SNDT Women's University, Mumbai

Bachelor Of Science
(Zoology)

B.Sc. In Zoology

As Per NEP – 2020

Semester – III & IV

Syllabus

(WEF. 2025-2026)

Structure with Course Titles

SN	Courses	Type of Course	Credits	Marks	Int	Ext
Semester III						
30132411	**Study of Non-chordates**	Major (Core)	4	100	50	50
30132412	**Genetics -I**	Major (Core)	4	100	50	50
30132413	**Applied Zoology - I**	Major (Core)	4	100	50	50
30332411	**Useful & Harmful Insects**	Minor stream	2	50	0	50
30432411	**Animal behaviour**	OEC	2	50	0	50
		AEC	2	50	50	0
31332401		FP	2	50	50	0
		CC	2	50	50	0
			22	**550**	**300**	**250**
SN	**Courses**	**Type of Course**	**Credits**	**Marks**	**Int**	**Ext**
Semester IV						
40132411	**Study of Chordates**	Major (Core)	4	100	50	50
40132412	**Genetics - II**	Major (Core)	4	100	50	50
40132413	**Applied Zoology - II**	Major (Core)	4	100	50	50
40432411	**Human Parasitic Diseases**	OEC	2	50	0	50
40732411	**Pet Care**	SEC	2	50	0	50
		AEC	2	50	0	50
41732401		CEP	2	50	50	0
		CC	2	50	50	0
			22	**550**	**250**	**300**

Exit with UG Diploma with 10 extra credits (44 + 10 credits)

Course Syllabus

Semester III

3.1 Major (Core)

Course Title	**Study of Non-chordates**
Course Credits	**4 (2 Theory + 2 Practicals)**
Course Outcomes	After going through the course, learners will be able to
	1. Relate the characteristic features of invertebrate phyla with their levels of organizations
	2. Interpret phylogenic relationships between the invertebrate phyla
	3. Identify the animals based on their observations of the external characteristics
	4. Perform experiments based on temporary mountings
	5. Prepare field report based on observations done during field excursions
Module 1(Credit 1) : General organization of Phylum Protozoa to Nematoda	
Learning Outcomes	After learning the module, learners will be able to
	1. Differentiate between the various levels of body wall and coelom organization
	2. Evaluate the development of organ systems across phylum Protozoa to Nematoda
Content Outline	General organization of: ● Unicellular organization Kingdom Protista - Phylum Protozoa ● Multicellular organization: ○ Colonization level - Phylum Porifera ○ Division of labour – Phylum Cnidaria ● Triploblastic acoelomate and pseudocoelomate organization ○ Acoelomate organization – Phylum Platyhelminthes • Pseudocoelomate organization – Phylum Nematoda
Module 2(Credit 1) : General organization of Phylum Annelida to Phylum Echinodermata	
Learning Outcomes	After learning the module, learners will be able to :
	1. Evaluate the development of organ systems across phylum Annelida to Echinodermata

	2. Interpret the phylogenic relationship between the invertebrate coelomates

Content Outline	● Triploblastic Coelomate organization ○ Animals with metameric segmentation: Phylum Annelida ○ Animals with jointed appendages: Phylum Arthropoda ○ Animals with mantle: Phylum Mollusca ○ Animals with enterocoel: Phylum Echinodermata ● General organization of Phylum Hemichordata
PRACTICAL COURSE: (2 Credits)	
Learning Outcomes	After learning the module, learners will be able to:
	1. Identify the invertebrate animals from their external characters
	2. Perform temporary mounting for observations and hands on experiments
	3. Sketch and label specific body structures of animals
	4. Prepare report based on field study

Content Outline	● Classification of Phylum: ○ Protozoa: *Amoeba, Euglena, Paramoecium, Plasmodium* ○ Porifera: *Leucosolenia, Euplectella*, *Euspongia* ○ Phylum Cnidaria: *Hydra*, *Obelia* colony, *Aurelia, Adamsia, Fungia, Madrepora* ○ Phylum Platyhelminthes: *Planaria*, Liver fluke, Tapeworm ○ Phylum Nematoda: *Ascaris* - male and female ○ Phylum Annelida: *Nereis*, Earthworm, Leech ○ Phylum Arthropoda: Crab, Lobster, *Lepisma*, Beetle, Dragonfly, Butterfly, Spider, Tick, Scorpion, Centipede, Millipede ○ Phylum Mollusca:Chaetoderma, Neopilina, *Chiton, Dentalium, Pila, Unio, Sepia, Nautilus* ○ Phylum Echinodermata: Starfish, Brittle star, Feather star, Sea urchin, Sea cucumber ○ Phylum Hemichordata : *Balanoglossus* ● Mounting of foraminiferan shells ● Observation of food vacuole and contractile vacuole in

	paramecium from live culture ● Mounting of Setae from Earthworm ● Study of locomotory appendages of arthropods : Leg of cockroach, appendages of prawn, wings of insects ● Types of metamorphosis in insects - Ametabolous (Lepisma), Hemimetabolous (Cockroach), Holometabolous (Butterfly) ● Types of crustacean larvae ● Study of different types of shell in Mollusca ● Study of modification of foot in mollusca ● Types of echinoderm larvae ● Study trip to local zoo / national park / aquarium / coastline / biodiversity park and submission of report.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Documentation using photography - biodiversity in and around the local vicinity / campus or videography (self-made videos uploaded on social media)
2. Padlet activity – Designing Infographics on topics related to the syllabus and uploading them on Padlet for collaborative learning
3. Submission of field report based on actual study trip or virtual.

