood typing.	12

	Multiple Allelic and Polygenic; Genetic Counselling	
V	Animal Behaviour**:** foraging, display, courtship, alarming behaviour, Communication in insects, Shelter and Nest Construction, Parental Care, Learning Behaviour.	12

Self-study	Biological Rhythms, Immune cells.

Textbook

1. Verma P. S .and Agarwal V K 2018. *Developmental Biology, Chordata embryology.* S. Chand & Co., India
2. Chaki, K K, Kundu, G, Sarkar, S 2011. *Introduction to General Zoology*: Volume I. new Central Book Agency, India.

References Books

1. Owen, J. A., Punt, J. & Stanford, S. A. 2013. Kuby*Immunology*. New York: W.H. Freeman & Company
2. Klug, W. S., Cummings, M. R. & Spencer, C. 2019. *Concepts of Genetics*. (12th ed.). New Jersey: Pearson Education
3. Mathur, R. 2005. *Animal Behaviour*. Meerut: RastogiPublications, Meerut, Uttar Pradesh.
4. Verma P.S. &Agarwal- *Developmental Biology, Chordata embryology*S. Chand & Co., India.
5. Subramanian. M.A. 2019. *Developmental Zoology.* MJP Publishers, India.

Web Resources

1. https://www.onlinebiologynotes.com/nerve-impulse-conduction/
2. https://www.onlinebiologynotes.com/physiology-of-vision/
3. https://www.onlinebiologynotes.com/developmental-biology-of-frog-embryonic-development/
4. https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html
5. https://www.youtube.com/watch?v=b04hc_kOY10

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1	2	2	3	2	2	2	3
CO2	1	1	1	2	2	2	2	2	2	2	1	2
CO3	2	2	2	3	3	2	3	3	2	2	2	3
TOTAL	4	5	5	7	6	6	7	8	6	6	5	8
AVERAGE	1.3	1.6	1.6	2.3	2.2	2.2.	2.3	2.7	2.2	2.2	1.6	2.7

3 - Strong; 2 - Medium; 1 - Low

SEMESTER II
ELECTIVE LAB COURSE II: ALLIED ZOOLOGY II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:

Students should be aware of surrounding living invertebrates and vertebrates and their basic structural differentiations and their habitats.

Learning Objectives

1. To develop practical skills in basic concepts of biology.
2. To foster a deeper understanding of fundamental biological principles.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recognize museum specimens, stages of cleavage, vital organs, genetic diseases of human.	**K1**
2.	explain the economic importance of animals, clinical procedures, dominant and recessive characters of humans.	**K2**
3.	use the skills relevant to basic and applied Zoology for identification and differentiation of animal forms.	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Experiments

1. Chick embryo 24, 48 & 72 hrs (Mounting)
2. Identification of blood groups.
3. Simple Mendelian traits in man.
4. Test for excretory products in animals
5. Mounting of frog's egg.
6. Model making of nest.

Spotters: Hemoglobin, ornithine cycle, Neuron, Frog's egg, Gastrula of frog, Human Placenta, Immunoglobulin, Thymus, Human karyosome, Down's syndrome, Bird's nest, Parental care (fish &birds) - Pouched mammals (Kangaroo & Koala).

Virtual laboratory / CD can be used as and when necessary.

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2	3	2	3	3	2	2	1
CO2	2	1	1	1	2	3	2	3	2	3	3	1
CO3	3	2	1	2	1	2	2	3	2	2	2	2
Total	8	5	4	6	5	8	6	9	7	7	7	4
Average	2.7	1.6	1.3	2.2	1.6	2.7	2.2	3	2.3	2.3	2.3	1.3

*3 - Strong; 2 - Medium; 1 - Low

SEMESTER II

NON-MAJOR ELECTIVE NME II
BIOCOMPOSTING FOR ENTREPRENEURSHIP

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232NM1	-	1	1	-	2	2	30	25	75	100

Pre-requisite

Students should aware about the effect of chemical pollution and the importance of organic farming.

Learning Objectives:

1. To highlight the importance of Bio composting for entrepreneurship in waste management.
2. To enable students for setting up Bio compost units and bins for waste reduction.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define the process of bio composting by earthworms and explain the economic cost of establishing small Biocom post units as a cottage industry.	**K1**
2.	demonstrate composting techniques for various applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc	**K2**
3.	establish a small Biocom post units as a cottage industry.	**K3**

K1- Remember; **K2**- Understand; **K3**- Apply

Units	Contents	No. of Hours
I	Bio composting – Definition, types; home composting, vermicomposting, aerobic composting, anaerobic composting. Compost Ingredients - ecological importance.	6
II	Bio composting technology: Field pits - ground heaps – tank - large-scale - batch and continuous methods – biology of the composting process. Humification of organic material. . Compost enrichment.	6
III	Methods of composing - Preparation of Biocom post pit and bed for Bangalore method, Indore method, Coimbatore method, NADEP method.	6
IV	Applications of Biocom post in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc. Drawbacks of	6

	using composts.	
V	Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).	6

Self-study	Bio composting – Definition, types and ecological importance.

Text Books

1. Seetha Lekshmy, M. and Santhi. R, 2012. *Verm technology*. Nagercoil: Saras Publications,Nagercoil.
2. Mary Violet Christy. A, 2008. *Vermitechnology*. MJP Printers and Publishers Pvt. Ltd., Chennai.

References

1. Bikas R. Pati&Santi M. Mandal, 2019. Recent trends in composting technology. IK International Publishing House Pvt. Ltd.
2. Dohama, A.K, 2004. *Vermicompost*, New Delhi: Vivekananda Kendra (NARDEP), Kaakumari.
3. Dahama, A.K, 2009. *Organic farming for sustainable Agriculture* (2nded.). Agrobios. Jodhpur
4. Sultan Ahmed Ismail, 2005. *The Earthworm* (2nded.).: Other India Press, Goa
5. Gupta, P.K, 2003. *Vermicomposting for sustainable Agriculture.*Agrobios, Jodhpur.

Web Resources

1. https://www.dhsgsu.edu.in/images/Community-College/02-COMPOSTING-TECHNIQUES.pdf
2. https://www.trustbasket.com/blogs/composting/methods-of-composting-indoor-method-bangalore-method-coimbatore-method-nadep-method
3. https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/chapter-2-composting-fundamentals/
4. https://www.brainkart.com/article/Composting_35265/
5. https://www.epa.gov/recycle/composting-home

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	3	2	3	3	2	3	2
CO2	3	1	1	3	2	3	2	3	3	2	2	3
CO3	3	2	2	2	2	2	2	2	2	3	2	2
TOTAL	6	5	4	8	6	8	6	8	8	7	7	7
AVERAGE	2.2	1.6	1.3	2.7	2.2	2.7	2.2	2.7	2.7	2.3	2.3	2.3

3 - Strong; 2 - Medium; 1 - Low

SEMESTER II
SKILL ENHANCEMENT COURSE SEC-1
ANIMAL BEHAVIOUR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZU232SE1	1	1	-	-	2	2	30	25	75	100

Prerequisite

Students should have the basic understanding of animal biology, strong observational and analytical skills.

Learning Objectives

1. To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis
2. To develop practical skills related to studying and analyzing animal behavior.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	Gain a comprehensive understanding of the key concepts related to the genetics, evolution, perception, learning, decision making and chronobiology of animal behaviour.	**K1**
2.	explain the evolutionary and ecological factors influencing social behaviour, the complexity of decision-making process in animals and the concepts of biological clocks.	**K2**
3.	interpret animal behaviour patterns, social behaviour dynamics, predict and manage animal physiology and behaviour, solve behavioural problems, optimise human health and well-being.	**K3**

K1- Remember; **K2**- Understand; **K3**- Apply

Unit	Contents	No. of hours
I	**Basics of Animal Behaviour** : Defining animal behaviour, Importance and significance of studying animal behaviour, Approaches to behavioural studies, Genetic basis of behaviour, Heritability of behaviour, Habitat and its impact on influencing behaviour, Social interactions and their role in shaping behaviour, Ethology and recording animal behaviour.	6
II	**Evolution and Social Behaviour:** Natural selection and Social Behaviour, Sexual selection, Altruism, Mating systems and Sexual strategy and social organization, Animal perception, Communication in Social animals, Group living, Parental Care, Visual adaptations to unfavourable environments.	6

III	**Animal and the Environment:** Habitat selection, Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning. Foraging behaviour, Competition, Environmental challenges and stressors.	6
IV	**Understanding Complex Behaviour:** Instinct, learning, Cognition and Memory, Decision making behaviour in Animals, Mechanism of Decision making, Complex reproductive behaviours, Complex behaviour of honey bees, Languages and mental representation, Animal awareness and Emotion.	6
V	**Chronobiology**: Circadian rhythm, Biological Clock, concept of central and peripheral clock system; circadian pacemaker system; photoperiodism, Influence of circadian rhythms on mating, feeding, and other behaviours, Ultradian and Infradian Rhythms, Chronobiology and Aging, Chrono pharmacology, chrono medicine, chronotherapy.	6

Self-study	Parental Care, Homeostasis

Textbook

1. Agarwal, V.K, 2009. *Animal Behaviour* (*Ethology*). S. Chand and Company Ltd., New Delhi.
2. Saha T. K, 2009. *An Introduction to Animal behaviour*. Emkay Publications, New Delhi.

Reference Books

1. SanjibChattopadhyay 2012. *LIFE: Evolution, Adaptation and Ethology*. Books and Allied (P) Ltd., Kolkata
2. Chandrashekaran, M.K, 1985. *Biological Rhythms*. Madras Science Foundation, Chennai.
3. Mohan P. Arora, 2016. *Animal Behavior*. Himalaya Publishing House. Chennai.
4. Auprey Manning and Mariam Stamp Dowkins, 2012. *An Introduction to Anima behavior*. Cambridge University Press. UK.
5. Machve K. K, 2016. *Evolution of Animal Behaviour*.Manglam Publications. Thiruvananthapuram

Web Resources

1. https://www.ncbs.res.in/content/animal-behaviour
2. https://bit.ly/3i6wUxR
3. https://www.behaviour.univie.ac.at/
4. https://www.ru.nl/bsi/
5. http://www.apiindia.org/pdf/progress_in_medicine_2017/mu_75.pdf

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2	3	2	3	3	2	3	2
CO2	3	1	2	3	2	3	2	3	3	2	2	3
CO3	3	2	1	2	2	2	2	2	2	3	2	2
Total	9	5	5	8	6	8	6	9	8	7	7	7
Average	3	1.6	1.6	2.7	2	2.7	2	3	2.7	2.3	2.3	2.3

***3 - Strong; 2 - Medium; 1 - Low**

	*Content addressed Gender
	*Content addressed Environment Sustainability
	*Content addressed Human Values
	*Content addressed Professional Ethics
	*Content addressed Indian Knowledge System

M.Sc. Syllabus (2023 Board)

SEMESTER I

CORE COURSE I: STRUCTURE AND FUNCTION OF INVERTEBRATES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CC1	5	1	-	1	4	7	105	25	75	100

Pre-requisite:

Students should know the taxonomical classification of invertebrates in relation to their functional morphology.

Learning Objectives:

1. To realize the range of diversification of invertebrate animals.
2. To understand the concept of classification and their characteristic features of major group of invertebrates.
3. To know the functional morphology of system biology of invertebrates
4. To enable to find out the ancestors or derivatives of any taxon.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	remember the general concepts and major groups in animal classification, origin, struct5re, functions and distribution of life in all its forms.	**K1**
CO2	understand the evolutionary process. All are linked in a sequence of life pattern	**K2**
CO3	apply this for pre-professional work in agriculture and conservation of life forms.	**K3**
CO4	analyze what lies beyond our present knowledge of life process.	**K4**
CO5	evaluate and to create the perfect phylogenetic relationship in classification.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Structure and function in invertebrates: Principles of Animal taxonomy;Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy	**21**
II	organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomes; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterate, Annelida and Echinodermata	**21**

III	Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration	**21**
IV	Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neural evolution	**21**
V	Invertebrate larvae: Larval forms of free-living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Concept and significance; Organization and general characters	**21**

Text Books:

1.Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd.

2. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.

3. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

Reference Books:

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.
2. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.

Web Resources

1. https://www.uou.ac.in/sites/default/files/slm/MSCZO-501.pdf
2. https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/structure-and-function
3. https://www.zoologytalks.com/category/structure-and-functions-of- invertebrates/
4. https://www.bilasagirlscollege.ac.in/newsData/D54.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	3	3	2
CO2	3	3	2	2	3	3	2
CO3	3	2	3	2	3	3	2
CO4	3	2	3	2	3	3	2
CO5	3	2	3	2	3	3	2
TOTAL	15	12	13	11	13	11	10
AVERAGE	3	2.4	2.6	2.2	2.6	2.2	2

3 – Strong, 2- Medium, 1- Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	2	3	3
CO3	2	2	3	3	2
CO4	3	3	3	3	3
CO 5	2	2	2	2	2
Total	13	13	12	14	12
Average	2.6	2.6	2.4	2.8	2.4

SEMESTER – I

CORE COURSE II: COMPARATIVE ANATOMY OF VERTEBRATES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CC2	**5**	**1**	**-**	**1**	**5**	**7**	**105**	**25**	**75**	**100**

Pre-requisite:

Students with knowledge and comprehension on zoology

Learning Objectives:

1. To impart conceptual knowledge about the animal life in the air and their behaviours.
2. To understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.

Course Outcomes:

On successful completion of the course, the student will be able to:		
CO1	remember the general concepts and major groups in animal classification, origin, structure, functions, and distribution of life in all its forms.	**K1**
CO2	understand the evolutionary process. All are linked in a sequence of life patterns.	**K2**
CO3	apply this for pre-professional work in agriculture and conservation of life forms.	**K3**
CO4	analyze what lies beyond our present knowledge of life process.	**K4**
CO5	evaluate and to create the perfect phylogenetic relationship in classification.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit	Contents	Hours
I	**Origin of vertebrates:** Concept of Protochordate; The nature of vertebrate morphology; Definition, scope and relation toother disciplines; Importance of the study of vertebrate morphology.	21
II	**Origin and classification of vertebrates:** Vertebrate integument andits derivatives. Development, general structure and function sofskinand its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.	21
III	**General plan of circulation in various groups:** Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs	21
IV	**Skeletal system:** Form, function, body size and skeletal elements of the body; Comparative account of jawsuspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series.	21
V	**Sense organs:** Simple receptors; Organs of Olfaction and taste; Lateral line system; Electroreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.	21
Self-Study	Scopeandrelation of vertebrate morphology toother disciplines, Vertebrate integumentand its derivatives, Evolution of aortic arches and portal systems, Comparative account of jawsuspensorium, Comparative anatomy of spinalcord	

Text Books:

1. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
2. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.
3. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
4. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
5. Ganguly, Sinha, Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.

Reference Books:

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
3. EkambaranathaAyyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
4. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

Web sources:

1. Swayam Prabha: https://www.swayamprabha.gov.in/index.php/program/archive/9
2. https://bit.ly/3Av1Ejg/
3. https://bit.ly/3kqTfYz/
4. https://biologyeducare.com/aves/

5. https://www.vedantu.com/biology/mammalia/

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	3	2	3	2
CO2	3	1	1	3	2	3	2
CO3	3	2	1	2	2	2	2
CO4	3	1	1	3	1	3	2
CO5	3	2	1	2	3	3	2
Total	15	8	5	13	10	14	10
Average	3	1.6	1	2.6	2	2.8	2

*3 - Strong; 2 - Medium; 1 - Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	2	2	3
CO3	2	2	3	2	2
CO4	3	3	3	3	3
CO 5	2	3	2	2	2
Total	13	14	12	12	12
Average	2.6	2.8	2.4	2.4	2.4

SEMESTER I

CORE LAB COURSE I: LAB COURSE IN INVERTEBRATES & VERTEBRATES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP231CP1	**-**	**-**	**4**		**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisite

Basic knowledge on the animals living in different habitats

Learning Objectives:

1. Understanding the salient features and functional anatomy of different systems and the skeletal system in invertebrates & vertebrates.
2. Developing the skill in mounting techniques of the biological samples.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	understand the structure and functions of various systems in	**K1**

	animals	
CO2	learn the adaptive features of different groups of animals	**K2**
CO3	learn the mounting techniques	**K3**
CO4	acquire strong knowledge on the animal skeletal system	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

INVERTEBRATES
Dissection
Earthworm : Nervous system *Pila* : Digestive and nervous systems *Sepia* : Nervous system Cockroach : Nervous system Grasshopper : Digestive system and mouth parts Prawn : Appendages, nervous and digestive systems Crab : Nervous system
Study of the following slides with special reference to their salient features and their modes of life
1. *Amoeba* 2. *Entamoeba histolytica* 3. *Paramecium* 4. *Hydra* with bud 5. Sporocyst – Liver fluke 6. *Cercaria* larva 7. *Tape worm (Scolex)* 8. *Ascaris* T. S. 9. Mysis of prawn
Spotters
1. Scorpion 2. *Penaeus indicus* 3. *Emerita* (*Hippa*) 4. *Pernaviridis*
Mounting
Earthworm : Body setae *Pila* : Radula Cockroach : Mouth parts Grasshopper : Mouth parts

VERTEBRATES
Study the nervous system of Indian dog shark - Dissection
1. Nervous system of *Scoliodonlaticaudatus* – 5^{th} or Trigeminal nerve 2. Nervous system of *Scoliodonlaticaudatus* – 7^{th} or Facial nerve 3. Nervous system of *Scoliodonlaticaudatus* – 9^{th} and 10^{th} or Glossopharyngeal &Vagus nerve

Study of the following specimens with special reference to their salient features and their modes of life
1. *Amphioxus* sp. (Lancelet) 2. *Ascidia* sp. (sea squirt) 3. *Scoliodonlaticaudatus*(Indian dog shark) 4. *Trygon*sp. (Sting ray) 5. *Torpedo* sp. (Electric ray) 6. *Arius maculatus* (Cat fish) 7. *Belonecancila*(Flute fish) 8. *Exocoetuspoecilopterus*(Flying fish) 9. *Mugilcephalus*(Mullet) 10. *Tilapia mossambicus*(Tilapia) 11. *Rachycentron canadum* (Cobia) 12. *Tetrodonpunctatus*(Puffer fish) 13. *Dendrophis*sp. (Tree snake)
Study of the different types of scales in fishes
1. Cycloid scale 2. Ctenoid scale 3. Placoid scale
Study of the frog skeleton system (Representative samples)
1. Entire skeleton 2. Skull 3. Hyoid apparatus 4. Pectoral girdle and sternum 5. Pelvic girdle 6. Fore limb 7. Hind limb
Mounting
1. Weberian ossicles of fish

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

Web Resources:

1. http://www.csrtimys.res.in/
2. http://csb.gov.in/
3. https://iinrg.icar.gov.in/
4. https://www.nationalgeographic.com/animals/invertebrates/
5. https://www.youtube.com/watch?v=b04hc_kOY10
6. https://bit.ly/3CzTEy8
7. http://tolweb.org/Chordata/2499
8. https://www.nhm.ac.uk/

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	3	3	2	3	2	2
CO2	3	2	3	3	3	2	2	2
CO3	3	2	3	3	3	2	2	2
CO4	3	2	3	3	2	2	2	2
TOTAL	12	6	12	12	10	9	8	8
AVERAGE	3	1.5	3	3	2.5	2.25	2	2

3 – Strong, 2- Medium, 1- Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3
CO2	3	3	2	2	3
CO3	2	2	3	2	2
CO4	3	3	3	3	3
Total	11	11	10	10	11
Average	2.75	2.75	2.5	2.5	2.75

SEMESTER I
ELECTIVE COURSE - I
(a) MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC1	**3**	**1**	**-**	**1**	**3**	**5**	**75**	**25**	**75**	**100**

Pre-requisite:

Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism, and functions of biomolecules.

Learning Objectives

1. Students should know the fundamentals of biochemistry.
2. To develop analytical and communicative skills to conduct experiments and interpretthe results

Course Outcome

On the successful completion of the course, student will be able to:		
CO1	learn the structure, properties, metabolism, and bioenergetics of biomolecules	**K1**
CO2	acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K2**
CO3	understand the fundamentals of biophysical chemistry and biochemistry, importance, and applications of methods in conforming	**K3**

	the structure of biopolymers	
CO4	comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K4**
CO5	familiarize the use of methods for the identification, characterization, and conformation of biopolymer structures	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Units	Contents	No. of Hours
I	Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules, and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).	15
II	Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism, and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids, and vitamins).	15
III	Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes	15
IV	Structural conformation of proteins and nucleic acids: Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).	15
V	Stabilizing interactions in biomolecules: Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.	15

Self-study	Structure of atoms, Hydrophobic interactions, Glycolysis t-RNA, Nucleic acid structures

Text Books

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695

References

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.

3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

Web Resources:

1. http://biochemical-pathways.com/#/map/1
2. https://www.ebi.ac.uk/chembl/
3. http://www.iubmb-nicholson.org/chart.html
4. https://www.sigmaaldrich.com/IN/en/search/enzymes?focus=products&page=1&perpage=30&sort=relevance&term=enzymes&type=product

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	1	2	3	1	3
CO 2	3	2	2	2	2	1	3
CO 3	3	3	2	2	3	2	3
CO 4	3	2	1	1	3	2	2
CO5	2	2	3	3	2	3	3
Total	14	12	9	10	13	9	14
Average	2.8	2.4	1.8	2	2.6	1.8	2.8

3 – Strong, 2 – Medium, 1 - Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3
CO2	3	3	2	2	3
CO3	2	2	3	2	2
CO4	3	3	3	3	3
CO5	3	2	2	3	3
Total	14	13	13	13	14
Average	2.8	2.6	2.6	2.6	2.8

SEMESTER I
ELECTIVE COURSE - I(b) FORENSIC BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC2	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Students should know the fundamentals of natural science and have a curiosity of criminology.

Learning Objectives:

1. Students should emphasize the importance of scientific methods in crime detection and disseminate information on the advancements in the field of forensic science.
2. Derive to skills to identify crime through various forensic techniques

Course Outcomes

On the successful completion of the course, student will be able to		
CO1	recall the fundamentals of forensic biology, psychology, and criminal profiling.	**K1**
CO2	outline the use of scientific evidence in a legal context using basic facts, fundamental principles, and functions of forensic science.	**K2**
CO3	apply the knowledge gained on forensic, dermatoglyphic, serological and odonatological techniques to render forensic service during real-time crime scenes.	**K3**
CO4	analyze fingerprints, personal identification evidence, bite marks and pug marks.	**K4**
CO5	evaluate information to find strategies to resolve problems in forensic biology.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Units	Contents	No. of Hours
I	Concepts and scope, functions, and historical aspects of forensic science. Importance, nature, location, collection and preservation of biological exhibits and crime scene investigation of biological evidence. Forensic dermatoglyphics - biological basis of fingerprints, formation of ridges, fundamental principles of fingerprinting, types of fingerprints, fingerprint patterns, automated fingerprint identification system.	15
II	Forensic examination of hair - importance, nature, location, structure, growth phases of hair, collection, evaluation, and tests for their identification. Forensic Serology - identification of body fluids, collection and preservation of blood evidence, distinction between human and non-human blood, semen - forensic significance of semen, composition and morphology of spermatozoa, collection, evaluation and tests for identification of semen. Composition and forensic significance of saliva, sweat, milk and urine.	15
III	Structural variation, types of teeth - human and non-human teeth, determination of age from teeth, eruption sequence, dental anomalies, their significance in personal identification. Bite marks - forensic significance, collection and preservation of bite marks, photography and evaluation of bite marks, lip prints in forensic investigations.	15
IV	Forensic Entomology - insects of forensic importance, collection of entomological evidence during death investigations. The role of aquatic insects in forensic investigations, insect succession on carrion and its relationship to determine time since death, factors influencing insect succession on carrion, its application to forensic entomology. Forensic Microbiology - types and identification of microbial organisms of forensic significance.	15

V	Importance of Wildlife Protection Act-1972- Schedules in the protection of endangered species of flora and fauna. Identification of wildlife materials such as skin, fur, bones, nails, horn, teeth, plants, plant parts and products by conventional and modern methods. Identification of pug marks of various animals, DNA techniques in wildlife investigations.	15

Self-study	Historical aspects of fingerprints, Collection, and preservation of blood Types of teeth, Forensic microbiology, DNA techniques

Text Books:

1. S. Chowdhuri (1971). *Forensic Biology*. New Delhi: BPRD.
2. R. Saferstein (1993). *Forensic Science Handbook* (Vol. 3). New Jersey: Prentice Hall.

