



जम्मू केंद्रीय विश्वविद्यालय

Central University of Jammu

राया-सूचानी (बागला), जिला सांबा-181143, जम्मू (जम्मू एवं कश्मीर)
Rahya-Suchani (Bagla), District: Samba - 181143, Jammu (J&K)



संख्या: CUJ/Acad/II-14/9/2021/441

26 नवम्बर, 2021

अधिसूचना संख्या 90/2021


Sub: Course Scheme and Syllabus Notification of I to X Semesters of Integrated M.Sc. in Zoology w.e.f Academic Session 2020-21-Reg

Ref: Notification No. 72 dated 04.10.2021

In partial modification to the notification under reference, Course Codes of the Elective Course of Semester II may be read as:

Elective Course						
Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
ICBOT2E001T	Plants in Human Welfare	4	25	25	50	100
ICBOT2E001L	Plants in Human Welfare Lab.	2	25	-	25	50

Rest of the contents of the notification remain unchanged.


26/11/21
(शैलेंद्र स्लाथिया)
सहायक कुलसचिव
अकादमिक
Jammu

Head, Dept. of Zoology

Encl: Notification No. 72

Copy to:

Controller of Examinations



जम्मू केंद्राय विश्वाविद्यालय Central University of Jammu

राहा - सूधानी, बागला, जिला सांबा - 181143 जम्मू, जम्मू एवं कश्मीर
Rahya - Suchani (Bagla), District Samba - 181143, Jammu (J&K)

No. CUJ/Acad./II-14/9/2021/366

04/09/2021

NOTIFICATION No. 72/2021

Sub: Course Scheme and Syllabus Notification of I to X semesters of Integrated M.Sc. in Zoology w.e.f. Academic Session 2020 - 21 - Reg.

Ref: i) Notification No. of 65 of 2021 dated 20.09.2021
ii) Notification No. 23 of 2019 dated 04.04.2019
iii) Notification No. 83 of 2018 dated 26.12.2018
iv) Notification No. 78 of 2018 dated 06.12.2018

In supercession to notification under reference (i), it is hereby notified for the information of all concerned that on the recommendations of the Board of Studies, Department of Zoology and School Board, School of Life Sciences, the Vice Chancellor in anticipation of approval of Academic Council has approved the Course Scheme and Syllabus of I to X semesters of Integrated M.Sc. in Zoology w.e.f. Academic Session 2020 - 21 as indicated against each semester. The approved course scheme and syllabus are as follows:

Semester I						
Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL1C004T	Animal Diversity - I	4	25	25	50	100
ICZOL1C004L	Animal Diversity - I Lab.	2	25	-	25	50
ICZOL1C005T	Cell Biology	4	25	25	50	100
ICZOL1C005L	Cell Biology Lab.	2	25	-	25	50
Elective Course*						
ICBOT1E001T	Plant Kingdom: Diversity in Form, Structure and Reproduction	4	25	25	50	100
ICBOT1E001L	Plant Kingdom: Diversity in Form, Structure and Reproduction Lab.	2	25	-	25	50
Foundation Course**						
ICECL1F002T	English	4	25	25	50	100
Total		22	-	-	-	550

Semester II						
Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL2C003T	Animal Diversity - II	4	25	25	50	100
ICZOL2C003L	Animal Diversity - II Lab.	2	25	-	25	50
ICZOL2C004T	Genetics	4	25	25	50	100
ICZOL2C004L	Genetics Lab.	2	25	-	25	50
Elective Course*						
ICBOT1E001T	Plants in Human Welfare	4	25	25	50	100
ICBOT1E001L	Plants in Human Welfare Lab.	2	25	-	25	50
Foundation Course**						
ICEVS2F001T	Environmental Sciences	4	25	25	50	100
Total		22	-	-	-	550

(Handwritten Signature)

Semester VI
Course
ICZ

Semester III

Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL3C007T	Animal Diversity - III	4	25	25	50	100
ICZOL3C007L	Animal Diversity - III Lab.	2	25	-	25	50
ICZOL3C008T	Biomolecules and Structural Biology	4	25	25	50	100
ICZOL3C008L	Biomolecules and Structural Biology Lab.	2	25	-	25	50
ICZOL3C009T	Comparative Anatomy of Vertebrates	4	25	25	50	100
ICZOL3C009L	Comparative Anatomy of Vertebrates Lab.	2	25	-	25	50
Elective Course*						
ICZOL3E001T	Biotechnology	4	25	25	50	100
ICZOL3E001L	Biotechnology Lab.	2	25	-	25	50
Foundation Course**						
ICZOL3F002T	Sericulture	4	25	25	50	100
Total		28	-	-	-	700

Semester IV

Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL4C007T	Animal Physiology	4	25	25	50	100
ICZOL4C007L	Animal Physiology Lab.	2	25	-	25	50
ICZOL4C008T	Developmental Biology	4	25	25	50	100
ICZOL4C008L	Developmental Biology Lab.	2	25	-	25	50
ICZOL4C009T	Evolution and Animal Behaviour	4	25	25	50	100
ICZOL4C009L	Evolution and Animal Behaviour Lab.	2	25	-	25	50
Elective Course*						
ICCHM4E002T	Chemistry	4	25	25	50	100
ICCHM4E002L	Chemistry Lab.	2	25	-	25	50
Foundation Course**						
ICZOL4F001T	Apiculture	4	25	25	50	100
Total		28	-	-	-	700

Semester V

Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL5C006T	Applied Zoology	4	25	25	50	100
ICZOL5C006L	Applied Zoology Lab.	2	25	-	25	50
ICZOL5C007T	Immunology	4	25	25	50	100
ICZOL5C007L	Immunology Lab.	2	25	-	25	50
Elective Course*						
ICZOL5E008T	Microbiology	4	25	25	50	100
ICZOL5E008L	Microbiology Lab.	2	25	-	25	50
ICZOL5E009T	Wildlife Conservation and Management	4	25	25	50	100
ICZOL5E009L	Wildlife Conservation and Management Lab.	2	25	-	25	50
Total		24	-	-	-	600


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Semester VI


Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL6C003T	Ecology	4	25	25	50	100
ICZOL6C003L	Ecology Lab.	2	25	-	25	50
ICZOL6C004T	Parasitology	4	25	25	50	100
ICZOL6C004L	Parasitology Lab.	2	25	-	25	50
ICZOL6C002D	Dissertation - I	6	-	-	-	150
Elective Course*						
ICZOL6E001T	Basics of Neuroscience	4	25	25	50	100
ICZOL6E001L	Basics of Neuroscience Lab.	2	25	-	25	50
Total		24	-	-	-	600

Semester VII

Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL7C006T	Cytogenetics and Molecular Biology	4	25	25	50	100
ICZOL7C006L	Lab based on ICZOL7C006T	2	25	-	25	50
ICZOL7C007T	Tools and Techniques	4	25	25	50	100
ICZOL7C007L	Lab based on ICZOL7C007T	2	25	-	25	50
ICZOL7C008T	Ethology	4	25	25	50	100
ICZOL7C008L	Lab based on ICZOL7C008T	2	25	-	25	50
ICZOL7C009T	Non-chordate Biology	4	25	25	50	100
ICZOL7C009L	Lab. Based on ICZOL7C009T and ICZOL7E001T	2	25	-	25	50
Elective Course*						
ICZOL7E001T	Bioinformatics	4	25	25	50	100
Total		28	-	-	-	700

Semester VIII

Course Code	Course Title	Credit	CIA	MSE	ESE	Max Marks
Core Courses						
ICZOL8C006T	Biochemistry	4	25	25	50	100
ICZOL8C006L	Lab based on ICZOL8C006T	2	25	-	25	50
ICZOL8C007T	Human Physiology	4	25	25	50	100
ICZOL8C007L	Lab based on ICZOL8C007T	2	25	-	25	50
ICZOL8C008T	Aquatic Biology	4	25	25	50	100
ICZOL8C008L	Lab based on ICZOL8C008T	2	25	-	25	50
ICZOL8C009T	Chordate Biology	4	25	25	50	100
ICZOL8C009L	Lab based on ICZOL8C009T and ICZOL8E001T	2	25	-	25	50
Elective Course*						
ICZOL8E001T	Biostatistical Methods	4	25	25	50	100
Total		28	-	-	-	700



 on 04/21

Semester IX		Course Title	Credit	CIA	MSE	ESE	Max. Marks
		Core Course					
ICZOL9C006T		Research Methodology in Life Sciences	4	25	25	50	100
ICZOL9C006L		Lab. based on ICZOL9C006T and ICZOL9C008T	2	25	-	25	50
ICZOL9C007T		Evolutionary Biology	4	25	25	50	100
ICZOL9C007L		Lab based on ICZOL9C007T	2	25	-	25	50
ICZOL9C008T		Endocrinology	4	25	25	50	100
		Elective Course* (Any One Set from Each Group)					
		Group - A					
ICZOL9E001T	Set I	Applied Entomology	4	25	25	50	100
ICZOL9E001L		Applied Entomology Lab.	2	25	-	25	50
ICZOL9E002T	Set II	Fish Biology	4	25	25	50	100
ICZOL9E002L		Fish Biology Lab.	2	25	-	25	50
ICZOL9E003T	Set III	Neurobiology of Brain Diseases and Ageing	4	25	25	50	100
ICZOL9E003L		Neurobiology of Brain Diseases and Ageing Lab.	2	25	-	25	50
ICZOL9E004T	Set IV	Animal Systematics and Taxonomy	4	25	25	50	100
ICZOL9E004L		Animal Systematics and Taxonomy Lab.	2	25	-	25	50
		Group - B					
ICZOL9E005T	Set I	Integrated Pest Management	4	25	25	50	100
ICZOL9E005L		Integrated Pest Management Lab.	2	25	-	25	50
ICZOL9E006T	Set II	Limnology	4	25	25	50	100
ICZOL9E006L		Limnology Lab.	2	25	-	25	50
ICZOL9E007T	Set III	Cognitive Neuroscience	4	25	25	50	100
ICZOL9E007L		Cognitive Neuroscience Lab.	2	25	-	25	50
ICZOL9E008T	Set IV	Wildlife Biology	4	25	25	50	100
ICZOL9E008L		Wildlife Biology Lab.	2	25	-	25	50
TOTAL			28				700