Note: Rubrics to be developed for subjective type of assessment

References:

1. Invertebrate Zoology - E. L. Jordan and P. S. Verma. Reprint Edition, 2015. S. Chand and Co.
2. A Textbook of Invertebrate Zoology: Vol. I. - T. C. Majupuria. 1st edition, 1962- , S. Nagin and Co.
3. Invertebrate Zoology - P. S. Dhami and J. K. Dhami, 1st Edition, 1979. R. Chand and Co.
4. Zoology - S. A. Miller and J. B. Harley, 8th Edition, 2009. Tata McGraw Hill

5. Modern Textbook of Zoology - R. L. Kotpal. Reprint Edition, 2012. Rastogi Publications.
6. A Textbook of Zoology, Invertebrates. Vol. I - T. J. Parker and W. A. Haswell. 1st Indian Edition, 1992.-CBS Publishers and Distributors Pvt. Ltd.
7. An Introduction to the Invertebrates - Janet Moore. 2nd Edition, 2006. Cambridge University Press.

3.2 Major (Core)

Course Title	**Genetics – I**
Course Credits	**4 (2 Theory + 2 Practicals)**
Course Outcomes	After going through the course, learners will be able to :
	1. Understand the basic concepts of inheritance
	2. Solve the case specific crosses of inheritance
	3. Relate the inheritance of various characteristics with mendelian genetics and its exceptions
	4. Identify and predict the various patterns of inheritance
	5. Perform experiments based on the concepts of genetics
Module 1(Credit 1) : Introduction to Mendelian inheritance	
Learning Outcomes	After learning the module, learners will be able to :
	1. Understand the basic concepts of inheritance
	2. Relate the inheritance of various characteristics with mendelian genetics and its exceptions
Content Outline	• Introduction to Genetics o Definition, Scope and Importance of Genetics o Classical and Modern concept of Gene o Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome • Mendelian Genetics o Mendelian Genetics: Mendel's Laws of Inheritance, Monohybrid & Dihybrid Cross, o Test Cross, Back Cross, Reciprocal cross, significance o Mendelian Traits in humans • Exceptions to Mendelian inheritance o Incomplete dominance and Co- dominance, o Lethal Genes - Dominant, recessive and intermediate o Epistasis - Recessive, Double recessive, Dominant and Double dominant • Cytoplasmic inheritance: Kappa particles in Paramecium, Shell coiling in Snails
Module 2(Credit 1) : Human Genetics	
Learning Outcomes	After learning the module, learners will be able to:
	1. Identify and predict the various patterns of inheritance

	2. Interpret the genetic basis for the various types of inheritance
Content Outline	• Pedigree Analysis: Autosomal dominant and recessive, X- linked dominant and recessive • Genetic Counselling: Risk of recurrence of hereditary diseases, causes and significance of genetic counseling. • Mendelian genetics in humans: • Autosomal Dominant inheritance: Huntington's chorea disorder, • Autosomal recessive inheritance: Harlequin-type Ichthyosis • X-linked recessive inheritance: Duchenne muscular dystrophy, • X-linked Dominant inheritance: Rett Syndrome. • Chromosomal Abberations: - - Numerical abnormality: Monosomy – Turner Syndrome; Tetrasomy/Trisomy – Down Syndrome.
PRACTICAL COURSE: (2 Credits)	
Learning Outcomes	After learning the module, learners will be able to:
	1. Solve the problems based on mendelian genetics
	2. Interpret the genetic basis of the case studies involving a given type of inheritance
	3. Perform experiments based on the concepts of genetics
Content Outline	• Problems in genetics based on Monohybrid cross • Problems in genetics based on Dihybrid cross • Analyzing the pattern of inheritance from the given pedigree chart • Constructing the pedigree chart from the given information • Extraction of DNA • Extraction of RNA • Study of polytene chromosomes • Study of chromosome morphology based on the position of centromeres • Study of karyotypes: Normal, Turner's syndrome, Klinefelter syndrome, Down's syndrome • Application of genetics in forensic science – concept of DNA fingerprinting and problems based on it

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Project on Survey of some hereditary characteristics in human population: Data collection, analysis of the distribution of dominant and recessive traits in a population,

- Experiment based on how the mitotic index is affected due to different environmental conditions. Different seeds / onion / garlic roots grown in normal water as control and different concentrations of test solutions could be observed and mitotic index calculated. Analysis to be done as to how cell division is

  affected. Data to be recorded along with photomicrographs. Report to be submitted.

References:

1. Gardner, E. J., Simmons, M.J. and Snustad, D.P. (2006) *Principles of Genetics*. (8th ed.). John Wiley and Sons.
2. Tamarin R.H. (2001). *Principles of Genetics.* (4th ed.). McGraw-Hill
3. Weaver R.F., Hedrick P.W. (1992). *Genetics* (2nd ed.). W.C. Brown.