References

1. R.S. Ramotowski (2013). Lee and Gaensleen's, Advances in Fingerprint Technology (3rd ed.). Boca Raton: CRC Press.
2. L. Stryer, (1988). Biochemistry (3rded.). New York: W.H. Freeman and Company.
3. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, (1993). Harper's Biochemistry. Norwalk: APPLETON and Lange.
4. M. Bernstein (1997). Forensic odontology in, Introduction to Forensic Sciences (2nd ed.), W.G. Eckert (Editor). Boca Raton: CRC Press.
5. J. Dix (1999). Handbook for Death Scene Investigations. Boca Raton: CRC Press.
6. V.J. Geberth, (2006). Practical Homicide Investigation. Boca Raton CRC Press.
7. W.G. Eckert and S.H. James (1989). Interpretation of Bloodstain Evidence at Crime Scenes. Boca Raton: CRC Press.
8. G.T. Duncan and M.I. Tracey (1997). Serology and DNA typing in, Introduction to Forensic Sciences (2nd ed.), W.G. Eckert (Editor.). Boca Raton: CRC Press.

Web Resources:

1. http://www.dnaftb.org/
2. https://forensicdental.wordpress.com/
3. https://www.forensicsciencesimplified.org/
4. http://www.istl.org/03-spring/internet.html

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	1	2	3	1	3
CO 2	3	2	2	2	2	1	3
CO 3	3	3	2	2	3	2	3
CO 4	3	2	1	1	3	2	2
CO5	2	2	3	3	2	3	3
Total	14	12	9	10	13	9	14
Average	2.8	2.4	1.8	2	2.6	1.8	2.8

3 – Strong, 2 – Medium, 1 - Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	2	2	3
CO3	2	2	3	2	2
CO4	3	3	3	3	3
CO5	3	2	2	3	3
Total	13	13	13	13	14
Average	2.8	2.6	2.6	2.6	2.8

SEMESTER: I

ELECTIVE COURSE - I

(c) WILDLIFE CONSERVATION AND MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC3	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Students should know the importance of wild-life and be responsible to conserve the environment and the ecosystem.

Learning Objectives

1. To equip students with adequate knowledge of various biodiversity monitoring methodologies,conservation, and management
2. To identify the issues of vertebrate pests, wildlife conflict and over abundant species, wildlifehealth and diseases.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues	**K1**
CO2	develop the ability to work collaboratively on team-based projects	**K2**
CO3	demonstrate proficiency in the writing, speaking, and critical thinking skills needed to become a wildlife technician	**K3**
CO4	gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management	**K4**
CO5	develop an ability to analyze, present and interpret wildlife conservation management information.	**K5**

Units	**Contents**	**No. of Hours**
I	Definition and importance of wildlife; Types of ecosystems. Causes of depletion of wildlife; Classification of wetland and animal inhabitants; Population vulnerability analysis and its components; Factors responsible for the extinction of animals;Types of protected areas and the concept of zoning within the protected areas.	15
II	Wildlife Sanctuaries and National Parks in India: Theories of	15

	population dispersal; Animal movement, concept of home range and territory; Tracking movement by remote sensing and GIS. Wildlife conservation, ethics and importance of conservation; Impact of habitat destruction and fragmentation on wildlife; Biological parameters such as food, cover, forage and their impact on wild life;	
III	Population attributes; concepts of exponential and logistic growth rates of wildlife; Density dependent and independent population regulation; Impact of introduced species on preexisting flora and fauna of wildlife; Identification and estimation of wild animals by fecal sample analysis, hair identification, pugmarks and census methods. Predator-prey models and impact of predation.	15
IV	Wildlife conservation objectives- Captive breeding techniques and translocation and reintroduction; Inviolate area and critical habitats and their impact on wildlife;Different terrestrial habitats of wildlife in India; Restoration of degraded habitat. Damage caused by wildlife in India and its mitigation; Sick animal refugesin protected areas. Type of wildlife management-manipulative, custodial; Management of over abundant wild animal populations causing damages to nearby inhabitants and their crops and animals;	15
V	Tools and techniques to control the menace of wild animals; man, wildlife conflict resolution and mitigation; Management of exotic and invasive wetland species in India. Habitat manipulation– control and regulation of grazing. Weed eradication; Major diseases of domestic and wild animals and their control and impact of wild life tourism.	15

Self-study	Types of ecosystems, Wild life sanctuaries and national parks in India, Wild life conservation, Weed eradication

Text Books

1. Caughley, G., and Sinclair, A.R.E. (1994) Wildlife Ecology and Management. BlackwellScience.
2. Goutam Kumar Saha &Subhendu Mazumdar (2017). *Wildlife Biology: An Indian Perspective*.New Delhi: PHI Learning Pvt. Ltd.
3. Singh, S.K (2015). *Textbook of wildlife management* (2nd ed.). Delhi: CBS Publishers and Distributors Pvt. Ltd.

ReferenceBooks

1. Woodroffe, R., Thirgood, S. and Rabinowitz, A. (2005) People and Wildlife, Conflict orCo-existence?CambridgeUniversity.
2. Bookhout, T.A. (1996) Research and Management Techniques for Wildlife and Habitats(5th edition)TheWildlifeSociety,Allen Press.
3. Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy. BlackwellSciences
4. Hunter M.L.,Gibbs,J.B.andSterling,E.J.(2008) Problemsolving inConservationBiology and Wildlife Management: Exercises for Class, Field, and Laboratory. BlackwellPublishing.
5. Taj Rawat (2012). *Biodiversity Conservation and Wildlife Tourism*. Delhi: Discovery Publishing House Pvt. Ltd.
6. Kumar, U. &Asija, M.J. (2007). *Biodiversity - Principle and Conservation* (2nd ed.). JodhpurStudent Editors

7. SeshadiriBalakrishnan, (1969). *The Twilight of India's Wildlife*. Chennai: Oxford University Press.
8. Gee, E.P. (1969). *Wildlife in India* (1st ed.). London: Collins Foundation Books.
9. Anthony R.E. Sinclair, John M. Fryxell& Graeme Caughley (2006). *Wildlife Ecology*,
10. Conservation, and Management(2nd ed.). USA: Blackwell Publishing.

Web Sources

1. https://education.nationalgeographic.org/resource/wildlife-conservation/
2. https://www.clearias.com/wildlife-conservation-projects/
3. https://www.wii.gov.in/
4. https://www.mdpi.com/2673-7159/1/2/9

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	3	3	2	2
CO2	3	2	3	3	3	2	2
CO3	3	2	3	3	3	2	2
CO4	3	2	3	3	3	2	2
CO5	3	2	3	3	3	2	2
TOTAL	15	10	15	15	15	10	10
AVERAGE	3	2	3	3	3	2	2

3 – Strong, 2- Medium, 1- Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	2	2	3
CO3	2	2	3	2	2
CO4	3	3	3	3	3
CO5	3	2	2	3	3
Total	13	13	13	13	14
Average	2.8	2.6	2.6	2.6	2.8

SEMESTER I

ELECTIVECOURSE –IIa) BIOSTATISTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC4	3	1	-	1	3	5	75	25	75	100

Pre-requisite:

Students should be aware of the importance of analysis of quantitative and qualitative information from biological studies

Learning Objectives:

The main objectives of this course are:

1. To enable the students to understand the basic concepts in Biostatistics and analyse the data to derive inferences in various biological experiments.
2. To develop analytical skills of statistics and draw valid conclusions in research.

Course outcomes

COs	Upon completion of this course the students will be able to:	CL
CO1	recall different biological data, methods of collection and analysis of data.	**K1**
CO2	comprehend the design and application of biostatistics relevant to experimental and population studies.	**K2**
CO3	acquire skills to perform various statistical analyses using modern statistical techniques and software.	**K3**
CO4	analyze the data and interpret the results manually or by using software	**K4**
CO5	evaluate on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate

Units	Content	No. of hours
I	Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram, and pie chart.	15
II	Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error, and coefficient of variation.	15
III	Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.	15
IV	Hypothesis testing: Student '*t*' test - paired sample and mean difference '*t*' tests. Correlation: Types - Karl Pearsons Co-efficient,	15

	Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.	
V	Analysis of variance: one way and two-way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).	15

Self-Study	Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

Textbooks

1. Arora, P. N. and P. K. Malhan. (1996). *Biostatistics*, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. (2005). *Introduction to Biostatistics*, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. (2004). *Academic Statistics in Biology and Psychology*, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. (1990). *Statistical Methods for Biologists*, Palani Paramount Publications, Tamil Nadu, pp-264.

Reference books

1. Pillai, R.S.N. and V. Bagavathi (2016). S*tatistics Theory and Practice* (8th ed.).New Delhi: S. Chand Publishing Company Ltd.
2. Khan, I. and Khanum, A. (2014). *Fundamentals of Biostatistics* (3rd ed.): Hyderabad. Ukaaz Publications.
3. Zar, J.H. (1984). *Biostatistical Analysis* (2nd ed.). London: Prentice-Hall International Inc.
4. Bailey, N.T.J. (1997). *Statistical methods in Biology* **(**3rd ed.). New York: Cam. University Press.
5. Sokal, R. and James, F. (1973). *Introduction to Biostatistics.* Tokyo, Japan: W.H. Freeman and Company Ltd.
6. Daniel, W.W. (1987). *Biostatistics: A foundations for Analysis in the Health Sciences*. New York: John Wiley &Sons.
7. Gupta, S.P. (1998). *Statistical Methods.* New Delhi: S. Chand and Company Ltd.
8. Banerjee, P.K. (2005). *Introduction to Biostatistics.* New Delhi: S. Chand and Company Ltd.
9. Pranab Kumar Banerjee (2009). *Introduction to Biostatistics*, New Delhi: S. Chand and Company Ltd.

Web Resources

1. https://faculty.ksu.edu.sa/sites/default/files/introduction_to_biostatistics-106.pdf
2. https://www.youtube.com/watch?v=1Q6_LRZwZrc
3. https://www.youtube.com/watch?v=7CqolAC_owc
4. https://www.ibm.com/docs/en/spss-statistics/25.0.0?topic=tutorial
5. https://www.statisticshowto.com/probability-and-statistics/spss-tutorial-beginners/

MAPPING WITH PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO 1	3	1	1	x	1	1	3
CO 2	3	3	2	1	2	2	3
CO 3	3	2	2	x	x	3	3

CO 4	3	2	1	1	2	3	3
CO 5	3	3	2	2	2	3	3
TOTAL	15	11	8	4	7	12	15
AVERAGE	3	2.2	1.6	0.8	1.4	2.4	3

S-Strong (3) M-Medium (2) L-Low (1)

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	3	2	3
CO3	2	3	3	3	2
CO4	3	3	3	3	3
CO5	3	2	3	3	3
Total	13	14	15	14	14
Average	2.6	2.8	3	2.8	2.8

SEMESTER I

ELECTIVE COURSE - II (b) APPLIED ZOOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC5	3	1	-	1	3	5	75	25	75	100

Prerequisite:

A genuine passion towards the culture of economically important cultivable organisms.