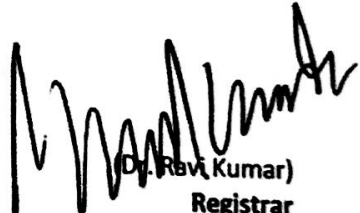
M.M. Wadhwa
on 02/02/21

Semester X

Course Code	Course Title	Credit	CIA	MSE	ESE	Max. Marks
Elective Course (Any One Stream to be selected by student)						
ICZOL10C006T	Insect Physiology	4	25	25	50	100
ICZOL10C006L		2	25	-	25	50
ICZOL10C007T	Medical Entomology	4	25	25	50	100
ICZOL10C007L		2	25	-	25	50
ICZOL10C008T	Insect Toxicology	4	25	25	50	100
ICZOL10C008L		2	25	-	25	50
ICZOL10C009T	Fisheries and Aqua Culture	4	25	25	50	100
ICZOL10C009L		2	25	-	25	50
ICZOL10C010T	Environmental Toxicology	4	25	25	50	100
ICZOL10C010L		2	25	-	25	50
ICZOL10C011T	Ecology and Environment	4	25	25	50	100
ICZOL10C011L		2	25	-	25	50
ICZOL10C012T	Advanced Neuroscience	4	25	25	50	100
ICZOL10C012L		2	25	-	25	50
ICZOL10C013T	Behavioural Neuroscience	4	25	25	50	100
ICZOL10C013L		2	25	-	25	50
ICZOL10C014T	Principles of Neuroscience	4	25	25	50	100
ICZOL10C014L		2	25	-	25	50
ICZOL10C015T	Conservation Biology	4	25	25	50	100
ICZOL10C015L		2	25	-	25	50
ICZOL10C016T	Wildlife Studies: Tools and Techniques	4	25	25	50	100
ICZOL10C016L		2	25	-	25	50
ICZOL10C017T	Wildlife Management and Practices	4	25	25	50	100
ICZOL10C017L		2	25	-	25	50
For all Streams						
ICZOL10C002D	ED	Dissertation-II	10	-	-	200
		TOTAL	28			650

*Generic Elective

**Ability Enhancement Compulsory Course


 (Dr. Ravi Kumar)
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 04/04/21

End: Copy of 1st to 10th semester syllabus of M.Sc. Zoology

To: Head, Department of Zoology

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Five Year Integrated B.Sc. (Honours) M.Sc. Programme

ZOOLOGY

Syllabus (NEW SCHEME)



DEPARTMENT OF ZOOLOGY
School of Life Sciences



Central University of Jammu
Rahya Suchani Bagla, District Samba
Jammu and Kashmir
India, 181143

B.SC. HONOURS ZOOLOGY (SEMESTER I TO VI)

SEMESTER – I

1. Core Course (CC)

CC-1: Animal Diversity-I

CC-2: Cell Biology

2. Foundation Course (FC)

FC-1: English

3. Elective Course (EC)

EC-1: Plant Kingdom: Diversity in form, structure and reproduction

SEMESTER – I

CC-I: ANIMAL DIVERSITY-I

Credit: 4

Course Code: ICZOL1C004T

UNIT – I

Structural organization in different classes of non-chordates. Basis of classification. Types of symmetry, Coelom and its types. Evolutionary significance of non-chordates.

UNIT – II

Salient features and classification of Protozoa upto orders. Locomotion, Nutrition, Osmoregulation and Reproduction in Protozoa. Type study: *Entamoeba*, *Paramecium* and *Plasmodium*

UNIT – III

Salient features and classification of Porifera upto orders. Skeleton system, Canal system and reproduction in Porifera. Type study: *Sycon* and Sponge.

UNIT – IV

Salient features and classification of Coelenterata upto orders. Corals and coral reefs. Defensive structures and their mechanism. Polymorphism in Coelenterates. Type study: *Hydra*, *Obelia* and *Aurelia*.

UNIT – V

Salient features and classification of Helminthes upto orders. Reproduction in Helminthes. Parasitic adaptations in Helminthes. Type study - *Planaria*, *Fasciola*, *Taenia* and *Ascaris*. Annelida –Salient features and classification upto orders.

Practical CC-I: ANIMAL DIVERSITY-I

Credit: 2

Course Code: ICZOL1C004L

1. Museum specimens: *Sycon*, *Leucosolenia*, *Euplectella*, *Spongilla*, *Obelia* (Polyp and Medusa forms), *Millepora*, *Physalia*, *Porpita*, *Aurelia*, *Tubipora*, *Gorgonia*, *Metridium*, *Favea*, *Astraea*, *Pennatula*, *Planaria*, *Fasciola*, *Taenia*, *Ascaris* (male and female). *Pheritima*, *Neries*, *Heteroneries*, *Chaetopterus*, *Arenicola*, *Glossiphonia*, *Pontobdella*, *Hirudinaria*, *Polygordius*
2. Microscopic slides (Whole Mount): *Euglena*, *Trypanosoma*, *Amoeba*, *Entamoeba*, *Leishmania*, *Giardia*, *Monosystis*, *Plasmodium*, *Paramecium*, *Opalina*, *Nyctotherus*, *Vorticella*, *Balantidium*,
3. Microscopic slides of *Paramecium* binary fission and conjugation
4. Life cycle of *Plasmodium*
5. Microscopic slides: L.S. and T.S. of *Sycon*, sponging spicules, sponging fibres and gemmules. *Hydra*, *Fasciola* T.S., Larval forms of *Fasciola* – Miracidium, Sporocyst, Redia, Cercaria, metacercaria. *Taenia* T.S. through mature proglottid, Cysticercus Larvae. *Ascaris* T.S. , T.S. of *Nereis*, Parapodium of *Heteroneries*.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified which is subject to availability of resources*

SEMESTER – I

CC-II: CELL BIOLOGY

Credit: 4

Course Code : ICZOL1C005T

UNIT – I

Structure of prokaryotic and eukaryotic cell, diversity of cell size and shape. Plasma membrane, structure, composition and function, different models of plasma membrane- Danielli Davson model, Unit membrane model, Fluid mosaic model. Membrane transport system, cell recognition, adhesion-antigen specificity, hormone receptors, endocytosis and exocytosis.

UNIT – II

Structure and function of Cell Organelles – Mitochondria, Golgi complex, Lysosome, Ribosome, Endoplasmic reticulum, peroxisomes, microtubular organelles.

UNIT – III

Nucleus, structure and organization of nucleus – nucleolus, chromosome. Structure of DNA, morphology, heterochromatin, euchromatin, Lampbrush chromosome, Polytene chromosome.

UNIT – IV

Cell division, types of Cell division. Mitosis and cell cycle, regulation of cell cycle, significance of mitosis. Meiosis, significance of meiosis. The biology of Cancer, types of cancer, causes of cancer, genetics of cancer. Theories of cancer, differentiation of cancer cells. Apoptosis.

UNIT – V

Cell signalling, Cell junctions, tight junctions, desmosomes, (belt and spot), gap junctions, Transport, Osmosis, diffusion (facilitated and mediated), active transport (Na^+/K^+ ATPase pump, Ca^{2+} ATPase pump), ionic basis of membrane excitation.

Practical CC-II: CELL BIOLOGY

Credit: 2

Course Code : ICZOL1C005L

1. Light microscope – components – use and principles
2. Microscopic slides: Stages of mitosis and meiosis
3. Squash preparation for the study of mitosis.
4. Identification of different stages of meiosis.
5. Micrometry (A) Camera Lucida (B) Stage micrometer (C) Ocular micrometer
6. Study of giant chromosomes
7. Identification of cancer tissues

8. Preparation of karyotype and idiograms

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified which is subject to availability of resources*

FC-I: English

Credit: 4

Course Code: ICECL1F002T

Unit – I

Language and Communication- Communication – Definition-process of communication, Barriers to communication: cultural, individual, attitudinal, Models of communication, Language as a tool of communication, Types of communication – formal and informal communication (grapevine), verbal and nonverbal.

Unit – II

Writing Skills- Paragraph construction: Writing Expository, Descriptive, Persuasive, Narrative, Argumentative, Deductive and Inductive, Precis Writing, Letter Writing: Formal and Informal Letters, Functional Grammar – Parts of Speech.