3.3 Major (Core)

Course Title	**Applied Zoology – I**
Course Credits	**4 (2 Theory + 2 Practicals)**
Course Outcomes	After going through the course, learners will be able to :
	1. Identify and describe the tools and techniques involved in apiculture and sericulture
	2. Interpret the role of various strategies of pest management
	3. Set up the vermicomposting unit
	4. Analyse the vermicompost soil parameters by performing experiments
	5. Prepare field report based on observations done during field excursions
Module 1(Credit 1) : Economic Entomology	
Learning Outcomes	After learning the module, learners will be able to
	1. Identify and describe the tools and techniques involved in apiculture and sericulture
	2. Interpret the role of various strategies of pest management
Content Outline	• Honeybee – Social life and communication, life history, apiculture, pests, enemies, diseases, commercial importance • Silk moth – Life history, sericulture, Diseases and control measures, economic importance • Life history and control measures of insect pests: Schistocerca gregaria, Aphids, Sitophilus oryzae • Insect Pest Management - Chemical and biological control: • Overview of chemical pesticides- Major classes of chemical pesticides and their mode of action • Biological control agents: Pathogens - Bacteria (Bacillus thuringiensis), Fungi, Viruses, Parasitoids
Module 2(Credit 1) : Vermiculture and Vermicomposting	
Learning Outcomes	After learning the module, learners will be able to :
	1. Demonstrate the process of vermiculture and vermicomposting
	2. Relate the scope of vermicomposting as entrepreneurship

Content Outline	● Earthworm Ecology: ○ Distribution, Habit and habitat, ○ Different species of earthworms useful in vermiculture ○ Role of earthworms in soil ecosystem ● Components of vermicomposting: ○ selection of suitable species of earthworms, ○ substrate and environmental conditions, ○ different models/designs of equipment used in vermicomposting (For small scale and commercial set up), maintenance ○ Enemies of earthworm ○ Harvesting ○ Applications of vermiculture- In aquaculture, poultry, piggery and vermicomposting ○ Benefits of vermicompost , use in agriculture • Vermiwash collection , composition and use
PRACTICAL COURSE: (2 Credits)	
Learning Outcomes	After learning the module, learners will be able to: 1. Identify and describe the tools and techniques involved in apiculture, sericulture and pest management 2. Prepare field report based on observations done during field excursions

Content Outline	• Study of honeybee: - Life cycle - types of legs - sting apparatus - mouthparts • General tools and techniques of apiculture (Study of Bee box) • Study of insect pests: Schistocerca gregaria, Aphids, Sitophilus oryzae, Tribolium confusum • Study of insect control - chemical and biological • Life cycle of silk moth • Identification of various types of earthworm species used for vermiculture • Study of types of vermicomposting set-up • Hands-on vermicomposting (to be carried out by students) • Study of various parameters of vermicompost soil– moisture, pH, organic content of • Field visit to sericulture / apiculture farms and report submission

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Infographics based on the social insects / parasite life cycles
- Project based on testing the efficacy of soil with and without vermicompost added on the growth of plants. Students to record observations w.r.t. the height of the plant, leaf measurements over a month at least. Analyze the data and submit the report
- Submission of field visit report

References:

1. Ahsan J. and Sinha S.P. Prasad () A handbook on Economic Zoology. S. Chand & Co.
2. Hassall K.A. (2013). The Chemistry of Pesticides Their Metabolism, Mode of Action and Uses in Crop Protection. Scientific Publishers, India.
3. Metcalf, C. L., Metcalf R. L. and Flint W. P. (2018) Destructive and Useful Insects. Agri Horti Press.
4. Rahman A. (2017) Apiculture in India. Indian Council of Agricultural Research.
5. Sathe T.V.(2020). Biological Pest Control. Astral Publication.
6. Sehgal P.K. (2018). Textbook of sericulture, apiculture and entomology. Kalyani Publishers.
7. Shukla G.S. and Upadhyay V. B. Economic Zoology. Rastogi Publication.

8. Kale R.D. (1998) Earthworms: Cinderella of organic farming,
   Prism Books Pvt. Ltd. Bangalore
9. Ismail ,S.A. (1997) Vermicology- The Biology of Earthworms, Orient Longman.
10. The complete technology book on Vermiculture and Vermicompost,
    (2010) published by National Institute of Industrial Research, delhi-7,
    India
11. Lekshmy, M.S., Santhi R. (2012) Vermitechnology , Sara Publications, New Delhi, India

3.4 Minor Stream

Course Title	**Useful and harmful insects**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to :
	1. Identify the useful and harmful insects
	2. Describe the life cycle of the insects
	3. Evaluate the economic importance of the insects
	4. Enlist the various control measures for harmful insects
	5. Create the record book / atlas of the insect fauna of the campus
Module 1(Credit 1) : Useful Insects	
Learning Outcomes	After learning the module, learners will be able to :
	1. Describe the useful insects
	2. Identify the stages in life cycle of insects
	3. Interpret the forensic investigations based on insect study
Content Outline	• Honey bee- Structure of bee hive, Life cycle and uses • Silk moth- Life cycle and uses • Lac insect-Life cycle and uses • Insects useful as biocontrol agents- Entomophagous insects- Ladybird beetle, Parasitoid wasps • Insects of forensic importance • Post Mortem Index using insects
Module 2 (Credit 1) : Harmful Insects	
Learning Outcomes	After learning the module, learners will be able to:
	1. Describe the life cycle of common insect pests
	2. Identify the insect pests
	3. Design / Propose the control measures with reference to the insect pests

Content Outline	• Life cycle and damage /disease caused by insect pests and control measures: ○ Common Household insect pests- cockroach, termites ○ Pests of stored grains- Rice weevil, Red Flour Beetle ○ Insects as vectors- Mosquito, Housefly, Rat flea ○ Insects of veterinary importance- Horse fly, Screw worm fly ○ Pests of agriculture- Red cotton bug, Rhinoceros beetle Lemon butterfly ○ Desert locust ○ Aphids

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Documentation using photography (Collection of photos and making the report)
2. Padlet Activity : Preparation Infographics based on the life cycles of insects and upload on Padlet

Note: Rubrics to be developed for subjective type of assessment

References:

1. Modern Entomology- Tembhare, D. B
2. Textbook of applied Entomology Volume I and Volume II- K. P. Srivastava- Kalyani Publishers
3. An Introduction to Sericulture- G. Ganga, J. Sulochana Chetty- Oxford & IBH Publishing Co Pvt Ltd
4. Lac culture in India farm information unit, DEMOFA, New Delhi, S. Krishnaswami
5. Lac culture in India- N. Ghorai. Published by International books & periodicals Supply Service
6. Applied Entomology- Dr. P. G. Fenemore, Dr. Alka Prakash, published by New Age International (P) Ltd.