Learning Objectives

1. To deepen the knowledge of students in general and applied areas of Zoology.
2. To provide employment and job opportunities in the public, private and government sector.

Course Outcomes

Upon completion of this course the students will be able to:		
CO - 1	apply the knowledge of animal husbandry in economic development.	**K1**
CO - 2	identify the kinds of bees and the methods of bee keeping.	**K2**
CO - 3	rear silkworms, harvest and market the cocoons.	**K3**
CO - 4	apply skills and experience about the management of poultry and Dairy farming.	**K4**
CO - 5	culture of economically important finfish and shell fishes.	**K5**

Units	Content	hours
I	**Apiculture:** Scope–classification and kinds of bees–bees and their society–life cycle of *Apis indica* –food of honey bees - relationship between plants and bees. Methods of bee keeping(primitive and modern) – Honey bee products: honey, bee wax, bee venom. **Lac culture** – scope – lac insect *Lacciferlacca* and its life cycle – processing of lac - lac products and importance.	15

II	**Sericulture:** Scope–Silk Road - CSB - Moriculture: varieties of mulberry, methods ofpropagation, harvesting of leaves – Common species of Silkworm– Life cycle of mulberry silkworm – Diseases of silkworm: pebrine, grasserie, sotto diseases, muscardine – pest of silkworm: uzifly. Rearing of silkworm – mounting – spinning - harvesting of cocoons – silk reeling and marketing.	15
III	**Poultry Keeping:** Scope–commercial layers and broilers - poultry housing - types of poultryhouses – management of chick, growers, layers and broilers – debeaking - sexing in chicks - Nutritive value of egg. Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis – vaccination.	15
IV	**Dairy Farming:** Scope–Breeds of Dairy animals–Establishment of a typical Dairy farm–Management of cow (Newborn, calf, Heifer, milking cow) – Diseases (Mastitis, Rinder Pest, FMD). Nutritive value of milk - dairy products (Standard milk, skimmed milk, toned milk and fermented milk-curd, ghee, cheese) Pasteurization. Leather industry – scope – processing of skin**.**	15
V	**Integrated Farming**: Definition and Scope.Agri-based fish farming–paddy cum fish culture–Horticulture-cum-fish farming. Integrated bee keeping - Live-stock fish farming - Duck-cum fish culture, fish-cum poultry farming, fish cum dairy farming, goat-cum fish integration, fish cum pig farming - multi-trophic aquaculture – Livestock – Poultry – Fish – Horticulture	15

Text Books

Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. **(**2011). *AppliedZoology*. Nagercoil: Saras Publications.

Reference Books

1. Vasantharaj David, B. (2004). *General and Applied Entomology* (2nd ed.). New Delhi: Tata McGraw-Hill Publishing Company Ltd.
2. Johnson, J. and Jeya Chandra, I. (2005). *Apiculture*.Marthandam: Olympic Grafix.
3. Tharadevi, C.S., Jayashree, K.V. and Arumugam, N. (2014). *Bee Keeeping*.Nagercoil : Saras Publications.
4. Johnson, M. and Kesary, M. (2015). *Sericulture* (5th ed.). Marthandam: CSI Press.
5. Ganga, G. and Sulochana Chetty (1997). *An Introduction to Sericulture*. Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
6. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. Hitone Publications.
7. Shukla, G.S. and Upadhyay, V.B. (1998). *Economic Zoology*. Jaipur: Rastogi Publications.
8. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
9. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.

Web Resources

1. https://guides.library.charlotte.edu/c.php?g=173165&p=1142033
2. https://www.slideshare.net/ManoKhan88/1-basic-concepts-in-economic-zoologypptx
3. https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20seri

culture%20upload.pdf

4. https://www.echocommunity.org/en/resources/e7940e6c-ebbb-4b78-9115-fa5de38fa0d7
5. https://www.fao.org/documents/card/en?details=cb5353en

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	1	-	1	1	3
CO 2	3	3	2	1	2	2	3
CO 3	3	2	2	-	-	3	3
CO 4	3	2	1	1	2	3	3
CO 5	3	3	2	2	2	3	3
TOTAL	15	11	8	4	7	12	15
AVERAGE	3	2.2	1.6	0.8	1.4	2.4	3

S-Strong (3) M-Medium (2) L-Low (1)

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	3	2	3
CO3	2	3	3	3	2
CO4	3	3	3	3	3
CO5	3	2	3	3	3
Total	13	14	15	14	14
Average	2.6	2.8	3	2.8	2.8

SEMESTER I

ELECTIVE COURSE – II(c) PEST MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EC6	3	1	-	1	3	5	75	25	75	100

Prerequisite:

Need to have a fundamental understanding of entomology, plant pathology, and integrated pest management strategies.

Learning Objectives

1. To provide awareness on various pests and their control measures.
2. To apply Integrated Pest Management strategies to resonate home based food products with the general public.

Course Outcomes

CO	Upon completion of this course the students will be able to:	
CO - 1	outline the pest groups affecting different agricultural crops and control measures.	**K1**
CO - 2	select correct IPM in cropping systems with traditional and	**K2**

	alternative control measures.	
CO - 3	analyze the impact of pesticides on environment and adopt better agricultural practices.	**K3**
CO - 4	evaluate the control measures adopted for pests of household and stored products.	**K4**

Units	Content	No. of hours
I	**Introduction:** definition of pest–outline of pest groups affecting agricultural crops–populationdynamics of pests – causes for pest out breaks. Pest control methods: cultural, chemical and biological - pesticides, precautions, safety devices - pesticide poisoning symptoms and first aid.	15
II	**Pesticides:** organochlorine, organophosphorus and organocarbamates–inorganic and natural pesticides. Preparation of pesticides: formulations – packages, manufacture. Toxicity levels – LD_{50} values. Mode of action of pesticides.	15
III	**Pests of Agricultural importance:** bionomics and life cycles of any two pests of the following: **c**ereals (rice); oilseeds (coconut, groundnut); vegetables (brinjal); pulses; plantation crops (coffee); fruits (citrus) and pesticide formulations.	15
IV	**Household pests and Pests of stored products:** household pests (cockroaches, termites,silverfish, flies and mosquitoes) and their control measures. Rodents as pests – local rodents, life history, feeding habits, reproduction, and behaviour – methods of rodent control. Stored grain pest (rice weevil, flour beetle, cigarette beetle).	15
V	**Mode of Pest Control:** Pesticide spraying appliances. Residual toxicity of pesticides–Environment degradation and its prevention. Biological control of pest – parasites, predators, and pathogens – chemosterilants – pheromones - Bacculovirus-mediated pest control. Integrated pest management and its relevance to 21st century.	15

1.Text Book

Dhawan, A.K., Balwinder Singh, Manmeet B Bhullar (2012). *Integrated Pest Management*. Chennai: Scientific Publishers.

Reference Books

1. Nayar, Ananthakrishnan and David (1976). *General and Applied Entomology*. New Delhi: Tata McGraw Hill Publishers.
2. Metcalf and Flint (1973). *Destructive and useful Insects* (4th ed.). New Delhi: Tata McGraw Hill Publishers.
3. Roya, D.N. and Abrown, A.W. (1981). *Entomology: Medical and Veterinary* (3rd ed.).
Bangalore: The Bangalore Printing and publishing company.
4. Cremlyn, R. (1979). *Pesticides: Preparation and mode of Action.* New Jersey: John Wiley & Sons Ltd.

5. Ignacimuthu, S. and B V David (2009). *Ecofriendly Insect Pest Management.* Delhi: Elite Publishing House Pvt Ltd (Ind).

Web Sources

1. https://guides.library.cornell.edu/c.php?g=672215&p=4733120
2. https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-insectlinks/
3. https://content.ces.ncsu.edu/insect-and-related-pests-of-vegetables
4. https://content.ces.ncsu.edu/insect-management-on-organic-farms
5. https://www.epa.gov/ipm/integrated-pest-management-tools-resources-support-ipm-implementation

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	1	x	1	1	3
CO 2	3	3	2	1	2	2	3
CO 3	2	2	3	2	3	3	3
CO 4	3	2	3	1	2	3	3
TOTAL	11	8	9	4	8	9	12
AVERAGE	2.75	2	2.25	0.8	2	2.25	5

S-Strong (3) M-Medium (2) L-Low (1)

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	3	2	3
CO3	2	3	3	3	2
CO4	3	3	3	3	3
Total	10	12	12	11	11
Average	2.5	3	3	2.5	2.5

SEMESTER I
ELECTIVE LAB COURSE I: MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY & BIOSTATISTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP231EP1	-	-	2		2	2	30	25	75	100

Pre-requisite

Basic practical knowledge on the molecules and their interaction to animal body and analysis of quantitative and qualitative information from biological samples.

Learning Objectives:

1. Understanding the salient features and functional anatomy of different systems and the skeletal system in invertebrates & vertebrates.
2. To design experimental problems, analyze and evaluate critically with inferential biostatistics.

Course Outcomes

COs	Upon completion of this course the students will be able to:	KL
CO1	learn and study of chemical and physical structure of biological macromolecules.	K1
CO2	analyze the biomolecules and physicochemical parameters in samples	K2
CO3	analyze and interpret the collected data using statistical methods	K3
CO4	design biological experiments and evaluate the samples applying appropriate statical methods.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Molecules and their Interaction Relevant to Biology

1. Colorimetry-Verification of Beer-Lambert's law.
2. Preparation of solutions in normality, percentage, ppt, ppm
3. Quantitativeestimationofglucose(Blood/ tissue) Standard graph method
4. Determination of velocity of salivary amylase activity by applying Michaelis - Menten equation.
5. Determination of pH of unknown solution using Known pKa – Application of Henderson–Hasselbalch equation.

Instruments/Charts/Models: Colorimeter, pH Meter, Centrifuge, Chromatogram, PAGE

Biostatistics

6. Measures of central tendency: mean, median and mode.
7. Measures of dispersion- Standard deviation and standard error.
8. Correlation co-efficient: Length and width of molluscan shells.

1. Geetha K. Damodaraan, 2010. Practical Biochemistry. Jaypee Brothers Medical Publishers Pvt. Ltd.
2. Divya Shanthi, 2018. An easy guide for practical Biochemistry. Jaypee Brothers Medical Publishers Pvt. limited, 01-Nov-2008 -
3. Gupta, S.P.(1998). Statical methods. New Delhi: S. Chand and Company Ltd.

4, Gurumani, N. An introduction to Biostatistics. 2004. MJP publishers, Triplicane, Chennai.

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	1	2	3	1	3
CO 2	3	2	2	2	2	1	3
CO 3	3	3	2	2	3	2	3
CO 4	3	2	1	1	3	2	2
Total	12	10	6	7	11	6	11
Average	3	2.5	1.5	1.75	2.75	1.5	2.75

3 – Strong, 2- Medium, 1- Low

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	2	3	2	2	3
CO3	2	2	3	3	2
CO4	3	3	3	3	3
CO5	2	2	3	3	3
Total	12	12	14	14	14
Average	2.4	2.4	2.8	2.8	2.8

SEMESTER I

SPECIFIC VALUE-ADDED COURSE

BASICS OF EXCEL

Course Code	Credits	Total Hours	Total Marks
ZP231V01	**1**	**30**	**100**

Prerequisite:

Basic computer literacy and familiarity with navigating computer applications.

Objectives:

To equip the students to present data using Excel's various features and printing options.