Unit - III

Reading Skills -Importance of reading skills, Types of reading skills, Methods of improving reading skills, Objectives of improving reading skills, Vocabulary Building: Antonyms, Synonyms, Homophones, One word substitution, word formation (Prefixes and Suffixes)

Unit – IV

Listening Skills - Importance of listening skills, Types of listening: Academic, Appreciative, Critical, Discriminative, Marginal etc., Process of Listening, Listening and Hearing, Active and Passive Listening

EC-I: Plant Kingdom: Diversity in Form, Structure

Credit: 4

Course Code: ICBOT1E001T

Unit – I

Introduction to Plant Diversity

General account of origin of life, origin of plants, Plant Diversity – concept, Plant Kingdom-Cryptograms and Phanerogams, Diversity in habit, habitat, duration of life and position of plants in five kingdom system.

Unit – II

Thallophytes

Algal diversity: origin, occurrence, habitat, thallus, cell structure, pigment and reserve food material, genetic reproduction and life cycle patterns, Fungal diversity, occurrence, cell

structure and general reproduction. Lichen diversity, morphology and reproduction as pollution indicators.

Unit - III

Cryptogams

Bryophyte diversity, Origin (in brief), occurrence, thallus, reproduction and sporophyte diversity. Life cycle pattern. Pteridophyte diversity: sporophyte, gametophyte and reproduction.

Unit - IV

Phanerogams

Gymnosperm diversity: Origin (in brief), sporophyte, gametophyte, reproduction (in general), affinities with pteridophytes and Angiosperms. Angiosperms: Introduction and evolution, dicots and monocots, basic mode of reproduction, sporophyte diversity with respect to habitat, mesophytes, xerophytes and hydrophytes.

Unit – V

Microbes

Viruses: Discovery, general structure, replication (general account), DNA (t- phage) and RNA viruses (TMV), Lytic and Lysogenic cycle, RNA virus (TMV), bacteria discovery, general characteristics and cell structure, reproduction, vegetative, asexual and sexual (conjugation), transformation and transduction modes.

PRACTICAL EC-I: Plant Kingdom: Diversity in Form, Structure

Credit: 2

Course Code: ICBOT1E001L

1. Study of different thallus forms of algae: Cyanophyceae, Chlorophyceae, Phaeophyceae and Rhodophyceae through specimens/photographs.
2. Study on local biodiversity through temporary mounts.
3. Identification of various types of fungi through temporary mounts/photographs.
4. Identification of various types of Lichens.
5. Identification of various types of Bryophytes using specimens/photographs.
6. Identification of various types of Pteridophytes using specimens/photographs.
7. Identification of various types of Gymnosperms with the help of specimens/photographs.
8. Identification of various forms of Angiosperms with reference to monocots and dicots from the local area.
9. Electron micrographs/Models of viruses – T-phage and TMV, line drawing/photograph of Lytic and Lysogenic cycle.

10. Types of Bacteria from temporary /permanent slides/photographs, electron micrographs of bacterial reproduction, Binary fission, Conjugation.

SEMESTER – II

1. Core Courses (CC) (4+2):

CC-III: Animal Diversity-II

CC-IV: Genetics

2. Foundation Course (FC) (4):

FC-2: Environmental Sciences

3. Elective Course (EC) (4+2):

EC-2: Plant in Human Welfare

SEMESTER – II

CC-III: ANIMAL DIVERSITY-II

Credit: 4

Course Code: ICZOL2C003T

UNIT – I

Salient features, origin and classification of Arthropoda up to orders. Metamorphosis. Larval forms in Crustaceans. Onychopora and its affinities.

UNIT – II

Salient features and classification of Molluscs up to orders. Torsion and de-torsion in Molluscs. Foot and Shell in Molluscs.

UNIT – III

Salient features and classification of Echinodermata up to orders. Water Vascular system. Echinoderm larvae and their significance.

UNIT – IV

Salient features and affinities of minor phyla-Mesozoa, Phoronida, Chaetognatha and Echiuroidea. Origin and phylogeny of Metazoa, Porifera, Colenterata, Bilateria.

UNIT – V

Molecular phylogenetics, Molecular clock. Phylogeny estimation methods- Distance data, Maximum-parsimony method, Maximum-likelihood method. Cladogram. Construction of phylogenetic tree. Phenogram, phylogram and cladogram. Cladistics, Phenetics

Practical CC-III: ANIMAL DIVERSITY-II

Credit: 2

Course Code: ICZOL2C003L

1. Museum specimens: *Peripatus*, *Limulus*, Spider, Scorpion, Centipede, Millepede, *Lepas*, *Balanus*, *Squilla*, *Eupagarus*, Crab, *Mantis*, *Apis*, *Locust*, Silkworm, Beetle, *Chiton*, *Dentalium*, *Aplysia*, *Cypraea*, *Mytilus*, *Loligo*, *Sepia*, *Nautilus*, Pearl Oyster, *Antedin*, *Holothuria*, *Cucumaria*, *Echinus*, *Pentaceros*, *Ophiothrix*, *Balanoglossus*
2. Microscopic slides: *Pediculus* (WM), Termites, Tick, *Cyclops*, *Daphnia*, Crustacean Larvae, *Anopheles*, *Culex* and *Ades* Male and Female (WM), Mouth parts of Male and Female *Anopheles*, *Culex* and *Ades*, WM of *Pila* gill, radula, VS of shell, WM of Glochidium larvae, Tude beet of Echinodermates
3. Anatomy of *Pheretima*: External features, general visceral organs, alimentary canal, nervous system, reproductive system, nephridia
4. Anatomy of *Periplanata*: External features, appendages, mouthparts, alimentary canal, nervous system, reproductive system
5. Anatomy of *Palaemon* : External features, appendages, alimentary canal, nervous system
6. Anatomy of *Pila*: External features, pallial organs, nervous system
7. Anatomy of *Asterias*: External features, general visceral organs, tube feet, water vascular system
8. Construction of Cladogram and Phylogenetic Tree. Distance-based methods of phylogenetic reconstruction using manual and computer methods

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified which is subject to availability of resources*

SEMESTER – II

CC-IV: GENETICS

Credit: 4

Course Code: ICZOL2C004T

UNIT – I

Mendel's Law of segregation and principles of Independent Assortment-Incomplete dominance and codominance – Evidences for DNA as the genetic material-penetrance and expressivity-effect of temperature and light on gene expression

UNIT – II

Multiple alleles – Definition, ABO blood groups system in man, Mn-blood group, Rh factor, Sickle Cell Anemia, Thalassemia. Polygenic Inheritance – Concept, characteristics, inheritance of kernel colour in wheat and skin colour in man-transgressive variation-heritability

UNIT – III

Linkage – Definition and history. Complete and incomplete linkage. Factors affecting linkage. Crossing over – Definition, mechanism of crossing over, types and theories. Cytological detection of crossing over - factors affecting crossing over. Genetic mapping – Definition and methods of gene mapping in *Drosophila*.

UNIT – IV

Sex determination in man and *Drosophila*. Sex linked, sex influenced and sex-limited inheritance. Extra chromosomal inheritance (Kappa particle in *Paramecium* and Coiling in snail)

UNIT – V

Gene mutation and chromosomal aberrations. Inborn errors of phenylalanine metabolism. Human pedigree. Human sex chromosomal and autosomal disorders - Genetic counselling

Practical CC-IV: GENETICS

Credit: 2

Course Code: ICZOL2C004L

List of Practicals:

1. Simulation of principles of segregation and independent assortment using coloured beads.
2. Application of laws of probability and chi-square test.
3. Study of Mono and dihybrid crosses in *Drosophila*. Sex-linkage: reciprocal crosses between red and white eyed *Drosophila* flies.
4. Study of pattern of inheritance of the traits in human populations: rolling of tongue and interlocking, and of the sex-influenced trait long versus short second finger in relation to the fourth finger (apply Hardy-Weinberg Law).
5. Study of mutants in *Drosophila* (Bar eye, white eye, yellow body, sepia eye, curled wing, dumpy wing, vestigial wing, sepia eye-curved wing, curled wing-ebony body-sepia eye).
6. Genotype analysis in the pedigree chart of the Victorian family affected with Haemophilia.
7. Preparation of flow charts to depict steps involved in: Production of transgenic mouse for

- a chosen gene and Gene therapy for a chosen human disease
8. Experiments on Mendelian inheritance, Polygenic inheritance
 9. Human pedigree construction for a family data. Blood group analysis (Demonstration only)
 10. Collection and identification of human finger prints

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified which is subject to availability of resources*

EC-2: PLANTS IN HUMAN WELFARE

Credit: 4

Course Code: ICBOT2E001T

Unit – I

Plants as part of human culture

Origin and role of agriculture in shaping human history, Centres of origin of plants, Evolution of plants during domestication and production of new varieties.

Unit – II

Food, Spices and Beverages.

Origin, morphology and uses of cereals (rice, wheat and maize); pulses (gram, arhar and pea); vegetables (potato, tomato and onion); spices (ginger, turmeric and cloves) and beverages (tea and coffee). Processing of tea and coffee.

Unit – III

Fruits, Nuts and Medicinal plants

Origin, morphology and uses of fruits (Apples, Banana and Mango) and nuts (Almond, Walnut and Cashew nut). General features and uses of medicinal plants (*Cinchona*, *Rauwolfia*, *Atropa*, *Catharanthus*, *Papaver*, *Cannabis* and *Azadirachta*).