3.5 OEC

Course Title	**Animal Behaviour**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to :
	1. Analyze and evaluate different types of learned behaviour with examples
	2. Analyze and evaluate different types of innate behaviour with examples
	3. Interpret the significance of different types of animal behaviour from various examples
Module 1(Credit 1) : Learned behaviour	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyze and evaluate different types of learned behaviour with examples 2. Relate the various types of behaviour through everyday life observations
Content Outline	• Definition, History and Scope of Animal Behaviour • Types of Animal behaviour - Innate and Learned behaviour • Learned Behaviour: o Habituation o Sensitization o Imprinting o Classical Conditioning o Operant conditioning o Insight learning
Module 2(Credit 1) : innate & social behaviour	
Learning Outcomes	After learning the module, learners will be able to:
	1. Analyze and evaluate different types of innate behaviour with examples
	2. Interpret the significance of different types of animal behaviour from various examples

Content Outline	• Introduction to innate behaviour
	  ○ Types of innate behaviour
	  a) Fixed Action pattern
	  b) Reflexes
	  c) Taxis
	  d) Instincts
	• Introduction to social behaviour in animals Aggression
	  ○ Schooling in fishes
	  ○ Flocking in birds
	  ○ Herding in mammals
	  ○ Social organization in Insects and Primates

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Project based on observation of a given species in its natural habitat: Select a species to observe in its natural habitat (e.g. dog, cat, birds in a park, squirrels, or insects / spiders) Spend time observing the animal(s) over a period of two weeks. Record different types of behaviors such as feeding, social interactions, territorial behaviors, and grooming. Record your observations in detail, noting the time of day, the animal's surroundings, and any stimuli that might trigger certain behaviors. Compile the findings into a report discussing key observations and linking them to biological principles like survival, adaptation, and communication.

- Study of Animal Communication: Vocalizations and Body Language: Record the bird calls, barking of dogs etc. Analyze the different calls as per the time of the day, and relate them to the body gestures such as flight and perching (birds) or while barking (dogs).

- Mini research project based on how environmental factors like light, temperature, or the presence of other animals affect the behavior of an animal species. Aquarium fish species or zebrafish could be used as model organism and subjected to manipulated environmental factors. Observations could be recorded for 10 minutes, data to be analyzed and report to be submitted with conclusions drawn from the experimental studies.

References:

1. Arora M. (2019). Animal Behaviour. (8th ed.). Himalaya Publications.
2. Eibl-Eibesfeldt, I. (1970). The biology of Behaviour. Ethology. Holt, Rineheart & Winston Publication, New York.
3. Manning A. and Dawkins M.S. (2012). An introduction to Animal Behaviour (6th ed.). Cambridge University Press.
4. McFarland D. (1999). Animal Behaviour Psychobiology, Ethology and Evolution. (3rd ed.). Longman Publication.

5. Vessey S., Jacob E., Vessey S. H. and Drickamer L. C. (2002). Animal Behaviour: Mechanisms, Ecology and Evolution. (5th ed.). McGraw-Hill.

3.7 Field Project

Semester III - Field Project Guidelines as per Zoology BoS Objectives:

1. Combine theoretical knowledge with practical learning experiences, guided by faculty support.

2. Strengthen research abilities, including skills in knowledge discovery, analytical techniques, methodologies, and ethical practices.

3. Promote problem-solving, decision-making, teamwork, and collaborative efforts.

Outcomes:

1. Demonstrate evidence of research aptitude and skills of critical thinking, analytical skills, and ethical research conduct in field work.
2. Display problem-solving abilities in making informed decisions in complex scenarios through practical situations.
3. Work in teams and collaborate to achieve common goals in the work field environments through collaborative efforts.
4. Prepare the presentation and a detailed report based on the research findings.

SOPs for the SY Semester III FIELD PROJECT under NEP

1. The purpose of the Field Project should be to instil the spirit of scientific research amongst the learners.
2. The Field Project will be carried out by the departments providing the Major subject to the learners.
3. The Field Project guidelines & rubrics for the evaluation should be approved by the BoS, followed by the academic council.
4. There will be only internal assessment of 50 marks.
5. A logbook should be maintained by the learner to record day wise observation & be signed by the mentor.
6. The learners can do small projects related to their major subject individually or in groups of not less than five learners in each group.
7. The department must guide the learners to carry out the research & promote the learners towards presentation & publication of the research outcome.
8. Total of 60 hours can be divided into notional hours (for research and writing) and actual hours of Field work. (and maybe a workshop on research and writing).
9. The learners must document & compile their observations to submit a written project report, both individually and as part of the group (if any).