COs	On completion of this course, students will be able to	KL
CO 1	recall the components of Excel's interface and basic cell formatting.	K1
CO 2	summarize the significance of relative, absolute, and mixed cell references in formulae.	K2
CO 3	apply data entry techniques and utilize basic calculations and formulas.	K3
CO 4	analyze different chart types to determine their suitability for presenting specific types of data.	K3
CO 5	evaluate the effectiveness of using functions and charts to ensure clarity and effective visualization.	K5
CO 6	design and create various types of charts (bar, column, pie) based on specific data sets.	K6

Unit 1: Excel Essentials and Interface: Introduction to Excel's - Excel interface, workbooks, and sheets – selection of cells, rows, and columns - basic cell formatting: font, alignment, and fill.

Unit 2: Data Entry, Formulas, and Functions: Data entry techniques and AutoFill - Introduction to formulas and basic calculations - Using SUM, AVERAGE, COUNT, and other functions - cell references: relative, absolute, and mixed.

Unit 3: Data Management and Analysis: Sorting and filtering data using find and replace to manipulate data – Data analysis using excel (t test, Regression, Correlation, ANOVA), data validation for data integrity.

Unit 4: Charts and visualization: Creating different chart types: bar, column, and pie charts - formatting and enhancing charts for clarity - Adding labels, titles, and legends to charts.

Unit 5: Printing, Sharing, and Review: Setting up print options and page layout - printing worksheets and workbooks - sharing workbooks via email and cloud storage - review of key concepts and practical exercises.

Reference books:

1. Kabir Das. 2021.Microsoft Excel: Short keys and formulas. Notion Press, India.
2. Maneet Singh Mehta. 2021. Microsoft Excel Professionals. 2021 guide. BPB Publications, India.
3. Lokesh Lalwani. 2019. Excel 2019 – All in one. 1st Edn. BPB Publications, India.
4. John Walkaenbach. 2015. Microsoft Excel 2016 Bible – Comprehensive tutorial resource. John Wiley and Sons, Indiana.
5. Greg Harvey. 2016. Microsoft Excel 2016. DummisPublisger

SEMESTER II

CORE COURSE III: CELLULAR AND MOLECULAR BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP232CC1	4	1	-	1	5	6	90	25	75	100

Pre-requisite

Students should have knowledge of the basic cellular structures and their salient functions.

Learning Objectives

1. To acquire knowledge on molecular organization of the cell and cell organelles, growth, and communications.
2. To develop skills needed to innovate and contribute to the advancement in cell and molecular biology.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall general concepts of cell biology and fundamental cellular structures and organelles.	**K1**
2.	explain the various cellular components and their activities.	**K2**
3.	identify the changes or losses in cell function caused by dysregulation.	**K3**
4.	compare different cellular processes, their regulation, and their significance.	**K4**
5.	assess the societal and environmental impacts through cellular and molecular research.	**K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate

Units	Contents	No. of Hours
I	General features of the cell: Cell theory; Diversity of cell size and shapes. Protoplasm and deutroplasm – cell organelles; Membrane structure and functions - membrane models, membrane/channel proteins, diffusion, osmosis, active transport, ion pumps (Sodium and potassium pump).	18
II	Cell organelles: Ultra-structure and functions of intracellular organelles – nucleus, nuclear pore complex, nucleolus, chromosomes, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, centrosomes, peroxisomes, ribosomes.	18
III	Cell cycle and cell division: Phases of Cell Cycle – Mitosis, Significance of Mitosis - meiosis,significance of meiosis. Control of the cell cycle - regulator molecules - positive regulation - negative regulation. Structure of DNA and RNA; Process of DNA replication, transcription, and translation in pro- and eukaryotic cells.	18
IV	Cell communication and cell signaling: Membrane - associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways (RTK pathway and MAP kinase pathway). Gap junction and tight junction, extracellular space and matrix, interaction of cells with other cells and non-cellular structures.	18
V	Cancer cells: Characteristic features of normal and cancer cells. Carcinogens: types and cancer induction. Metastasis. Oncogenes and tumor suppressor genes, therapeutic interventions of uncontrolled cell growth. Apoptosis – mechanism and regulation. Ageing and senescence.	18

Self-study	Diversity of cell size and shapes, Ultra-structure and functions of lysosomes, Stages in cell cycle, Gap junction and tight junction, Characteristic features of normal and cancer cells.

Textbooks

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. *Lewin's Cells* (Third Edition), Jones & Bartlett, New Delhi.
2. Ajoy Paul, 2011. *Textbook of Cell and Molecular Biology*, Books and Allied Pvt. Ltd.

Reference Books

1. Alberts, B., A. Johnson, J. Lewis, *et al*., 2015. *Molecular Biology of the Cell* (Sixth Edition), Garland Science, New York.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al*., 2013. *Molecular Cell Biology* (Seventh Edition), Macmillan, England.
3. Karp, G. 2010. *Cell Biology* (Sixth Edition), John Wiley & Sons, Singapore.
4. Tropp, B, 2008. *Molecular Biology Genes to Proteins* (Third Edition), Jones & Bartlett, US.
5. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007. *Cell and Molecular Immunology* (Sixth Edition), Saunders, Philadelphia.

Web Resources

1. https://www.inspiritvr.com/general-bio/cell-biology/passive-and-active-transport-study-guide
2. https://www.khanacademy.org/test-prep/mcat/cells/eukaryotic-cells/a/organelles-article
3. https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/changes-in-signal-transduction-pathways/a/intracellular-signal-transduction
4. https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology/Book%3A_CellsMolecules_and_Mechanisms_(Wong)/11%3A_Protein_Modification_and_Trafficking/11.02%3A_Protein_Trafficking
5. https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/control-of-the-cell-cycle/

MAPPING WITH PROGRAMME OUTCOMES
PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3
CO2	3	3	1	2	2	2	2	3	1	2	2	1
CO3	3	3	3	3	3	3	2	2	3	2	3	2
CO4	3	3	1	2	2	2	2	2	3	2	3	2
CO5	2	3	3	3	3	3	3	2	3	3	2	3
TOTAL	14	15	11	13	13	13	12	12	12	12	13	11
AVERAGE	2.8	3.0	2.2	2.6	2.6	2.6	2.4	2.4	2.4	2.4	2.6	2.2

3-Strong, 2- Medium, 1- Low

SEMESTER II

CORE COURSE IV: DEVELOPMENTAL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP232CC2	4	1	-	1	5	6	90	25	75	100

Pre-requisite

A basic understanding of biology and genetics is recommended to effectively grasp the concepts in developmental biology.

Learning Objectives

1. Understand the principles of developmental biology to analyze and compare the embryonic development of different animal species.
2. Study the concepts, procedures, and uses of genes and hormones to propose strategies to improve and control the development of certain animal species.

Course Outcome

On the successful completion of the course, student will be able to:		
CO - 1	recall and summarize the chief events in animal development, recognizing their significance and historical context	**K1**
CO - 2	understand the different mechanisms and how extrinsic and intrinsic factors influence embryonic development in various animal embryos.	**K2**
CO - 3	apply their knowledge to explain the role of hormones in animal development.	**K3**
CO - 4	analyze the different stages of embryonic development and the genetic control mechanisms involved.	**K4**
CO - 5	critically evaluate ethical issues associated with cryopreservation in mammalian reproduction.	**K5**
CO - 6	design and propose experiments related to biochemical changes during regeneration or cryopreservation techniques.	**K6**

. **K1**- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	Contents	No. of Hours
I	Pattern of animal development: Chief events in animal development. Gametogenesis: Origin of germ cells, spermatogenesis - sperm morphology in relation to the type of fertilization, oogenesis - oogenesis in insects and amphibians; composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians.	18
II	Fertilization:Sperm aggregation, sperm activation, chemotaxis, sperm maturation and capacitation in mammals, acrosome reaction. sperm – egg interaction. Sperm entry into the egg - egg activation -intracellular calcium release - cortical reaction - physiological polyspermy - fusion of male and female pronuclei - post fertilization metabolic activation – parthenogenesis.	18

III	Cleavage and gastrulation:Pattern of embryonic cleavage, mechanisms of cleavage – Gastrulation - morphogenic movements - gastrulation in respective animal embryos (Sea urchin, Amphibians, Mammals); Fate maps - (Amphibian and Chick),Epigenesis and preformation – Formation of primary germ layers	18
IV	Embryonic Development; Embryonic development of fish and birds, formation of extra embryonic membranes in mammal –Formation and migration of neural crest cells - types of neural crest cells - primary and secondary neurulation. Organogenesis (mammal): Development of ectodermal derivatives (nervous system). endodermal (digestive system), mesodermal (circulator system). Gene and development: Anterior- posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes	18
V	Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Types of regeneration, Regeneration in planaria and frog - Regenerative ability in different animal groups. Factors stimulating regeneration. – Aging and senescence: Biology of senescence- cause of aging- mechanism involved in apoptosis. Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation	18

Self-study	Spermatogenesis**,** Oogenesis in amphibians, parthenogenesis, Fate maps, Regenerative ability in different animal groups..

Textbooks

1. Gilbert. S. F. 2006. *Developmental Biology*, 8th Edition, INC Publishers, USA
2. Balinsky, B. I. 1981. *Introduction to Embryology*. (5th Edition), CBS College Publishers, New York.

Reference books

1. Tyler, M.S, 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA.
2. Subramoniam, T, 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India.
3. Slack J.M.W, 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA.
4. Mari-Beffa, M. and J. Knight, 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK.
5. Lewis Wolpert, Cheryll Tickle, Alfonso Martinez Arias, 2019. *Principles of Development*. Sixth Edition. Oxford University Press, USA.

Web resources

1. https://www.easybiologyclass.com/tag/developmental-biology/
2. www.studocu.com › document › lecture-notes › view
3. ocw.mit.edu › courses › 7-22-developmental-biology-f.
4. https://learninglink.oup.com/access/barresi-12e

5. https://www.khanacademy.org/science/biology/developmental-biology

MAPPING WITH PROGRAMME OUTCOMES

PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PO7
CO1	3	2	1	3	2	3	3	3	2	3	2	2
CO2	3	1	1	3	2	3	3	3	2	2	3	2
CO3	3	2	1	2	2	2	2	2	3	2	2	2
CO4	3	1	1	3	1	3	3	3	3	3	3	2
CO5	3	2	1	2	3	3	2	3	2	2	2	2
Total	15	8	5	13	10	14	13	14	12	12	12	10
Average	3	1.6	1	2.6	2	2.8	2.6	2.8	2.4	2.4	2.4	2

3 - Strong; 2 - Medium; 1 - Low

SEMESTER II

CORE LAB COURSE II: LAB COURSE IN CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hrs	Marks		
								CIA	External	Total
ZP232CP1	**-**	**-**	**4**	**-**	**2**	**4**	**60**	**25**	**75**	**100**

Pre-requisite

Students should have acquired basic knowledge relevant to this lab course.

Learning Objectives

1. To demonstrate significant cellular, molecular biological principles into practical understanding.
2. To gain theoretical knowledge and hands-on skills in developmental biology.

Course Outcomes

1.	recall the principles of using a micrometer for cell size determination and the stages of mitosis & meiosis and their characteristics.	**K1**
2.	comprehend the steps involved in preparing blood smears and mounting the muscle fibers using microscopy.	**K2**
3.	develop handling - skills through the wet-lab course.	**K3**
4.	interpret observations & make connections between reproductive processes and the ecological context of the organisms studied	**K4**
5.	evaluate and compare different developmental stages in chick embryos.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate;

Cell and Molecular Biology

1. Determination of cell size using micrometer.
2. Identification of Mitotic stages in onion root tips.
3. Identification of various stages of meiosis in the testes of grasshopper.
4. Observation of polytene chromosome in salivary gland cells of Chironomus larva.