Unit – IV

Timber, Fibres, Oil, Sugars and Rubber

Botanical description and uses of timber (Teak, Bamboo and Deodar); oils (Groundnut, Olive, Mustard and Coconut); essential oils (Rose and Lemon grass); fibres (Cotton, Jute and Flax); Rubber (*Hevea brasiliensis* and *Ficus elastica*) and sugar (sugarcane and sugar beet).

Unit – V

Lower Plants and Microbes

Utilization of algae, fungi, lichens, bryophytes and pteridophytes in agriculture, in medicine and as food products. Their role in nitrogen fixation, treatment of waste and as pollution indicators.

PRACTICAL EC-2: PLANTS IN HUMAN WELFARE

Credit: 2

Course Code: ICBOT2E001L

List of Practicals:

1. Cereals: Study of habit, L.S./T.S. of grain, starch grains and microchemical tests of rice and wheat.
2. Legumes: Study of habit, fruit, seed structure, micro-chemical tests of pea and groundnut.
3. Sugars: Study of habit of sugar cane and sugar beet.
4. Spices: Study of habit and sections of black pepper, fennel, clove and cumin seeds.
5. Beverages: Study of morphology of tea and coffee plants.
6. Oils and Fats: Coconut – T.S. of mature fruit, Mustard – plant and seed morphology and microchemical tests of crushed seeds.
7. Essential oil yielding plants: Study of morphology of *Rosa*, *Vetiveria*, *Cymbopogon*, *Santalum* and *Eucalyptus* (specimens/photographs).
8. Rubber: Study of plant morphology using specimen or photograph, model of tapping, samples of rubber products.
9. Drug-yielding plants: Study of specimens of *Digitalis*, *Rauwolfia*, *Papaver* and *Cannabis*.
10. Woods: Study of specimens and sections of young stem of *Tectona*, *Dalbergia sisso* and *Pinus*.
11. Fiber yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz fibers, whole mount of fiber and test for cellulose), Jute (specimen, test for lignin on transverse section of stem and fiber).

FC-2: ENVIRONMENTAL SCIENCES

Credit: 4

Course Code: ICEVS2F001T

Unit - I

ECOSYSTEMS

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: - Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit - II

NATURAL RESOURCES: RENEWABLE AND NON--RENEWABLE RESOURCES

Land resources and land Use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit - III

BIODIVERSITY AND CONSERVATION

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots India as a mega--biodiversity nation; Endangered and endemic species of India Threats to biodiversity: Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity: In--situ and Ex--situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. (8 lectures)

Unit - IV

ENVIRONMENTAL POLLUTION

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution Nuclear hazards and human health risks Solid waste management: Control measures of urban and industrial waste. Scope and importance; Concept of sustainability and sustainable development. (8 lectures)

Unit - V

ENVIRONMENTAL POLICIES & PRACTICES

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site--Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems--pond, river, Lake etc.

SEMESTER – III

1. Core Courses (CC) (4+2):

CC-5: Animal Diversity-III

CC-6: Biomolecules and Structural Biology

CC-7: Comparative Anatomy of Vertebrates

2. Elective Course (EC) (4+2):

EC-3: Biotechnology

3. Foundation Course (FC) (4):

FC-3 : Sericulture

SEMESTER – III

CC-5: ANIMAL DIVERSITY-III

Credit: 4

Course Code: ICZOL3C007T

UNIT – I

Origin and salient features of Hemichordata and Chordate- Protochordates, Urochordates and Cephalochordates -classification upto orders and their interrelationship. Agnatha - salient features-Type study- Affinities

UNIT – II

Fishes-classification upto orders. Extinct forms. Accessory respiratory organs, Fish migration and Parental care.

UNIT – III

Amphibians – Salient features and classification upto orders, parental care. Brief account of Urodeles and limbless amphibians.

UNIT – IV

Reptiles- Salient features and Classification upto orders. Extinct reptiles. Difference between venomous and non venomous snakes. Birds- Salient features and classification upto orders. Flightless birds, bird migration, principles of bird flight

UNIT – V

Mammals-Origin, classification upto orders and salient features-aquatic mammals, flying mammals-Primates-brief account of Monotremes, Marsupials. Dentition and Placentation in mammals.

Practical CC-5: ANIMAL DIVERSITY-III

Credit: 2

Course Code: ICZOL3C007L

1. Museum specimens: *Balanoglossus*, *Saccoglossus*, *Herdmania*, *Ascidia*, *Bptryllus*, *Myxine*, *Pyrosoma*, Ammocoete Larva, *Petromyzon*, , *Scoliodon*, *Sphryna*, *Torpedo*, *Amia*, *Labeo*, *Chimera*, *Acipenser*, , *Lepidosteus*, *Clarius*, *Anguilla*, *Hippocampus*, *Sungnathus*, Flat fish, *Echeneis*, *Exocoetus*, *Protopterus*, *Lepidosiren*, *Ichthyopsis*, *Proteus*, *Necturus*, *Ambystoma*, *Siren*, Axolotl larva, *Salamander*, *Alytes*, *Rachophorus*, *Chelone*, *Testudo*, *Hemidactylus*, *Varanus*, *Phyrnsoma*, *Draco*, *Chameleon*, *Sphenodon*, *Mabuya*, *Eryx*, *Hydrophis*, *Viper*, *Naja*, Krait, *Crocodylus*, *Alligator*, *Gavialis*, *Archaeopteryx*, *Pavo cristatus*, Ostrich, Emu, *Ornithorhynchus*, *Tachyglossus*, *Didelphis*, *Shrew*, *Kangaroo*, Bats, *Manis*, Hedgehog, Porcupine, *Loris*, *Presbyis*, *Macaca*
2. Microscopic slides (Whole Mount): *Doliolum*, *Salpa*, *Oikopleura*, *Amphioxus*. *Amphioxus* T.S. passing through different regions of the body, Ammocoete Larvae T.S. passing through different parts of the body, *Scoliodon*: T.S. passing through different parts of the body, Fish scales, Amphibian skin V.S., Reptilia Skin, V.S., Aves skin V.S., Mammalian histology - T.S. of Liver, Ling, testes, Ovary, pancreas, thyroid, parathyroid, adrenal, stomach, intestine, bone, cartilage, pituitary, skin V.S.
3. Dissection Pisces, Amphibia, Reptilia, Aves, Mammalia : Cranial Nerves, Afferent and efferent branchial arteries, internal ear of *Scoliodo*; Frog cranial nerves
4. Comparative osteology of Frog, *Varanus*, Fowl and Rabbit

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – III

CC-6: BIOMOLECULES AND STRUCTURAL BIOLOGY

Credit: 4

Course Code: ICZOL3C008T

UNIT – I

Chemical foundations of Biology: pH, pK, acids, bases, buffers, weak-bonds, exergonic and endergonic reactions, free energy, high energy compounds – importance of ATP.

UNIT – II

Amino acids and proteins: Characterization-classification-amino acids-structure of protein-primary, secondary, tertiary and quaternary-protein folding and denaturation.

UNIT – III

Carbohydrates: Classification-structure and properties of Monosaccharide Polysaccharides; homo polysaccharides and hetero-polysaccharides.

UNIT – IV

Lipids: Classification and properties of lipids. β -oxidation of fatty acids-defects in lipid metabolism.

UNIT – V

Enzymes: Classification -holoenzyme, coenzyme-cofactor, active site, isoenzyme. Factors affecting enzyme activity-effect of pH, Temperature, enzyme concentration, substrate concentration-mechanism of enzyme action. Enzyme inhibition-irreversible and reversible inhibition.

Practical CC-6: BIOMOLECULES AND STRUCTURAL BIOLOGY Credit: 2

Course Code: ICZOL3C008L

1. Colorimetric determination of pK value
2. Qualitative test for carbohydrates, amino acids, proteins, lipids, nucleic acids and urea (Thiourea)
3. Saponification value of fat.
4. Acids number of fat
5. Estimation of Iodine number

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – III

CC-7: COMPARATIVE ANATOMY OF VERTEBRATES

Credit: 4

Course Code: ICZOL3C009T

UNIT – I

Structure and function of integument and its derivatives in vertebrates. Anatomy of axial and appendicular skeleton in vertebrates. Muscle fibre, types and function in vertebrates.

UNIT – II

Structure and function of digestive system including alimentary canal and associated glands in vertebrates. Structure and function of respiratory system, accessory respiratory organs in vertebrates.

UNIT – III

Structure of heart and circulatory system in vertebrates. Comparative study of excretory system in vertebrates. Evolution of kidney in vertebrates.

UNIT – IV

Comparative study of structure of brain and types of nervous system in vertebrates. Types of sense organs in vertebrates. Thermoregulation. Endocrine system in vertebrates – Endocrine glands, hormones and their function in vertebrates.

UNIT – V

Comparative account of testes and ovaries in vertebrates. Modes of reproduction, estrous and menstrual cycle, implantation, gestation, parturition, lactation and birth control. Ovipary, Ovo-vivipary and Vivipary.