10. The project should be related to the major subject of the learners.
11. Some of the examples of the topics for the Field Project: water audit/energy audit in school, college, apartments, etc, documenting the hatching/nesting behavior of insects/birds in their natural habitats, hydrological parameters of lentic/lotic habitats, seasonal survey of fishes in local markets/landing centres, census of stray dogs/animals in locality, preparing the checklist of birds in eco-habitats, proximate composition of ready-to-eat/fresh products from markets, seasonal measurement of sound pollution, impact of bursting crackers in AQI, measurement of BMI of selected human groups, documentation of the genetic traits in human population, etc.
12. The format for the report should be provided to the learners by the department
13. All staff members of the department should mentor the learners for the projects
14. For external field projects, learners may work on a weekly & public or holiday or the vacation of the earlier semester.
15. The department must put together a report of the project.
16. The department must send in the names of the learners who have completed the project satisfactorily, as well as the report, to the respective Vice Principals, by the last teaching day of the Semester.

Rubrics for FP assessment:

	Criteria for Evaluation			
	Project Design and Planning	**Research methods and data collection**	**Report submission**	**Presentation**
Total Marks Allotted	**10 marks**	**20 marks**	**10 marks**	**10 marks**
	Levels of Evaluation			
	Outstanding	Good	Satisfactory	Needs Improvement
Range of Marks (%)	**80 -100%**	**60 -79%**	**59 – 40%**	**Below 40%**

Semester IV

4.1 Major (Core)

Course Title	**Study of Chordates**
Course Credits	**4 (2 Theory + 2 Practicals)**
Course Outcomes	After going through the course, learners will be able to:
	1. Compare the characteristics between the chordate classes
	2. Interpret phylogenic relationships between the chordate classes
	3. Identify the animals based on their observations of the external characteristics
	4. Perform experiments based on temporary mountings
	5. Prepare field report based on observations done during field excursions
Module 1(Credit 1) : General organization of lower chordates	
Learning Outcomes	After learning the module, learners will be able to:
	1. Differentiate between the organization of invertebrate phyla studied earlier and the lower chordates
	2. Interpret the evolutionary advancement among lower chordates
Content Outline	• General characteristics of chordates • General organization of Sub-phylum Urorchordata and Cephalochordata • General organization of Cyclostomata
Module 2(Credit 1): General organization of Vertebrates	
Learning Outcomes	After learning the module, learners will be able to
	1. Distinguish between the various systems of the all the classes
	2. Relate the characteristic features of various classes with reference to the adaptations for the mode of living
Content Outline	• General organization of Class: o Pisces o Amphibia o Reptilia o Aves o Mammalia
PRACTICAL COURSE: (2 Credits)	
Learning Outcomes	After learning the module, learners will be able to:
	1. Identify the animals based on their observations of the external characteristics
	2. Perform experiments based on temporary mountings

	3. Prepare field report based on observations done during field excursions
Content Outline	● Identification of Urochordata: (*Herdmania*), Cephalochordata
	(*Amphioxus*), Cyclostomata (*Petromyzon, Myxine*) ● Identification of Pisces: Chondrichthyes (Shark, Sting ray, Electric ray) & Osteichthyes (Mackerel, Flying fish, Puffer fish and Sea horse) ● Identification of Amphibia (Frog, Toad, Salamander, Caecilian) ● Identification of Reptilia (Chameleon, *Calotes*, *Phrynosoma*, Russel's Viper, Cobra, Rat snake, Python, Turtle, Tortoise, Crocodile) ● Identification of Aves (Kite, Duck, Parakeet) ● Identification of Mammalia : Duck-billed Platypus, Kangaroo, Shrew, Hedgehog, Guinea pig, Bat ● Mounting of scales in fish – Cycloid, Ctenoid and Placoid ● Types of tailfins in fishes – Cartilaginous and Bony ● Types of Feathers, Beaks and Feet in birds ● Study of parental care in fishes ● Study of parental care in amphibians ● Study of neotenic forms in Amphibia ● Identification keys for venomous and non-venomous snakes ● Adaptations of aquatic Mammals - Dolphin, Seal, Walrus, Dugong, Blue Whale ● Study trip to local zoo / national park / aquarium / coastline / biodiversity park and submission of report.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Documentation using photography based on biodiversity in and around the local vicinity / college campus) or videography (self-made videos uploaded on social media)
2. Padlet activity - Designing Infographics on topics related to the syllabus and uploading them on Padlet for collaborative learning
3. Digitization of the museum (if available)- Barcoding of the specimens and slides (The information on classification and distinguishing characteristics to be included to assist learning of taxonomy)
4. Submission of field report based on actual study trip or virtual.

References:

1. Chordate Zoology - E. L. Jordan and P.S. Verma. 14th Revised Edition, 2013. S. Chand and Co. Ltd.
2. Chordate Zoology - P. S. Dhami and J. K. Dhami, Reprint Edition, 1991. R. Chand and Co.
3. Zoology- S. A. Miller and J. B. Harley, 8th Edition, 2009. Tata McGraw Hill
4. Modern Textbook of Zoology : Vertebrates - R. L. Kotpal. 2010. Global Media Publications
5. A Textbook of Zoology, Vol. II- T. J. Parker and W. A. Haswell-Low Price Indian Edition. 1991. CBS Publications and Distributors Pvt. Ltd.
6. Chordate Zoology And Elements of Animal Physiology - E. L. Jordan, P. S. Verma. 1st Edition, 1980. S. Chand and Co. Ltd