5. Detection of sex chromatin in squamous epithelium.
6. Identification of blood cells in the haemolymph of the cockroach.
7. Identification of blood cells in human blood.
8. Mounting of the coxal striated muscle fibers of cockroach.
9. Observationofadipocytes-fatbodyofcockroach.
10. Isolation of total RNA from bacterial cells/ tissues. (Demonstration)

Spotters:

Fluidmosaicmodel,Golgicomplex,Cancercell,Cadherins,Karyotype,Haemocytometer.

Developmental Biology

Gametogenesis - Observation of gametes from gonadal tissue sections

1. **Oogenesis:**Section through ovary of shrimp, fish, frog and mammals
2. **Spermatogenesi**s: Section through testis of shrimp, fish, calottes and mammals.
3. **Fertilization**: Induced spawning in fish.
4. **Embryogenesis**: Observation and whole mount preparation of the
   i. Chick blastoderm - 18 hours of development
   ii. Chick embryonic stage - 24 hours of development
   iii. Chick embryonic stage - 48 hours of development
   iv. Chick embryonic stage - 72 hours of development
   v. Chick embryonic stage - 96 hours of development
5. **Histological observation:** Section through various developmental stages in chick embryo
6. **Experimental Embryology:** Regeneration in Frog Tadpoles - Blastema formation.
7. **Metamorphosis:** Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine
8. **Cryopreservation:** Demonstration of cryopreservation of gametes of fin fish/shell fish

Reference books:

1. Renu Gupta, SeemaMakhija, Dr. Ravi Toteja, 2018. *Cell Biology : Practical Manual*. Prestige Publishers, Idia.
2. MamtaVerma, 2023. Practical Book Cell Biology &Cytogenetics Lab. Krishna Prakashan Media (P) Ltd., Idia.
3. Wilt, F.H. and N.K. Wessel, 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
4. Slack J.M.W, 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
5. Mari-Beffa, M. and J. Knight, 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	3	2	3	3	2	3	2
CO2	3	1	1	3	2	3	2	3	3	2	2	3
CO3	3	2	1	2	2	2	2	2	2	3	2	2
CO4	3	1	1	3	1	3	2	3	3	3	3	3
CO5	3	2	1	2	3	3	2	2	3	2	2	2
Total	15	8	5	13	10	14	10	13	14	12	12	12
Average	3	1.6	1	2.6	2	2.8	2	2.6	2.8	2.4	2.4	2.4

3 - Strong; 2 - Medium; 1 - Low

SEMESTER II

ELECTIVE COURSE III: a) ECONOMIC ENTOMOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP232EC1	2	1		1	3	4	60	25	75	100

Pre-requisite

Basic background in biological sciences with a special emphasis on the study of insects.

Learning Objectives

1. Develop the ability to identify and classify insects into major orders and understand their economic importance.
2. Acquire practical skills in observing and documenting the life cycles and behaviors of beneficial and destructive insects.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the features of various insect orders and describe the life history, social organization, and management practices of insects.	**K1**
2.	understand the biology of insects associated with medical, household, and veterinary/public health importance.	**K2**
3.	apply their knowledge of pest biology to assess damage and beneficial insect life cycles to practical rearing.	**K3**
4.	analyze the causes of pest outbreaks and the economic threshold levels.	**K4**
5.	synthesize knowledge to propose effective control measures for vectors associated with medical, household, and veterinary/public health importance.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate;

Unit	Contents	No. of hours
I	Overview of insects and insect taxonomy:Insects and their biological success - Man and insects;SalientfeaturesofClassInsectaandorders-Orthoptera,Isoptera,Hemiptera, Diptera, Coleoptera, Lepidoptera, Dermaptera, Odonata, Neuroptera andHymenoptera. Basic concepts in Insect Taxonomy and classification.	12
II	Beneficial insects:Silkworms - types, life cycle of *Bombyxmori*, diseases and its management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects - life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.	12
III	Destructive insects:Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.	12
IV	Pest management/Control strategies:Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control- Development and uses of pest	12

	resistant plant varieties - Integrated pest management - Concepts and practice.	
V	Vector biology:Stable fly and cattle fly; Fowl - shaft louse and chickenflea; sheep and goat - head maggot and sheep ked. Insects associated with medicalimportanceandmanagement-headlouse *Pediculushumanuscapitis*,mosquitoes-*Anopheles, Culex, Aedes*, flea – *Xenopsyllacheopis*, eye fly, sand fly, ticks, mites andbedbug.Insectsassociatedwithhouseholdinsects-cockroaches,termitesandsilverfish. Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures.	12

Self-study	Types of honey bees, Pest of Paddy, Natural control of pest.

Textbooks

1. Ayyar, L.V. R, 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi.
2. Vasantharaj David, B. and V.V. Ramamurthy, 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York.
3. Ross. H.H. 195. A Text Book of Entomology, John Wiley & Sons Inc., New York.

Reference Books

1. Chapman, R.F., S.J. Simpson and A.E. Douglas, 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, Lodo.
2. Daly, H.V., J.T. Doyen and P.R. Ehrlich, 1978. Introduction to Insect Biology and Diversity. McGraw-Hill Kogakusha Ltd., Tokyo.
3. Hill, D.S, 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York.
4. Krishnaswami. S, 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
5. Mani, M.S, 1982. General Entomology. Oxford & IBH Publishing Co., India.

Web Resources

1. https://egyankosh.ac.in/bitstream/123456789/85342/1/Unit-4.pdf
2. https://www.rlbcau.ac.in/pdf/PGCourse/Entomology/Insect%20Taxonomy%20(APE%20503).pdf
3. https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20sericulture%20upload.pdf
4. https://agritech.tnau.ac.in/farm_enterprises/fe_api_pestanddiseases.html
5. https://cpacollege.ac.in/assets/uploads/1645091697APPLIED_ZOOLOGY_SEM_NOTE_pdf.pdf

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	3	2	3	2	3	3	3
CO2	3	2	3	3	2	3	2	3	3	2	2	3
CO3	2	2	3	3	2	2	2	2	2	3	2	2
CO4	2	2	3	3	2	2	2	2	3	3	3	3
CO5	2	2	3	3	2	2	2	2	2	2	3	3
Total	12	10	15	13	14	12	10	12	12	13	13	14
Average	2.4	2	3	2.6	2.8	2.4	2	2.4	2.4	2.6	2.6	2.8

3 - Strong; 2 - Medium; 1-Low

SEMESTER II

ELECTIVE COURSE III: b) PARASITOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hrs.	Marks		
								CIA	External	Total
ZP232EC2	2	1	-	1	3	4	60	25	75	100

Pre-requisite:

The students with a basic background in biological sciences with a special emphasis on the study of parasites.

Course Objectives:

1. To enable the students to be aware of the cosmopolitan distribution of parasites.
2. Develop skills for employment in clinical laboratories and health departments.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	define the basic biology and life cycle of parasites including epidemiology, diagnosis, and treatment.	**K1**
2.	explain morphological characters of parasites, developmental stages and their infestation.	**K2**
3.	identify appropriate techniques and develop basic skills for detection of parasites.	**K3**
4.	analyse the medical and public health aspects of human parasitic infections.	**K4**
5.	compare the diagnostic methods of parasitic infestation in veterinary hospitals, clinics and research laboratories.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit	Contents	No. of hours
1	Taxonomy and classification of parasites - origin and evolution ofparasitism - host parasite relationship, classification of parasites and hosts - transmissionofparasites-Parasiticzoonoses-pathogenesis-clinicalmanifestationsofparasitic diseases.	12

II	Protozoan parasites: Introduction and classification. Intestinal Amoeba – Pathogenic free-living amoeba- Intestinal flagellates-Trypanosomiasis, Leishmaniasis, Balantoidiasis, Malaria,Isosporiasis, *Toxoplasmosis, Cryptosporidiosis, Pneumocystis*.Protozoans of minor medical importance.	12
III	Helminthparasites: *Trichuriasis, Trichinellosis*, Strongyloidiasis, Ascariasis,Enterobiasis,Filariasis,hookwormdiseases,Dracunculiasis,Onchocerciasis,Loiasis, Larvamigrants.Nematodesoflessermedicalimportance-Diphyllobothriasis,Taeniasis,Echinococcosis,Sparganosis,Schistosomiasis,Fasciolopsiasis,Fasciolopsiasis, Paragonimiasis, Clonorchiasis,Trematodes of minor medical importance.	12
IV	**ParasiticInsects**:Prevalence, transmission, and control of parasitic infections.Parasiticinfectioninacompromisedhost.AppliedParasitology - Eosinophilia inparasiticinfections,Nosocomialparasiticinfections. Evasion and parasitic mode oflife - morphological, biochemical, and ethological adaptations. Quality assurance andlaboratorysafety.	12
V	**Diagnostic methods in parasitology**: General rules for microscopical examination.Microscopicalexaminationofblood,stool,urine, sputum and biopsy material forparasites. Culturalexamination-preparationofmedia-techniquesforcultivationof *E. histolytica*, Leishmania, Plasmodium. *Immunodiagnosticmethods* - *IFA, AGD,IHA,IFAT,CFT,DAT,BF,DFAT*.Molecularcharacterizationofstagespecificantigennucleotideprobes for diagnosis of protozoan diseases.	12

Self-study	host parasite relationship, Intestinal Amoeba, Quality assurance andlaboratorysafety, General rules for microscopical examination

Textbooks

1. JayaramPanikerC. K. &SougataGhosh, 2013. Paniker's Textbook of Medical Parasitology. Jaypee Brothers Medical Publishers, Maharastra, India.
2. Rajesh Karyakarte&AjitDamle, 2008. *Medical Parasitology* (2nded.). BooksandAllied (P) Ltd., Kolkata.

ReferenceBooks

1. IchhpujaniR.L.&RajeshBhatia, 2002.*MedicalParasitology*. Jaypee printers. NewDelhi
2. Patvaik,B.D, 2001.*ParasiticInsects*.Delhi:DominantPublishersandDistributors.
3. Jones, A.W, 1976. *Introduction to Parasitology*.: Addison -Wesley PublishingCompany. Boston, USA
4. Subah,C.P,2001.*TextbookofMedicalParasitology*:AllPublishers and Distributors.Chennai.
5. Elizabeth Zeibig, 2012. *Clinical Parasitology: A Practical Approach*. 2nd Edition. Saunders, United States.

Web Resources

1. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/medicalparasitology.pdf
2. https://www.amboss.com/us/knowledge/general-parasitology/
3. https://www.jaypeedigital.com/eReader/chapter/9789352704804/ch1
4. https://www.physio-pedia.com/Parasitic_Infections
5. https://www.mdpi.com/2414-6366/7/10/253

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	3	2	3	2	3	3	3
CO2	3	2	3	3	2	3	2	3	3	2	2	3
CO3	2	2	3	3	2	2	2	2	2	3	2	2
CO4	2	2	3	3	2	2	2	2	3	3	3	3
CO5	2	2	3	3	2	2	2	2	2	2	3	3
Total	12	10	15	13	14	12	10	12	12	13	13	14
Average	2.4	2	3	2.6	2.8	2.4	2	2.4	2.4	2.6	2.6	2.8

3 - Strong; 2 - Medium; 1-Low

SEMESTER II
ELECTIVE COURSE III: c) AGROCHEMICALS AND PEST MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hrs.	Marks		
								CIA	External	Total
ZP232EC3	**2**	**1**		**1**	**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisite

The students with a basic background in biological sciences with a special emphasis on the study of fertilizers and insects' pests.