Practical CC-7: COMPARATIVE ANATOMY OF VERTEBRATES

Credit: 2

Course Code: ICZOL3C009L

1. Study of placoid, cycloid and ctenoid scales through permanent slides/ microphotographs
2. Study of axial and appendicular skeleton of vertebrates
3. Comparative study of brain in vertebrates.
4. Comparative study of heart in vertebrates.
5. Comparative study of urino-genital system in vertebrates
6. Carapace and plastron of turtle /tortoise
7. Comparative study of skin in vertebrates through microscopic slides.
8. Integument and its derivatives in vertebrates

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – III

EC-3: BIOTECHNOLOGY

Credit: 4

Course Code: ICZOL3E001T

UNIT-I

Biotechnology - Introduction, concept and scope. History of Biotechnology. Techniques in Gene Manipulation, process of genetic engineering. Recombinant DNA technology. Gene isolation. Restriction enzymes. Cloning Vectors – Plasmids, Cosmids, Phasmids, BAC, YAC, HAC, Shuttle and Expression.

UNIT-II

Transformation techniques in microbes, plants and animals. Mammalian Cell cloning, DNA integration methods- Electroporation and Calcium Phosphate Precipitation method. Animal Cell Culture techniques. Organ Culture techniques. Primary Culture, Cell lines. Culture media-natural and synthetic. Stem Cells, Cryopreservation.

UNIT-III

Techniques in Biotechnology. Agarose and Polyacrylamide Gel Electrophoresis. Southern blotting, Northern blotting and Western blotting. DNA sequencing - Sanger method. Polymerase Chain Reaction. DNA Fingerprinting and DNA microarray. Genetic Engineering, Shot gun cloning, Genomic library, cDNA library. In situ hybridization, DNA probes, site directed mutagenesis.

UNIT-IV

Transgenic Animals. Nuclear transplantation, Retroviral method, DNA microinjection method. Transgenic plants and animals. Examples of transgenic- Dolly, Polly and Transgenic fishes. Single cell protein, Mushroom culture. Human Genome project

UNIT-V

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy. Recombinant Proteins- Insulin, Growth hormones. Bio-safety protocols. Bio-safety of Transgenic organisms. Biofloc Technology.

Practical EC-3: BIOTECHNOLOGY

Credit: 2

Course Code: ICZOL3E001L

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantification using Agarose Gel Electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III
6. Preparation of competent cells and Transformation of *E. coli* with plasmid DNA using CaCl₂, Selection of transformants on X-gal and IPTG (Optional)

7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – III

FC -3 : SERICULTURE

Credit: 4

Course Code: ICZOL3F002T

UNIT – I

Sericulture: Definition, history and present status, Silk Route.

UNIT – I

Types of Silk worm, distribution and races, exotic and indigenous races of Silkworm. Mulberry and Non-mulberry sericulture. Visit to various sericulture centres.

UNIT – III

Biology and rearing of Silkworm, Life cycle of *Bombyx mori*. Structure of silk gland and secretion of silk. Selection of mulberry variety and establishment of mulberry gardens. Rearing houses and rearing appliances.

UNIT – IV

Disinfectants – Formalin, bleaching powder, RKO. Silkworm rearing technology: Early and Late age rearing

UNIT – V

Pests of Silkworm, Uzi fly, dermestid beetles and vertebrates. Pathogenesis of silkworm diseases- Protozoan, Viral, Fungal and Bacterial. Control and prevention of pests and diseases.

SEMESTER – IV

1. Core Courses (CC) (4+2):

CC-8: Animal Physiology

CC-9: Developmental Biology

CC-10: Evolution and Animal Behaviour

2. Elective Course (EC) (4+2):

EC-4: Chemistry

3. Foundation Course (FC) (4):

FC-4: Apiculture

SEMESTER – IV

CC- 8: ANIMAL PHYSIOLOGY

Credit: 4

Course Code: ICZOL4C007T

UNIT – I

Formation and compositions of Blood. Structure and functions of haemoglobin. Haemostasis. Blood coagulation. Kallikrein-Kininogen system, Complement system & Fibrinolytic system. Haemopoiesis. Blood groups. Rh factor, ABO and MN.

UNIT – II

Structure of mammalian heart. Blood circulation. Origin, conduction and regulation of Heart beat. Cardiac cycle. Frank-Starling Law. Nervous and chemical regulation of heart rate. Electrocardiogram. Blood pressure and its regulation.

UNIT – III

Structure of trachea and lungs. Mechanism of respiration. Pulmonary ventilation, respiratory volumes and capacities. Oxygen and carbon dioxide transport in blood. Respiratory pigments. Dissociation curves. Carbon monoxide poisoning. Control of respiration.

UNIT – IV

Structural organization and functions of gastrointestinal tract and its associated glands. Digestion of food - mechanical and chemical. Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins. Nutritional requirements and disorders. Metabolism-concept, pathways and regulatory features. Hormonal control.

UNIT – V

Structure of nephron and kidney. Mechanism of urine formation. Regulation of water balance; Regulation of acid-base balance.

Practical CC-8: ANIMAL PHYSIOLOGY

Credit: 2

Course Code: ICZOL4C007L

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystal.
5. Recording of frog's heart beat under *in situ* and perfused conditions
6. Recording of blood pressure using a sphygmomanometer
7. Microscopic slides of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney
8. Ionic regulation of erythrocytes in two different media
9. Qualitative test for sugars, proteins, lipids
10. Activity of salivary amylase

Note:

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SEMESTER – IV

CC-9: DEVELOPMENTAL BIOLOGY

Credit: 4

Course Code: ICZOL4C008T

UNIT – I

Introduction: Historical perspective and basic concepts: Phases of development, Cell-Cell interactions, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division.

UNIT – II

Early Embryonic Development: Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, egg membrane; Fertilization (External and Internal): Changes in gametes, Planes and Patterns of cleavage; Types of Blastula; Fate maps; Early development of chick up to gastrulation; Embryonic induction and organizers.

UNIT – III

Late Embryonic Development: Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Types of Placenta.

UNIT – IV

Post Embryonic Development: Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Concept, epimorphosis, morphallaxis and compensatory regeneration (with one example each).

UNIT – V

Implications of Development Biology: Teratogenesis: teratogenic agents and their effects on embryonic development; in vitro fertilization, Stem cell (ESC), Amniocentesis

Practical CC-9: DEVELOPMENTAL BIOLOGY

Credit: 2

Course Code: ICZOL4C008L

1. Study of whole mounts and sections of development stages of chick through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of development stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72 and 96 hours of incubation.
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture.
4. Study of different sections of placenta (photomicrograph/slides).
5. Project report on *Drosophila* culture/chick embryo development.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – IV

CC-10: EVOLUTION AND ANIMAL BEHAVIOUR

Credit: 4

Course Code: ICZOL4C009T

UNIT – I

Concept of evolution –Origin of life- geological time scale-formation and dating of fossils

UNIT – II

Theories of organic evolution: Darwinism and Neo - Darwinism; Lamarckism and Neo-Lamarckism; DeVries theory of mutation

UNIT – III

Polymorphism-polyploidy-isolation and speciation-mimicry. Hardy-Weinberg Law of genetic equilibrium-Genetic drift-evolution of horse and man

UNIT – IV

Concept and patterns of behaviour. Instinct and learning, Innate behaviour, Learned behaviour. Types of learning, Role of hormones and pheromones, Control of behaviour. Methods of studying animal behaviour. Orientation, navigation, homing, biological clock.

UNIT – V

Reproductive behaviour, aggressive behaviour. Social organisation, advantages of sociality, the evolution of sociality, communication.

Practical CC-10: EVOLUTION AND ANIMAL BEHAVIOUR

Credit: 2

Course Code: ICZOL4C009L

1. Gene frequencies calculation for human autosomal traits and multiple alleles
2. Study of fossils
3. Mimicry and Polymorphism
4. Animal adaptation, Analogy and homology
5. Study of various animal behaviour

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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EC- 4: CHEMISTRY

Credits: 4

Course Code: ICCHM4E002T

UNIT – I

Atomic structure and wave mechanics: Characteristics of Black-body radiation, Planck's radiation law, Bohr's model of hydrogen atom and its limitations, Rutherford's atomic model, Bohr's theory, Dual nature of electrons, de Broglie hypothesis and its derivation, Heisenberg's uncertainty principle, Quantum numbers and their significance, Atomic orbitals, Shapes of *s*, *p*, *d* orbitals and their characteristics, Aufbau and Pauli exclusion principles, Hund's multiplicity rule and (n+l) rule, Electronic configurations of the elements (*s*, *p* and 3*d*-block elements).

UNIT – II

Chemical bonding: Covalent Bond, Valence bond theory and its limitations, Directional characteristics of covalent bond, Various types of hybridization and Shapes of simple molecules, Valence shell electron pair repulsion (VSEPR) theory, Molecular orbital theory, Postulates, Properties of ionic compounds, Unit cell, Types of unit cells, Packing in ionic solids, Structures of some common ionic solids: NaCl, CaF₂.

UNIT – III

Basics of organic chemistry: Classification and nomenclature of organic compounds, Hybridization, Shapes of molecules, Influence of hybridization on bond lengths, Bond angles and bond energy, Inductive effect, Polar covalent bonds and dipole moment, Delocalized bonds and resonance, Drawing resonance structures, Hyperconjugation, Steric effect, Steric inhibition of resonance, Hydrogen bonding, Inter- and intramolecular hydrogen bonding, Effect on boiling point and solubility.