4.2 Major (Core)

Course Title	**Genetics – II**
Course Credits	**4 (2 Theory + 2 Practicals)**
Course Outcomes	After going through the course, learners will be able to :
	1. Understand the various inheritance patterns related to diverse types of factors
	2. Apply the knowledge to explain inheritance of various types such as linkage, sex-linkage, multiple alleles and multiple genes
	3. Make predictions by solving the crosses related to real-world examples
	4. Perform experiments based on the genetics related studies
	5. Prepare the field report based on the study visits
Module 1(Credit 1) : Linkage, Crossing over and multiple alleles	
Learning Outcomes	After learning the module, learners will be able to:
	1. Describe the concepts of linkage, crossing over, multiple alleles, polygenic inheritance
	2. Apply the knowledge to explain real-world examples / case studies
Content Outline	• Linkage and Crossing Over: ○ Introduction to Linkage ○ Crossing over, Types of crossing over, Cytological basis of crossing over • Multiple Alleles: ○ Concept of Multiple Alleles, ○ Coat colour in rabbit, ○ ABO and Rh blood group system, ○ Bombay blood group • Polygenic inheritance with reference to skin colour and eye colour in humans. • Concept of Pleiotropy
Module 2(Credit 1) : Sex determination and Sex-linkage	
Learning Outcomes	After learning the module, learners will be able to
	1. Describe the various methods of sex determination and related phenomena
	2. Analyze the cases related to sex-linked inheritance and predict the probability by solving crosses

Content Outline	• Sex- determination o Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW o Sex determination in Honey bees- Haplodiploidy o Sex determination in Drosophila-Genic balance theory, Intersex, Gynandromorphs o Hormonal influence on sex determination- Freemartin and Sex reversal. o Role of environmental factors- Bonelia and Crocodile
	o Barr bodies and Lyon hypothesis o Parthenogenesis • Sex linked, sex influenced and sex-limited inheritance. o X-linked: Drosophila, Colour-blindness, Haemophilia o Y-linked: Hypertrichosis o Sex-influenced genes o Sex-limited genes
PRACTICAL COURSE: (2 Credits)	
Learning Outcomes	After learning the module, learners will be able to:
	1. Perform the experiments of temporary mounting preparation
	2. Evaluate the data obtained for the survey project
	3. Apply theoretical knowledge to solve problems based on inheritance
Content Outline	• Study of Barr body from buccal epithelium cells. • Detection of blood groups and Rh factor • Problems in Genetics based on X- linked inheritance • Problems in Genetics based on Multiple Alleles • Observation of Drosophila culture for the various phenotypic characteristics • Project – Survey of blood groups w.r.t. ABO and Rh factor among human population • Study of Griffith's transformation experiments, Avery- Macleod and McCarty, Hershey Chase experiment of Bacteriophage infection • Visit to the blood bank or a diagnostic centre to understand the blood transfusion protocols - submission of report of the visit

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Survey-based project on different types of characteristics that are determined by polygenic inheritance. Data compilation, analysis to draw conclusions about the extent of diversity found in the human population. Submission of report.

- Participate in the blood donation drive organized by NSS and submit the report based on the observations regarding the blood typing procedure and

the donor criteria

References:

1. Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., & Silver, L. M. (2021). Genetics: From Gene to Genome (7th ed.). McGraw Hill Education.
2. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (2006). Principles of Genetics. (8th ed.). John Wiley and Sons.
3. Pierce, B. A. (2017). Genetics: A Conceptual Approach. (6th ed.). W.H. Freeman and Company, New York.
4. Russel, P. J. (2006). Genetics: A Mendelian Approach. Pearson Benjamin Cummings.
5. Strickberger, M. W. (2015). Genetics. (3rd ed.). Pearson Education India
6. Weaver, K. F., & Hedrick. (1992). Genetics. (2nd ed.). McGraw Hill Education.

4.3 Major (Core)

Course Title	**Applied Zoology – II**
Course Credits	**4 (2 Theory + 2 Practicals)**
Course Outcomes	After going through the course, learners will be able to :
	1. Describe the various Indian cattle breeds
	2. Evaluate the economic importance of dairy industry
	3. Describe the economically important fishes in India
	4. Evaluate the economic importance of fishery in India
	5. Evaluate and appreciate the role of ICAR in supporting the economy and employability.
Module 1(Credit 1) : Dairy Science	
Learning Outcomes	After learning the module, learners will be able to:
	1. Understand scope of dairy industry
	2. Describe various cattle breeds and relate their importance in Indian dairy industry
Content Outline	• Overview of Indian Cattle Breeds - Origin, distribution, Salient features & Economic significance of: o Gir, Malvi, Hariyana, Deoni, Red Sindhi and Khillari o Nagpuri, Bhadawari, Murrah, Jafrabadi • Common cattle diseases and vaccination • Dairy Processing: Filtration, cooling, chilling, clarification, pasteurization, freezing • Milk and milk products: Composition of milk, Types of milk - Buffalo milk & Cow milk (A1 and A2), Whole milk and toned milk, Milk products • Dairy development in India: Role of dairy development in rural economy, employment opportunities
Module 2(Credit 1) : Fishery	
Learning Outcomes	After learning the module, learners will be able to :
	1. Describe the various fisheries and the commercially important fishes in India
	2. Evaluate the economic significance of fisheries and its products

Content Outline	• Introduction to fisheries in India – Freshwater, Marine, Brackish
	• Crafts & Gears used on Indian coasts:
	  ○ Crafts – Dugout, Outrigger, Masula, Catamaran, Satpati, Trawler
	  ○ Gears – Gill and drift net, Dol net, Cast net, Purse seiene, Lines and hooks
	• Fishery biology of commercially important fishes : Catla, Rohu, Catfish, Mackeral, Sardine, Pomfret, Bombay duck
	• Fish Preservation, Processing and value addition
	• SONAR, GPS, Remote Sensing, Tidal and lunar pattern