Learning Objectives

1. To enable the students to be aware of the various types of biological pesticides and their uses.
2. Able to control Pest and about their selective mode of action. It also gives an account of eco-friendlybiological pesticides.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	outline agrochemicals, their modes of action and their fate in the agro-ecosystem.	**K1**
2.	recognize pesticide families based on their specific modes of activity.	**K2**
3.	apply appropriate pesticide management strategies by evaluating specific pest type.	**K3**

4.	analyze the impact of agrochemicals and pesticides for effective pest management.	**K4**
5.	evaluate the efficacy of organic manures, chemical fertilizers, conventional pesticides and bio-pesticides for agronomical practices.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit	Contents	No. of hours
I	Definition, classification, morphology, and internal systems; Plant pests – weeds, bacteria, fungi, Viruses, nematodes, molluscs, Arthropods, birds, mammals etc.; Causes of outbreak of pest, growth and development; Classification based on nature of damage: Public health pests, Agricultural pests, Domestic pests, Animal husbandry pests, Structural pests.	12
II	Manures: types, composition and value, sources of manures, Compost-Different composting technologies-Mechanical compost. plants-Vermicomposting- Green Manures - Oil cakes, Sewage Sludge-Biogas plant slurry.	12
III	Chemical fertilizers: Classification and value. N- fertilizers: Manufacturing of Ammonium Sulphate, Ammonium Chloride, Ammonium Nitrate and urea; P- fertilizers: sources, processing rock phosphate, bones for bone meal preparation; K- fertilizers: sources, Potassium Chloride, Potassium Sulphate and Potassium Nitrate; Biofertilizers: Classification and value; *viz*., *Rhizobium*, *Azotobacters*, *Azolla*, Blue Green Algae, VAM	12
IV	Conventional chemicals/ pesticides based on target species: Acaricides, Fungicides, Rodenticides, Nematicides, Molluscicides, Fumigants and Repellents; Based on chemical nature: Organophosphates; Organochlorines, Carbamates etc.; Structure, chemical name, physical and chemical properties; Mode of action, uses, toxicity; Application of Pesticides, devices used; dose estimation for field application.	12
V	Potential pesticidal plants; Plant extracts and Bio-organisms: Azadirachtin and its role in pest control; Other biopesticides: Pyrethrins, Pyrethroids, Rotenone, Nicotine and Nicotinoids. Growth inhibitors or physiological antagonists, chemo-sterilant; pheromones and attractants; Insect growth regulators, juvenile hormones, moulting hormones; BT methodology, genetically modified and transgenic plants	12

Textbooks

1. Sathe, T. V. 2008. *Agrochemicals and Pest Management.*Daya Publishing House, New Delhi.
2. Patil, T. V. Sathe. 2003. *Insect Predators and Pest Management*. Daya Publishing House, New Delhi.

Reference books

1. Dent, D, 2000. *Insect pest management.* 2nd edition. CAB International. E-pdf.

2. Roberts, D.A, 1978. Fundamentals of Plant Pest Control. First Edition. W. H. Freeman.
3. Koul, O. and Dhaliwal, G.S, 2003. Phytochemical Biopesticides, Harwood Academic Publishers,Amsterdam.
4. Pedigo, L.P, 1996. Entomology and pest management, Prentice Hall, N. Delhi.

Web Resources

1. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/165/5582/et/35%20script200306101003033939.pdf
2. https://byjus.com/biology/effects-of-agrochemicals/
3. https://www.vedantu.com/biology/agrochemicals
4. https://www.gov.nl.ca/ecc/files/env-protection-pesticides-business-manuals-applic-chapter7.pdf
5. https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Lecture-Notes-IPDM.pdf

MAPPING WITH MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	2	3	3	2	3	3	3
CO2	3	2	3	3	2	2	2	3	3	2	2	3
CO3	3	2	3	3	2	2	2	2	2	3	2	2
CO4	3	2	3	3	2	2	2	2	3	3	3	3
CO5	3	2	3	3	2	2	2	2	2	2	3	3
Total	15	10	15	15	10	10	10	12	12	13	13	14
Average	3	2	3	3	2	2	2	2.4	2.4	2.6	2.6	2.8

3 - Strong; 2 - Medium; 1-Low

SEMESTER II
ELECTIVE COURSE IV: a) RESEARCH METHODOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232EC4	**2**	**1**		**1**	**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisite

Students should have a good understanding of the fundamental methods used in experimental biology.

Learning Objectives

1. To impart knowledge on the basic principle, methodologies and applications of instruments in biological sciences.
2. Develop essential research skills to operate and apply various biological science instruments.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the principles of laboratory equipment's, research techniques and the process of scientific report writing.	**K1**
2.	Explain the procedures involved in operating laboratory equipment, applying research techniques, and engaging in scientific writing.	**K2**
3.	apply biological techniques in laboratory settings to gain practical experience in research processes and scientific report writing.	**K3**
4.	analyze the principles and techniques to make wise choices in experimental design, data interpretation, and research reports in biological sciences.	**K4**
5	evaluate the quality, reliability, and limitations of data generated by research techniques and obtained from literature for specific research goals.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyze; **K5** - Evaluate

Units	Contents	No. of hours
I	Analytical Techniques: Good laboratory practice (GLP), pH meter, Colorimeter, Spectrophotometer - UV-Visible, Atomic Absorption, Flame photometer, FTIR spectrometry.	12
II	Microscopy & Micro technique: Principle, Working mechanism and applications of Bright field, Phase contrast, Electron, Confocal Microscope and Atomic force microscope. Histology – Fixation, Sectioning and Staining. Histochemistry for carbohydrates, proteins, lipids.	12
III	Separation Techniques: Centrifugation – Differential and Density gradient, types and applications of Centrifuges. Chromatography - Principle, HPLC and Affinity chromatography, GAS Chromatography Mass Spectrometry. Electrophoresis - Principle, Agarose gel electrophoresis and PAGE.	12
IV	Tracer techniques: Radioactive isotopes, Radiolabeling, Radiocarbon dating,Radio activity counters - Scintillation Counter, Geiger Muller Counter.	12
V	Scientific Writing: Essential steps in research, Review of literature, Literature citation, Research report – Abstract, Tables - Figures - Formatting and typing, Open access journals, Predatory journals, Impact factor, Citation index, H-index, Plagiarism, Copy Right.	12

Self-study	Principle, Working mechanism and applications of Electron and Phase contrast Microscope, Centrifugation - Principle, types and applications of Centrifuges, Bioinstrumentation of pH meter, Colorimeter, and UV-Visible Spectrophotometer, Quantification of carbohydrate, protein, lipid, Essential steps in research.

Textbooks

1. Veerakumari. L, 2006.*Bioinstrumentation*.MJP Publishers.Triplicane, Chennai.
2. Gurumani. N, 2006.*Research Methodology for Biological Sciences*.MJP Publishers.Triplicane, Chennai

Reference Books

1. Marimuthu. R, 2008.*Microscopy and Microtechnique*.MJP Publishers.Chennai.

2. Keith Wilson and John Walker, 2018. *Principles and Techniques of Practical Biochemistry* (8th ed.). Cambridge University Press. India.
3. Pranav Kumar, 2018. *Fundamentals and Techniques of Biophysics and Molecular Biology*.Pathfinder publication. India.
4. Paneerselvam R, 2016. *Research Methodology.*PHI Learning Pvt. Ltd. India.
5. Gurumani N, 2010.*Scientific thesis writing and paper presentation*. MJP Publishers. Chennai

Web Resources

1. https://en.wikipedia.org/wiki/Microtechnique
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206469/
3. https://www.vedantu.com/physics/spectroscopy
4. https://en.wikipedia.org/wiki/Blot_(biology)
5. https://en.wikipedia.org/wiki/List_of_research_methods_in_biology

MAPPING WITH PROGRAMME OUTCOMES
MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	3	2	3	3	2	3	2
CO2	3	1	1	3	2	3	2	3	3	2	2	3
CO3	3	2	1	2	2	2	2	2	2	3	2	2
CO4	3	1	1	3	1	3	2	3	3	3	3	3
CO5	3	2	1	2	3	3	2	2	3	2	2	2
Total	15	8	5	13	10	14	10	13	14	12	12	12
Average	3	1.6	1	2.6	2	2.8	2	2.6	2.8	2.4	2.4	2.4

3 -Strong; 2 -Medium; 1 -Low

SEMESTER II

ELECTIVE COURSE IV: b) APICULTURE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
ZP232EC5	**3**	1	-	-	**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisite

Students should be aware of importance of honey bees and their impacts on the ecosystem.

Learning Objectives

1. Impart knowledge on the morphology, life cycle, characteristics of honey bees and bee keeping.
2. Acquired skills to perform bee keeping from managing colonies of bees to harvest honey and other bee related by-products in different setups and as an Entrepreneurial venture.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	understand the morphology, life cycle, characteristics of honey bees and bee keeping.	**K1**
2.	acquire skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.	**K2**
3.	knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.	**K3**
4.	identify of different bee enemies and diseases and control measures and its management	**K4**
5.	evaluate the honey chemical composition of different environment.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4**-Analyze **K5**-Evaluate

Units	Contents	No. of Hours
I	Introduction to Apiculture. Scope and importance. History, classification, types of honey bees - morphology, mouth parts and sting of Honey bees – life cycle of different species and their behavioural patterns. Social organization of bee colony. morphology, mouth parts and sting of Honey bees –	12
II	Bee-keeping system, tools and equipment's needed for bee keeping. Types of bee hives, structure, and functional features. Criteria for site selection for apiculture and factors affecting them. Flora for apiculture – selection of Bees for apiculture, Method of bee keeping.	12
III	Identification and Preventive measures to be taken against pests (The Greater wax moth & Wasps and Hornets) and parasites (trachealmite). Diseases (Nosema disease, Sac-brood disease, European foulbrood disease), and their control measures. Colony collapse disorder and its management.	12
IV	Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom. Harvesting, Processing, Packaging and Marketing of bee products.	12
V	Apiculture industry around the world and Role of Central Bee Research & Training institute in India. Apiculture as an Entrepreneurial venture.	12

Self-study	Introduction to Apiculture. History, classification, types, life Cycle, Tools and equipment's needed for bee keeping, Diseases affecting honey bees and their control measures. Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom.

Text book

1. Singh, D., Singh, D. Pratap. 2006. *A Handbook of Beekeeping*. Agrobios, India.
2. Mishra R.C. 2002. *Perspectives in Indian Apiculture*, Agrobios, India.

Reference Books

1. Dharam P. Abrol, 2019. Beekeeping: A compressive guide to bees and beekeeping. Scientific Publishers. Jodhpur, India.
2. Caron, D.W, 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. United States.
3. Dewey M. Caron, Lawrence John Connor, 2013. Honey Bee Biology and Beekeeping, Revised Hardcover. Wicwas Press. United States.
4. Ross Conrad, Gary Paul Nabhan, 2007. *Natural Beekeeping: Organic Approaches to Modern Apiculture.*Chelsea Green Publishing. United States.
5. Alphonse Avitabile, Jan Propst, 1998. The Beekeeper's Handbook.Comstock Pub. Associates. Cornell University Press.

Web Resources

1. https://www.britannica.com/topic/beekeeping
2. https://nbb.gov.in/pdf/Pests&DiseasesHoneybees&Management.pdf
3. https://www.aakash.ac.in/important-concepts/biology/apiculture-in-indian
4. https://vikaspedia.in/agriculture/farm-based-enterprises/bee-keeping-1/about-bee-keeping
5. https://beebuilt.com/pages/beekeeping-for-beginners

MAPPING WITH PROGRAMME OUTCOMES

PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	2	3	3	2	2	3	2	2
CO2	3	1	2	2	1	3	2	2	2	3	2	2
CO3	3	2	2	2	2	2	1	2	2	3	2	2
CO4	2	3	3	2	2	3	3	2	3	3	2	2
CO5	3	2	3	2	3	2	3	2	3	3	2	2
TOTAL	13	9	12	10	10	13	12	10	12	15	10	10
AVERAGE	2.6	1.8	2.4	2	2	2.6	2.4	2	2.4	3	2	2

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE – IV: c) SERICULTURE

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232EC6	**2**	**1**		**1**	**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisite:

Students should have a fundamental knowledge of biology, an entrepreneurial mindset, and an appreciation for the economic and cultural significance of sericulture.