UNIT – IV

Introduction to organic reaction mechanism: Addition, elimination, substitution and rearrangement reactions, Homolytic and heterolytic C–C bond fission, Electrophiles and nucleophiles, Structure and stability of reactive intermediates: carbocations, carbanions and free radicals.

Aromaticity: Resonance in benzene, Huckel's rule, Aromatic, non-aromatic and anti-aromatic compounds, Aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples.

UNIT – V

Gaseous state of matter: Postulates of kinetic theory of gases, Gas laws from kinetic equation, Relation between kinetic energy and temperature, Thermal motion of molecules, Maxwell distribution of molecular velocities and kinetic energies, Effect of temperature, Most probable velocity, Average velocity and root mean square velocity, Evaluation of these velocities using Maxwell equation, Deviation from ideal behavior, Equation of state for real gases (van der Waals equation), Virial equation of state.

PRACTICAL EC- 4: CHEMISTRY

Credits: 2

Course Code: ICCHM4E002L

General Instructions: Demonstration and concept of good lab practices including safety, chemical/glassware handling, chemical nature understanding, waste management, notebook maintenance.

Part A

1. Calibration and use of apparatus
2. Preparation of solutions of different Molarity/Normality

Part B: Volumetric Analysis:

Acid-Base Titrations

1. Titration of HCl Vs NaOH (strong acid Vs strong base)
2. Titration of HCl Vs Na₂CO₃ (strong acid Vs weak base)
3. Titration of Oxalic acid Vs NaOH (weak acid Vs strong base)

Oxidation-Reduction Titrations

1. Estimation of Fe (II) using KMnO₄.
2. Estimation of oxalic acid using KMnO₄.
3. Estimation of Fe (II) using K₂Cr₂O₇.

Part C: Qualitative inorganic analysis

Qualitative semi-micro analysis of inorganic anions: List of anions: CO₃²⁻, SO₄²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻ etc.

SEMESTER – IV

FC-4: APICULTURE

Credit: 4

Course Code: ICZOL4F001T

UNIT – I

Biology of Bees - History, classification and types. Social Organization of Bee Colony.

UNIT – II

Rearing of Bees. Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth type. Bee Pasturage, selection of bee species for Apiculture.

UNIT – III

Bee keeping equipment. Methods of Extraction of Honey (Indigenous and Modern)

UNIT – IV

Diseases and Enemies - Bee diseases and enemies. Control and preventive measures. Bee Economy - Products of Apiculture, Industry and its Uses (Honey, Bees Wax, Propolis), Pollination.

UNIT – V

Entrepreneurship in Apiculture: Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.

SEMESTER – V

1. Core Courses (CC) (4+2)

CC – 11 Applied Zoology

CC – 12 Immunology

2. Elective Course (EC) (4+2)

EC – 5 Microbiology

EC – 6 Wildlife Conservation and Management

SEMESTER – V

CC – 11: APPLIED ZOOLOGY

Credit: 4+2

Course Code: ICZOL5C006T

UNIT – I

Insects of economic importance. Silk-moth and sericulture, Honey bee and apiculture. Lac insect and lac culture. Insect pests of medical and veterinary importance with special reference to mosquitoes, flies, lice and ticks.

UNIT – II

Vermiculture - Types of earthworm. Biology of *Eisenia foetida*. Rearing of earthworms. Equipments and devices used in vermiculture. Vermicompost Technology. Methods and products. Vermiwash Collection, Composition & use.

UNIT – III

Prawn culture - Types of prawn fishery. Culture of fresh water prawn. Culture of marine prawn. Preparation of farm. Preservation, processing and export of prawn

UNIT – IV

Pisciculture – Essentials of fish culture, Breeding Pond, Fish Seed, Hatching pond. Transport of fish fry to rearing ponds. Harvesting – Preservation of fish – Composite fish forming. By products of fishing industry.

UNIT – V

Poultry Management – Breeds of fowl, Housing and Equipment. Deep litter System, Laying cages. Methods of brooding and Rearing, Debeaking. Management of growers, Layers, Broilers – Feed formulations for chicks, Growers and Broilers. Diseases of fowl. Nutritive value of egg and meat. Incubation and hatching of eggs.

Practical CC-11: APPLIED ZOOLOGY

Credit: 2

Course Code: ICZOL5C006L

1. Prawn culture in laboratory aquarium
2. Apiculture equipments.
3. Demonstration of sericulture methods, rearing of silkworm, different diets, mulberry varieties weight of cocoons at sericulture laboratory
4. How to do Vermicomposting in our Departmental garden? Protocol related to it
5. Poultry breeds, feeding utensils in poultry
6. A visit to piggery/poultry/ apiculture centre/sericulture centre/ Dairy farm/Fish Farm
7. Morphology of Edible, freshwater fishes-Catla, Rohu, *Labeo*, Mrigala, *Notopterus*, *Mystus* sp. *Channa*, *Heteropneustes*, *Wallago*
8. A visit to poultry, candling of egg to check viability, double yolk, incubators used in egg hatching, identify diet related to healthy egg laying.
9. Different types of fishing gears.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified subjected to availability of resources*

SEMESTER – V

CC-12: IMMUNOLOGY

Credit: 4

Course Code: ICZOL5C007T

UNIT – I

Overview of Immune system, Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system.

UNIT – II

Innate and Adaptive Immunity, Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial (Vaccines) and natural Immunity, Immune dysfunctions (Brief account of autoimmunity with references to rheumatoid Arthritis and tolerance, AIDS).

UNIT – III

Antigens: Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes.

UNIT – IV

Immunoglobulins, Structure and function of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.

UNIT – V

Major Histocompatibility Complex, Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation, Cytokines-Properties and functions of cytokines, Therapeutic Cytokines.

Practical CC-12 : IMMUNOLOGY

Credit: 2

Course Code: ICZOL5C007L

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs.
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
6. Demonstration of ELISA

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified which is subject to availability of resources*

SEMESTER – V

EC – 5: MICROBIOLOGY

Credit: 4

Course Code: ICZOL5E008T

UNIT – I

History of Microbiology. Milestones of the historical development of Microbiology. Discovery of Microorganisms. Contributions of Antony von Leeuwenhoek. Theory of spontaneous generation and biogenesis. Contributions of Edward Jenner, Louis Pasteur, Joseph Lister, Robert Koch, Metchnikoff, Beijerinck, Ivanowsky, Alexander Fleming, Selman Waksman (in brief).

UNIT-II

The Microbial World. Groups of microorganisms: Viruses, Prokaryotes (Cyanobacteria, Bacteria), Eukaryotes (Algae, Fungi, Protozoa). Study of ultra structure of typical prokaryotic cell and eukaryotic cell and its comparative account. General Principles of classification and nomenclature of microorganisms (Haeckel's three kingdom classification and Whittaker's five kingdom classification)

UNIT – III

Types of microscopes, their construction and working principles, Simple microscope (dissection microscope), Compound microscope (Types of microscopy Bright field, Dark field, Phase contrast and Fluorescence), SEM, TEM. Stereomicroscope. Recent developments in the field of Microbiology. Branches of Microbiology. Scope of Microbiology.

UNIT – IV

Bacteria - Occurrence, shape and arrangement of bacterial cells, Structure of bacterial cell – cell wall (Gram positive or Gram negative), capsule, cell membrane, cytoplasm, ribosomes, nucleoid, plasmids, flagella, pili (fimbriae), inclusion bodies, multiplication by cell division, endospore formation classification in brief as per Bergey's Manual of Systematic Bacteriology.

UNIT – V

Viruses - Definition, history of virology, General characteristics of viruses – size, shape and chemical composition, properties used for classification of viruses, isolation and identification of viruses. Study of structure and replication of viruses: Bacteriophages - T4 phage. Cyanophages. – LPP, Phytophagenaec – TMV, Zoophagenaec – Influenza and HIV. Importance of viruses. Viroids and Prions

Practical EC-5 MICROBIOLOGY

Credit: 2

Course Code: ICZOL5E008L

1. Study of simple and compound microscopes, their handling including oil immersion objective
2. Preparation of stains, mordant and mounting media – Methylene blue, Crystal violet, Safranin, Nigrosin, Carbol Fuchsin, Malachite green, Gram's iodine, Cotton blue, Glycerine & Lactophenol
3. Preparation of microorganisms for light microscopic observation – simple (direct and indirect) staining, differential staining (Gram-staining), Structural staining – capsule and endospore of bacteria)
4. Staining and mounting of algae and fungi.
5. Microscopic measurements of microorganisms/spores using stage and ocular micrometer.
6. Demonstration of laboratory equipments – autoclave, pressure cooker, hot air oven, incubator, Inoculation hood/ chamber, Inoculation loop, Inoculation needle, membrane filter and colony counter.

7. Preparation of chromic acid and its use. Use and mode of action of detergents, disinfectants – phenol ethyl alcohol, formaldehyde, mercuric chloride and iodine.
8. Display of photographs of microscopes mentioned in the theory.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – V

EC –6 : WILDLIFE CONSERVATION AND MANAGEMENT

Credit: 4

Course Code: ICZOL5E009T

UNIT – I

Introduction to wildlife, values of wildlife - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies: WCS, CBD, Agenda 21.