PRACTICAL COURSE: (2 Credits)	
Learning Outcomes	After learning the module, learners will be able to:
	1. Identify the various Indian cattle breed
	2. Perform the experiments related to simple dairy techniques
	3. Identify the various commercially important fishes and their crafts and gear used
	4. Write the field visit report based on the practical knowledge gained
Content Outline	• Breeds of Indian cows and buffaloes • Breeds of Indian goats and sheep • Extraction of casein from milk and its qualitative estimation • Preparation of paneer from given milk sample • Preparation of various milk sweets/products • Measurement of density of milk using different samples by Lactometer • Study of crafts and gears • Study of commercially important fishery (Catla, Rohu, Catfish, Mackeral, Sardine, Pomfret, Bombay duck) • Study trip to dairy farm / apiculture centre / fisheries institutes / docks to observe fish landing / aquaculture farms etc.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Survey related to milk products available in the market, brands,shelf life , preservatives used. Submit the report analyzing the data compiled.
2. Study of characteristics of fresh fish and spoiled fish from suitable fish samples. Submit the report.
3. Model making of various craft and gear used in Indian fishery as well as

the dairy products prepared by students. An exhibition could be held displaying these and to appreciate the economic importance of these two industries that come under ICAR

References:

1. Banerjee G.C. (2021). A Textbook of Animal Husbandry. (8th ed.). Oxford & IBH Publishing, New Delhi
2. Candler, W., & Kumar, N. (1998). India: The dairy revolution: The impact of dairy development in India and the World Bank's contribution. World Bank Publications.
3. Park, Y. W., & Haenlein, G. F. (Eds.). (2013). Milk and dairy products in human nutrition: production, composition and health. John Wiley & Sons,
4. Venkatasubramanian, V., Singh, A. K., & Rao, S. V. N. (2003). Dairy development in India: An appraisal of challenges and achievements. Concept Publishing Company,

4.4 OEC

Course Title	**Human parasitic diseases**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to :
	1. Relate the various types of host-parasite interactions
	2. Interpret the pathogenicity of the various parasitic infections
	3. Describe the pathogenicity of the various zoonotic diseases
	4. Evaluate the importance of national health programs for control of zoonotic infections
Module 1(Credit 1) : Introduction to parasitology	
Learning Outcomes	After learning the module, learners will be able to
	1. Relate the various types of host-parasite interactions
	2. Interpret the pathogenicity of the various parasitic infections
Content Outline	• Introduction to Parasitology and Types of Parasites: o Definitions: Parasitism, Host, Parasite, Vector- biological and mechanical o Types of parasite: Ectoparasite, Endoparasite and their parasitic adaptations o Types of host: Intermediate and definitive, reservoir • Life cycle of the parasite, pathogenicity, control measures and treatment of : • Amoebic dysentery • Malaria • Leishmaniasis (Kala azar) • Taeniasis (Tape worm infection) • Filariasis • Ascariasis
Module 2(Credit 1) : Zoonotic diseases	
Learning Outcomes	After learning the module, learners will be able to :
	1. Describe the pathogenicity of the various zoonotic diseases
	2. Evaluate the importance of national health programs for control of zoonotic infections

Content Outline	• Introduction to zoonosis:
	• Causes, symptoms, prevention and treatment of :
	  ○ Bird flu
	  ○ Rabies
	  ○ Toxoplasmosis
	  ○ Japanese Encephalitis
	  ○ outbreaks of Nipah Virus
	  ○ Outbreaks of nCovid-19
	• Role of National Center for Vector Borne Diseases for disease control through various awareness programs and health services

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Literature review on epidemiology of the various parasitic diseases - Five research articles and newspaper articles to be included. Statistical data to be collected and conclusions drawn from these as report submission.
- Conduct a survey-based project on the awareness of the general public regarding the causes of parasitic diseases and their control. The findings could be compiled and submitted as a brief report.

References:

1. Parasitology. Chatterjee K. D. Chatterjee Medical Publishers.
2. Textbook of Medical Parasitology- C. K. Jayaram Paniker, Jaypee Brothers.
3. Essentials of Parasitology- Gerald D. Schmidt: Universal Bookstall, New Delhi.
4. Introduction to Parasitology- Chandler and Read John Wiley & Sons

4.5 SEC

Course Title	**Pet Care**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to :
	1. Identify and describe the various breeds of pets in India
	2. Interpret the various types of pet behaviours and relate them to their health conditions
	3. Apply the pet management guidelines
	4. Create healthy and easy pet nutritional products
Module 1(Credit 1): Breeds of Pets in India and their grooming	
Learning Outcomes	After learning the module, learners will be able to :
	1. Identify and describe the various breeds of pets found in India
	2. Identify and relate the various behaviour that pets show during the various phases of life
Content Outline	• Identification of exotic breeds of dogs in India- German shepherd, Beagle, Bull dog, Great dane, Indian spitz, Pug, Labrador, Golden retriever, Shih Tzu, Siberian Husky. • Identification of Indian breeds of dogs- Indian Pariah dog, Rajapalayam, Gaddi, Rampur hound, Mudhol hound, Chippiparai, Kanni dog, Himalayan sheepdog (Bhutia), Kaikadi, Jonangi. • Identification of common breeds of cats- Persian cats, Bombay cats, maine coons, Turkish van, Siamese cat, Ragdoll. • Identification of behaviour of a pet animal from its body language- Dog and Cats (Body language charts). • Study of the stages of the oestrus cycle in female cats and dogs through behavioural changes, vocalization, and physical signs. • Study of grooming techniques- brushing, bathing, nail trimming, and ear cleaning, teeth brushing, hair trimming.
Module 2(Credit 1): Pet health management	
Learning Outcomes	After learning the module, learners will be able to:
	1. Identify the various need-based regimens for a healthy pet
	2. Apply the theoretical knowledge to prepare the various quality pet foods