Learning Objectives:

1. To gain in-depth knowledge of silk fiber types, sources, properties, and the significance of sericulture in India.
2. To develop practical skills in moriculture, silkworm rearing, and cocoon processing.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall and describe the fundamental concepts, terminology, and processes related to sericulture, and sericulture industry practices.	**K1**
2.	demonstrate the key concepts, processes, properties of silk fiber, mulberry cultivation techniques, cocoon characteristics, and the significance of sericulture practices in the silk production industry.	**K2**
3.	apply their knowledge of sericulture principles and practices to solve practical problems and optimizing cocoon processing techniques.	**K3**
4.	critically analyze the challenges and opportunities in the sericulture industryand assess the economic and environmental implications of sericulture practices.	**K4**
5.	evaluate the effectiveness of different sericulture practices, technologies, and policies, and make informed decisions to optimize silk production.	**K5**

K1 -Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit	**Contents**	**No. of hours**
I	Introduction to textile fibers; types - natural and synthetic fibers; sources of silk fiber - Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel; properties and importance of silk fiber.History, development, status, characteristics, and advantages of sericulture in India.	12
II	Host plants; Moriculture - distribution, morphology, propagation- seedling, cutting, grafting, layering and micropropagation methods, maintenance-irrigation, manuring and pruning, pests and diseases of mulberry.	12
III	*Bombyx Mori*- morphology, anatomy, life cycle, geographical locations, larval moults, voltinism, indigenous and commercial races. Diapause. Egg-storage and transportation.	12
IV	Rearing houses and equipment. Rearing operations- disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods- chawki, lasso, showa, shelf-rearing, floor-rearing and shoot rearing. Diseases of *Bombyxmori*- protozoan, bacterial, viral and fungal. Pests of silkworm- Uzi fly, dermestids, mites, ants, nematodes, aves and mammals.	12
V	Physical and commercial characteristics of cocoons. Cocoon harvesting and marketing. Cocoon sorting, stifling, deflossing, riddling, cooking, brushing, reeling and re-reeling. Weaving.By-products of sericulture industry.	12

Self-study	Sources of silk fiber - Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel.

Textbooks

1. Ganga, G and J. SulochanaChetty, 2019. An Introduction to sericulture (2nd edn). Oxford and IBH Pub. Co. Pvt. Ltd., Delhi.
2. Johnson, M. and Kesary, M, 2019. Sericulture. Saras publications, Nagercoil.

Reference Books

1. Food and Agriculture organization 1976. Manual on sericulture I, II & III. Delhi: Oxford and IBH Pub. Co. Pvt. Ltd., Delhi.
2. M.S. Jolly, 1987. Appropriate Sericulture Techniques. CSR & TI, Mysore
3. S.R. Ullal and M.N. Narasimhanna, 1987. Hand book of practical sericulture. CSB, Bangalore.
4. M.N. Narasimhanna, 1988. Manual on silkworm egg production. CSB, Bangalore.
5. Dandin, S.B., Jayaswal, J. and Giridhar. K, 2010. Handbook of sericulture technologies, Central Silk Board, Bangalore, India.

Web Resources

1. https://agritech.tnau.ac.in/sericulture/
2. https://csb.gov.in/
3. https://silks.csb.gov.in/
4. https://www.britannica.com/topic/sericulture
5. https://agritech.tnau.ac.in/sericulture/seri_index.html
6. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/sericulture
7. https://vikaspedia.in/agriculture/farm-based-enterprises/sericulture/sericulture-in-india

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	1	1	1	1	1	2	1	1	3	1	1
CO 2	2	2	1	1	1	1	2	1	1	3	1	1
CO 3	3	2	1	1	1	1	2	1	1	3	1	1
CO 4	3	3	1	1	1	1	2	1	1	3	1	1
CO 5	3	3	1	1	1	1	2	1	1	3	1	1
TOTAL	13	11	5	5	5	5	10	5	5	15	5	5
AVERAGE	2.6	2.2	1	1	1	1	2	1	1	3	1	1

3 – Strong, 2 – Medium, 1 - Low

SEMESTER II

ELECTIVE LAB COURSE -II: ECONOMIC ENTOMOLOGY & RESEARCH METHODOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232EP1	2	1		1	3	2	30	25	75	100

Pre-requisite:

Students should have knowledge relevant to economic entomology & research methodology.

Learning Objectives:

1. To equip students with skills in both the practical aspects of economic entomology and the essential research methodology.
2. To acquire skills necessary for conducting meaningful studies in these field.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	comprehend the principles and concepts of economic entomology & research methodology.	**K1**
2.	summarize the economic impact of insect pests. explain the principles behind different techniques& research designs	**K2**
3.	utilize appropriate methodologies to collect and analyze data of insects and apply statistical techniques to interpret and draw conclusions.	**K3**
4.	interpret practical solutions to address challenges in economic entomology, incorporating research methodology principles.	**K4**
5.	evaluate research methodologies and experimental designs used in economic entomology studies.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate;

Economic Entomology

1. Collect and identify common insect pests in your local environment.
2. Dissection: Silk glands of silkworm.
3. Mounting: Mouth parts of honey bee. Mosquito.
4. Phototactic behavior of insect pests.
5. Collection and Identification of insect pests in the mulberry plants.

Specimen/Spotters/Models: Silk worm larva, pupa and adult, honey bee colony, Rhinoceros beetle, Red Palm Weevil, Banana Stem Weevil.

Research Methodology

1. Whole mount preparation of two specimens.
2. Separation of amino acids using thin layer chromatography.
3. Sectioning and staining of a tissue.
4. Separation of pigments by column chromatography using plant extract (Demonstration).
5. Agarose Gel electrophoresis (Demonstration).

Instruments/ Charts/ Models: Phase contrast microscope, fluorescent microscope, spectrophotometer, HPLC, flame photometer, microtome, electrophoretic apparatus.

Textbooks

1. Bajia, R., R.N. Kencharaddi, B. Bairwa, K. Kumar, V. Kumar. *Practical handbook on fundamentals of entomology.* Second edition. Kalyani Publishers.Chennai.
2. Gurumani N, 2019. *Research Methodology: For Biological Sciences.* Kindle Edition. Chennai.

Reference Books

1. Trigunayat, M.M, 2016. *A Manual of Practical Entomology*. 3rd Ed. Scientific Publishers. Jodhpur, Rajasthan.
2. Agrawal, N, 2022. *Fundamental Entomology: A Practical Manual*. Narendra Publishing House, New Delhi.
3. Ch Raja Goud, 2022. *Practical Manual on Fundamentals of Entomology*. Om Publishers. New Delhi
4. VinayakBairagi&MousamiVaibhavMunot, 2019. *Research Methodology: A Practical and Scientific Approach*. CRC press. Florida, United States.
5. Catherine Dawson, 2002. *Practical Research Methods*: *A User-Friendly Guide to Mastering Research Techniques and Projects*. Ubs Publishers' Distributors Pvt.Ltd.Ernakulam, Kerala.

Web Resources

1. https://www.researchgate.net/publication/327282644_A_Textbook_of_Economic_Entomology_M_Dayib
2. https://academic-accelerator.com/encyclopedia/economic-entomology
3. https://books.google.co.in/books?id=z2s6nQAACAAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
4. https://jru.edu.in/studentcorner/labmanual/agriculture/Insect%20morphology%20and%20%20systematics.pdf
5. https://www.scribbr.com/dissertation/methodology/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	1	1	1	1	1	1	2	1	1	2	1	1
CO 2	1	1	1	1	1	1	2	1	1	2	2	1
CO 3	2	1	1	1	2	1	2	1	1	3	2	2
CO 4	3	2	2	2	1	3	2	1	1	3	1	3
CO 5	3	2	2	3	3	1	2	1	2	3	3	3
TOTAL	10	7	7	8	5	7	10	5	6	13	9	10
AVERAGE	2.6	2.2	2.2	2.4	1.4	2.2	2	1.4	1.6	2.4	1.8	2.6

3 – Strong, 2 – Medium, 1 - LowSS

SEMESTER II

SKILL ENHANCEMENT COURSE I: POULTRY FARMING

Course Code	L	T	P	S	Credits	Inst. Hours	Total hours	Marks		
								CIA	External	Total
ZP232SE1	2	1		1	2	4	60	25	75	100

Pre-requisite

Students should be aware of economic and cultural importance of Poultry farming**.**

Learning Objectives:

1. To know the needs for Poultry farming and the status of India in global market.
2. Acquire the skills to apply the techniques and practices needed or Poultry farming.

Course Outcomes:

On the successful completion of the course, students will be able to:		
1.	recall the key components of a poultry house to ensure optimal living conditions for poultry.	**K1**
2.	explain the different methods of rearing and the significance of proper vaccination programs in poultry farming.	**K2**
3.	develop a practical feeding plan for a specific stage of poultry considering their nutritional requirements.	**K3**
4.	analyze the impact of different housing systems on poultry welfare and productivity,	**K4**
5.	critically assess the effectiveness of poultry feeds and the disease control measures in poultry farming,	**K5**
6.	design a comprehensive waste management and recycling system for poultry farms.	**K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Unit	Contents	No. of hours
I	General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming	12
II	Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.	12
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.	12
IV	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.	12
V	Selection, care and handling of hatching eggs - Egg testing. Methods of hatching. - Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.	12

Text Books

1. Sreenivasaiah., P. V, 2015. *Textbook of Poultry Science*. 1st Edition. Write & Print Publications, New Delhi.
2. Jull A. Morley, 2007. *Successful Poultry Management*. 2nd Edition. Biotech Books, New Delhi.
3.

Reference Books

1. Jadhav, J, Siddique, M.F., KavithaMeena, 2019. *Handbook of Poultry Production and Management*. 3rd Edition.Jaypee Brothers Medical Publishers, Chennai.
2. Jagdish Prasad, 2015. *Poultry Production and Management Paperback – 1*. 5h EditionKalyani Publishers, Chennai.
3. Das, D, 2021. *Textbook on Poultry Management.*Narendra Publishing House, New Delhi.
4. Eiri Board, 2008. *Hand Book of Poultry Farming and Feed Formulations*. Engineers India Research Institute. India.
5. Sharma R P et al. *Poultry Production in India*. Poultry Science, India.

Web Resources

1. https://dahd.nic.in/sites/default/filess/Excerpts%20of%20Poultry%20Farmn%20Manual.pdf
2. https://www.fao.org/3/i3531e/i3531e.pdf
3. https://egyankosh.ac.in/bitstream/123456789/59735/1/Poultry%20farming%20in%20india.pdf
4. https://seyianwo.files.wordpress.com/2015/04/poultry-lecture-note.pdf
5. https://surendranathcollege.ac.in/new/upload/SUMAN_TAMANGPoultry%20Farming2021-02-14Poultry%20Farming-converted.pdf

.MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	1	2	1	2	2	2	2	1	1	3	3	3
CO2	1	1	2	3	1	2	2	1	2	2	1	2
CO3	2	1	2	2	1	3	2	1	2	2	2	2
CO4	3	2	1	2	1	2	1	2	2	1	1	1
CO5	1	2	2	2	2	2	3	2	3	2	2	3
CO6	2	3	3	2	3	3	3	3	2	3	2	2
Total	13	11	11	14	10	14	13	10	12	13	11	13
Average	2.1	1.8	1.8	2.3	1.6	2.3	2.1	1.6	2	2.1	1.8	2.1

3 - Strong; 2 - Medium; 1-Low

	*Content addressed Gender
	*Content addressed Environment Sustainability
	*Content addressed Human Values
	*Content addressed Professional Ethics
	*Content addressed Indian Knowledge System