UNIT – II

Evaluation and Management of Wildlife and Wildlife Habitat. Habitat analysis - Physical parameters, Topography, Geology, Soil and Water; Biological Parameters - food, cover, forage, browse and cover estimation. Standard evaluation procedures. Remote sensing and GIS. Habitat Management, setting back succession, grazing logging; Mechanical treatment; Advancing the successional process. Cover construction. Restoration of degraded habitats. Preservation of general genetic diversity.

UNIT –III

Population Estimation, Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, and Hair identification; Pug marks and Census methods.

UNIT– IV

Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animals: Zoonosis (Ebola and Salmonellosis), Rabies, Foot and Mouth Disease, *Mycobacterium* TB, Bovine and Avian Flu

UNIT – V

Management Planning of Wildlife in Protected Areas. Estimation of carrying capacity; Human-wildlife conflict; Eco tourism / wild life tourism in forests; Climax communities: characteristics and theories; Ecology of purterbance. Protected Areas, National parks and sanctuaries; Biosphere reserves; Conservation and Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India and Management challenges in Tiger reserve.

Practical EC-6 : WILDLIFE CONSERVATION AND MANAGEMENT

Credit: 2

Course Code: ICZOL5E009L

1. Identification of mammalian fauna, avian fauna, herpeto-fauna through direct and indirect evidences seen on a field trip to a wildlife conservation site.

2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field: Identification of animals through pug marks, hoof marks, scats, nests and antlers.
4. Demonstration of different field techniques for flora and fauna: PCQM.
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).
6. Identification of big cats: Lion, tiger, panther, cheetah, leopard and jaguar.
7. A report based on a visit to National Park/Wildlife Sanctuary/Biodiversity Park or any other wildlife conservation site.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.
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SEMESTER – VI

1. Core Courses (CC) (4+2):

CC-13: Ecology

CC-14: Parasitology

CC-15: Dissertation (Credit – 06)

2. Elective Course (EC): (4+2)

EC-7: Basics of Neurosciences

SEMESTER – VI

CC-13: ECOLOGY

Credit: 4

Course Code: ICZOL6C003T

UNIT – I

Define Ecology, importance of studying Ecology. Concept of Ecosystem, Ecological niche, habitat and ecological equivalents. Energy flow through an ecosystem, Laws of thermodynamics. Food chain and food web. Nutrient cycling: Nitrogen and Sulphur. Productivity of an ecosystem : Primary and Secondary

UNIT – II

Organization of communities: Characteristics of a community. Ecological dominance, species diversity in communities, Ecotones and Edge Effect. Ecological Succession: Concept and types of pioneer species and climax communities, climax concept and mechanism of succession. The terrestrial biota. Aquatic zonation and biota

UNIT – III

Attributes of a population – Natality, Mortality, Age Distribution, Biotic Potential, Population growth forms, Carrying Capacity concept. Population structure, Aggregation and Allee's principle, Isolation and Territoriality, dispersal and dispersion. Biological invasion. Negative Interactions - Competition, Parasitism and Predation. Positive Interactions – Commensalism, Cooperation and Proto-cooperation, Mutualism and Social behaviour.

UNIT – IV

Biogeographical regions of India – Trans Himalayan zone, Himalayan zone, Desert, Semi Arid, Western Ghats, Deccan Plateau, Gangetic Plains, North East, Coasts. Andaman Nicobar Island

UNIT – V

Remote Sensing and Geographic Information System: Definition, Importance and application. Biodiversity –its types and factors effecting biodiversity. Biodiversity assessment, conservation and management. Non-conventional source of energy and their utilization. Environmental Impact Assessment. Ecological Modelling.

Practical CC-13: ECOLOGY

Credit: 2

Course Code: ICZOL6C003L

1. To study the density and frequency of a population by quadrat method.
2. To study the concept of food chain and food web.
3. To study the primary productivity through the light and dark bottle method.
4. To study the concept of ecological succession through model.
5. To study the terrestrial biota, aquatic biota.
6. To study the Biogeographical Realms of India.
7. To study the remote sensing technique.
8. To study the Geographic Information System (GIS).
9. To study some physico-chemical parameters of water.
10. To study the soil ecology.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – VI

CC-14: PARASITOLOGY

Credit: 4

Course Code: ICZOL6C004T

UNIT – I

Introduction to Parasitology, brief introduction of parasitism, parasite, parasitoid and vectors (mechanical and biological vector). Host parasite relationship

UNIT – II

Parasitic Protozoists, Study of morphology, life cycle, prevalence, epidemiology, pathogenicity, diagnosis, prophylaxis and treatment of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambianse*, *Leishmania donovani* and *Plasmodium vivax*

UNIT – III

Parasitic Platyhelminthes, Study of morphology, life cycle, prevalence, epidemiology, pathogenicity, diagnosis, prophylaxis and treatment of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana*

UNIT – IV

Parasitic Nematodes Study of morphology, life cycle, prevalence, epidemiology, pathogenicity, diagnosis, prophylaxis and treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancroftii* and *Trichinella spiralis*. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), *Pratylenus*

UNIT – V

Parasitic Arthropoda, Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius*. Parasitic Vertebrates, brief account of parasitic vertebrates, Cookicutter Shark, Candiru, Hood mocking bird and Vampire bat

Practical CC-14: PARASITOLOGY

Credit: 2

Course Code: ICZOL6C004L

1. Study of life stages of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambianse*, *Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs
2. Study of adult and life stages of *Fasciolopsis buski*, *Schistosoma haematobium*, *Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
3. Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancroftii* and *Trichinella spiralis* through permanent slides/micro photographs
4. Study of plant parasite root knot nematode *Meloidogyne* from the soil sample
5. Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/photographs
6. Study of monogenea from the gills of fresh/marine fish
7. Study of nematode/cestode parasites from the intestines of Poultry bird

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – VI

CC- 15: DISSERTATION

Credit: 6

Course Code: ICZOL6C001T

- Small project work will be assigned to the student.
- Evaluation on the basis of regular presentation.

Final dissertation report will be submitted at the end of semester.

SEMESTER – VI

DSE- 7: BASICS OF NEUROSCIENCE

Credit: 4

Course Code: ICZOL6E002D

UNIT – I

Introduction to Neuroscience: Origins of Neuroscience; Neuroanatomy, Neurophysiology and Systems Neurobiology.

UNIT – II

The Nervous system-An Introduction: Introduction to the structure and function of the nervous system: Cellular components: Neurons, Neuroglia. The prototypical neuron-axons and dendrites as unique structural components of neurons. The ionic bases of resting membrane potential; the action potential-its generation and properties; the action potential conduction.

UNIT – III

Cellular and Molecular Neurobiology: Molecular and cellular approaches used to the CNS at the level of single molecules, Synapse: Synaptic transmission, types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission.

UNIT – IV

Neurotransmitters: Different types of neurotransmitters- catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

UNIT – V

Neurobiology and Neuropharmacology of Behaviour: The principles of signal transduction and information processing in the vertebrate central nervous system and the relationship of functional properties of neural systems with perception and behavior; sensory system, molecular basis of behavior including learning and memory. Molecular pathogenesis of neurodegenerative diseases such as Parkinson's and Alzheimers's.

Practical EC-7: BASICS OF NEUROSCIENCE

Credit: 2

Course Code: ICZOL6E001L

1. Study of human brain anatomy.
2. Study of human eye structure.
3. Study of human internal ear structure.
4. Staining and sectioning techniques.
5. Nerve cell preparation from the spinal cord.
6. Study of neurons by Nissl, Giemsa or Luxol Fast Blue staining.
7. Study of novelty, anxiety and spatial learning

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified which is subject to availability of resources*

M.SC. ZOOLOGY (SEMESTER VII TO X)

SEMESTER – VII

1. Core Courses (CC):

CC-16: Cytogenetics and Molecular Biology (4)

CC-17: Tools and Techniques (4)

CC-18: Ethology (4)

CC-19: Non-chordate Biology (4)

2. Elective Course (EC):

EC-8: Bioinformatics (4)

SEMESTER – VII

CC-16: CYTOGENETICS AND MOLECULAR BIOLOGY

Credit: 4

Course Code: ICZOL7C006T

UNIT-I

Genetic material & Genome: Genome size, gene density, ultra structure of Chromosomes in prokaryotic & eukaryotic cell. DNA supercoiling and topoisomerases, repetitive DNA, transposons. DNA structure, - single stranded and double stranded DNA, -, ZDNA, B-DNA. Equivalence rule, Packaging of DNA: Nucleosome and solenoid. Specialized chromosome types- Lampbrush and Polytene chromosomes. Accessory chromosomes, occurrence, behaviour, transmission and origin. Organization of chloroplast and mitochondrial genomes. Numerical and structural chromosomal variations.