Content Outline	• Pet First Aid tips- wound care, seizures, choking and poison. • Study of Body Condition Scoring (BCS) techniques for Weight assessment and overall Well-being in Dogs and Cats. • Estimation of moisture content in dry pet food. • Formulation of Nutrient-Rich Dry Food for Dogs and Cats. • Study of common parasites in pets: Understanding, Treating, and Preventing in Dogs and Cats – Fleas, Ticks, Mites (Ear mites and Sarcoptic mites), Tapeworm and Giardia. • Study of deworming, vaccination schedules, and other preventive healthcare measures for cats and dogs. • Study of Zoonotic and reverse zoonotic diseases.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Literature review and survey of pet owners to prepare reports on rights and responsibilities of pet owners in India.
- Assignment on rearing and care of lesser-known pet animals.
- Visit to an animal rescue centre/ animal care centre and prepare a report based on it.
- Visit an animal training centre/ veterinary hospital/ pet grooming centre and prepare a report based on it.

References:

1. Yeates, J. (Ed.). (2019). Companion animal care and welfare: The UFAW companion animal handbook. John Wiley & Sons. ISBN:9781118688793
2. Alderton, D., Edwards, A., Edwards, A., Larkin, P., Stockman, M. The Complete Book of Pets & Petcare: The Essential Family Reference Guide to Pet Breeds and Petcare T Hong Kong: Anness Publishing. 2018. ISBN:9781844779338.
3. Companion Animals: Their Biology, Care, Health, and Management. Campbell, Karen L., and Campbell, John R.. United Kingdom, Pearson Prentice Hall, 2009. ISBN:9780135047675
4. The Book of Indian Dogs. Baskaran, S. Theodore. Aleph. 2017. ISBN:9789384067571.
5. Encyclopedia of Dogs: A Comprehensive Guide to Dog Breeds. United Kingdom, NPP Books, 2014. ISBN:9780755494958

4.7 CE

Semester 4 CEP Guidelines as per Zoology BoS, SNDTWU

Course Objectives:

1. Promote Social Responsibility and Civic Engagement
2. Bridge the Gap Between Theory and Practice
3. Foster Holistic Development

Course Learning Outcomes: After completing the program, the learners will be able to:

1. Demonstrate a deeper understanding of societal issues, such as poverty, health, education, and environmental concerns, along with empathy for marginalized communities.
2. Apply academic knowledge in real-world scenarios, showcasing practical problem- solving and communication skills, while contributing effectively to community-driven projects.
3. Improve their leadership capabilities by organizing and leading community initiatives while also working collaboratively with peers, community members, and organizations to address issues collectively.

SOPs for CEP (As per Zoology BoS)

1. The purpose of the Community Engagement Project is to sensitize the learners regarding various issues & problems within their locality.
2. The Community Engagement Programme should be completed by the concerned learners in semester 4.
3. Every learner should complete 60 hours (2 credits) of CEP that comprises both actual contact hours with the community and notional hours.
4. The mentor teachers should spend 8-10 hours of contact lectures to explain the purpose of the Community Engagement Project & guide the learners to identify the local problems & translate it into the project.
5. The CEP should be undertaken either as a single collective activity by the class or an activity undertaken by several smaller groups - not less than three.
6. The nature of the CEP should be directed towards achieving some community need or requirement (example: tutoring underprivileged school students in computer literacy, environmental awareness through beach cleaning or tree plantation, organizing a blood donation drive, conditions of roads in locality, quality of drinking water, erratic train/bus schedules during monsoon, water seepage problems in different types of constructions, rainwater harvesting/solar panels in modern constructions, issue of stray dogs in your locality, insignificant use of antibiotics by the people, domestic violence, quality of toned/fresh milk through simple tests, etc.)
7. The teacher should be involved to facilitate and guide their learners with defining the activity and achieving their CEP outcomes.
8. Concerned learners should keep a logbook for documenting their observation & furnish proof through photography/videography of the hours of the activities undertaken under CEP in order to earn 2 credits.
9. Concerned learners should document their CEP activity outcomes in the format provided by the department and submit it to the head of their

department.

10. There will be only internal assessment of 50 marks.
11. The rubrics for the evaluation/grading of the learners must be approved by the BoS & Academic Council.
12. Heads of departments should certify & submit to their respective Vice Principals by the end of March the names of their learners who have successfully completed the CEP mandated hours.
13. Department heads should submit to their respective Vice Principals an overall report of the CEP activities undertaken by their learners during the semester.

Rubrics for CEP assessment:

	Criteria for Evaluation			
	Active Participation and Engagement	**Application of Knowledge and Skills**	**Impact on the community engaged**	**Report submission**
Total Marks Allotted	**20 marks**	**10 marks**	**10 marks**	**10 marks**
	Levels of Assessment			
	Outstanding	**Good**	**Satisfactory**	**Needs Improvement**
Range of Marks (%)	**80 -100%**	**60 -79%**	**59 – 40%**	**Below 40%**