UNIT-II

DNA replication (both prokaryotic and eukaryotic), Enzymes of DNA replication. Molecular mechanism of DNA replication. Prokaryotic and Eukaryotic transcription, RNA polymerases, General and specific transcription factors, Regulatory elements involved in regulation of transcription. Transcriptional and post-transcriptional mechanisms, gene splicing. Post-transcriptional modification in RNA- Cap formation, End processing and polyadenylation, Splicing and editing, Nuclear export of mRNA, & RNA stability

UNIT-III

Prokaryotic and eukaryotic translation, Translation machinery; Ribosomes, Composition and assembly: Genetic code, Mechanism of initiation, elongation and termination, Regulation of translation. Recombination and repair - Holliday junction, gene targeting and gene disruption, FLP/FRT and Cre-Lox recombination, Rec-A and other recombinases. Regulation of Gene expression both in Prokaryotes and eukaryotes, Lac Operon concept, Role of cAMP receptor molecule, *gai*-operon model DNA repair mechanisms

UNIT-IV

Gene Structure and Function- Concept of gene, *dis-trans* test. *rII* Locus of T4 phages, complex loci in eukaryotes, Gene function, transcription and translation in pro- and eukaryotes. Regulation of gene expression in pro and eukaryotes. Gene controlled biosynthetic pathway Viz: Anthocyanin, Phenylalanine- tyrosine, Haemoglobin biosynthesis.

UNIT-V

Genome influx - Mobile genetic elements in prokaryotes and eukaryotes, mechanism of DNA repair. Gene therapy and Human Genome Project, Genetic basis of following: Huntington's disease, Cystic fibrosis, Duchene Muscular Dystrophy, Hemophilia, Thalassemia, G-6PD and Fragile-X

SEMESTER – VII

CC-17: TOOLS AND TECHNIQUES

Credit: 4

Course Code: ICZOL7C007T

UNIT-I

Principles and uses of analytical instruments - pH meter, Colorimeter, Chromatography electrophoresis, centrifugation and density gradient centrifugation. Ultracentrifuge, Radioisotope, mass isotope techniques in biology: sample preparation for radioactive counting, Autoradiography, metabolic labelling and magnetic resonance imaging (MRI), UV-Visible Spectrophotometer, Densitometer, spectrofluorometer, chemoluminometers, radioactivity counters, differential scanning calorimeter and HPLC, NMR spectrometers, principles of Ground and remote sensing methods

UNIT-II

Microscopy - Principle of light transmission, numerical aperture, limit of resolution, types of objectives, ocular & stage micrometers, bright field microscope, dark field microscope, electron microscope, phase-contrast, fluorescence, confocal, scanning electron microscopes. Microphotography and image analyzers. Microbiological techniques

UNIT-III

Cell culture techniques – Culture Media preparation, cell harvesting and sterilization, Inoculation and growth monitoring, use of fomenters, biochemical mutants and their uses, methods of microbial assays, Cell proliferation measurements, Cell viability testing, Design and functioning of tissue culture laboratory. Cryotechniques- Cryopreservation for cells, tissue, organisms, Cryotechniques for microscopy, Freeze-drying for physiologically active substances

UNIT-IV

Detection of proteins, DNA-protein and protein-protein interaction. Western blotting, DNA foot printing, EMSA, restriction enzymes, cloning vectors, preparation and screening of cDNA and genomic DNA libraries, Polymerase chain reaction principle and application

UNIT-V

Principles of radiation protection, Radioactivity and decay, Radiation interaction, beam quality and dose, half-life. Radioactive measurements and calibrations. Applications of radioisotopes in biological sciences. Measurement of radioactivity (alpha, beta & gamma radiations), Safety and precautionary measures

SEMESTER – VII

CC-18: ETHOLOGY

Credit: 4

Course Code: ICZOL7C008T

UNIT-I

Introduction to Ethology- Branches and significance of Ethology, Ethophysiology. Ethoendocrinology, Neuroethology, Human ethology, Behavioural genetics and Sociobiology. Concept of Ethology: Introduction, definition and outline, Fixed action pattern

UNIT-II

Social organization and its advantages. Social behaviour, Parental care. Courtship and mating, aggression and territorial behaviour, evolution of social systems. Home range, Core area.

UNIT-III

Neuroethology - Structure of mammalian brain and behaviour. Hypothalamus and innate behaviour. Behavioural endocrinology. Orientation- taxis and kinesis, bird migration and navigation

UNIT-IV

Learning and Imprinting: Introduction, Habituation, Conditioning, Trial and Error. Neural mechanism of learning, short and long term memory, neural mechanism of learning. Feeding and sexual strategies in animals. Chronobiology

UNIT-V

Co-operation, Reciprocation, Altruism, Reciprocal Altruism, Proximate and ultimate causation, Kin Selection, group selection, Darwinian fitness, individual fitness. Communication in animals: Tactile, visual, Auditory, Echolocation, Infra and ultra sounds, Pheromones in invertebrates and vertebrates, Honey bee language, circle dance, waggle dance.

SEMESTER – VII

CC-19: NONCHORDATE BIOLOGY

Credit: 4

Course Code: ICZOL7C009T

UNIT-I

Structural organization of non-chordates – Origin of Protozoa, parazoa, metazoa, radiata and bilateria, Body plan and symmetry, Origin, characters and types of metamerism, Coelom organization: Origin, evolution and types of coelom, Minor phyla: origin, significance and salient features

UNIT-II

Locomotion in non chordates – Locomotory organs and types of locomotion: Amoeboid locomotion, Ciliary locomotion, Flagellar locomotion, Non jointed appendages, Jointed appendages, Hydrostatic movements, Mechanism of locomotion

UNIT-III

Feeding and digestion & Respiration in non chordates. Feeding types and methods, Microphagy, Macrophagy, Herbivores, Omnivores, Carnivores, Filter feeding, Ciliary feeding, Intracellular and extracellular digestion. Respiration in non chordates, Organs of respiration, Respiratory pigments, Mechanism of respiration

UNIT-IV

Primitive nervous system, Advanced nervous system, Neurosecretory cells. Endocrine structure and role of hormones in moulting and metamorphosis in insects and crustaceans. Excretion in non chordates, Organs and mechanism, Osmoregulation

UNIT-V

Reproduction in non chordates – Asexual reproduction, Sexual reproduction, Parthenogenesis, Regeneration. Significance of Larval forms in Non Chordates.

SEMESTER – VII

PRACTICAL 1 (Based on CC-16, CC-17 and CC-18)

Credit: 6

Course Code: ICZOL7C006L, ICZOL7C007L and ICZOL7C008L

CC-16 (2)	<ol style="list-style-type: none">1. Preparation and study of metaphase chromosomes2. Preparation of human karyotype and study of chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided.3. Study of transcriptional activity in polytene chromosome upon heat shock induction by uridine incorporation.4. Study of sex chromatin in buccal smear and hair bud cells (Human).
CC-17 (2)	<ol style="list-style-type: none">1. Gel filtration2. Density gradient centrifugation3. Thin layer chromatography4. Spectrophotometry5. Microscopy and Histological techniques6. Setting up of darkfield and phase contrast microscope7. Measurement of microscopic object by using ocular & stage micrometer8. Study of bacterial growth curve9. Estimation of fractionated molecules from spectrophotometric methods
CC-18 (2)	<ol style="list-style-type: none">1. An introduction to animal behaviour – Animal Psychology2. Classification of behavioural patterns3. Perception of the environment – Examples4. communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)5. Ecological aspects – Food selection, optimal foraging, prey and predator, Host-Parasite relations6. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization – insects7. Reproductive behaviour – mating systems, sexual selection, parental care8. Biological rhythms – examples – migration of fish, turtle and bird

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – VII

PRACTICAL 2 (Based on CC-19 and EC-8)

Credit: 2

Course Code: ICZOL7C009L

CC-19	<ol style="list-style-type: none">1. Study of structural organization of non-chordates2. Types of Body plan, Symmetry.3. Body segmentation4. Locomotor organs in non-chordates5. Feeding mechanism in non-chordates6. Respiration in non-chordates7. Nervous system in Non chordates8. Osmoregulation9. Larval forms
EC-8	<ol style="list-style-type: none">1. Accessing different biological databases2. Retrieval of nucleotide and protein sequences from the databases.3. To perform pair-wise alignment of sequences (BLAST) and interpret the output4. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences5. Predict the structure of protein from its amino acid sequence.

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – VII

EC - 8: BIOINFORMATICS

Credit: 4

Course Code: ICZOL7E001T

UNIT-I

Introduction to bioinformatics. Importance and scope of bioinformatics. Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics.

UNIT-II

Introduction to biological databases. Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD)

UNIT-III

Introduction to Data Generation and Data Retrieval. Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez).

UNIT-IV

Basics of sequence alignment. Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.

UNIT-V

Application of Bioinformatics- Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts). Introduction to computational genomics and proteomics.

SEMESTER – VIII

1. Core Courses (CC):

CC- 20: Biochemistry (4)

CC- 21: Human Physiology (4)

CC- 22: Aquatic Biology (4)

CC- 23: Chordate Biology (4)

2. Elective Course (EC):

EC-9: Biostatistical Methods (4)

SEMESTER – VIII

CC-20: BIOCHEMISTRY

Credit: 4

Course Code: ICZOL8C006T

UNIT-I

Introduction to Biochemistry – Reaction kinetics and mechanism, Chemical equilibrium, Natural products with their physiological and pharmacological importance. Types of macromolecules and their general properties. Second law of thermodynamics and its application. Concept of free energy and calculations based on free energy change.

UNIT-II

Amino Acids and Proteins- Structure, function and properties of Amino acids. Types of proteins and their classification, Forces stabilizing protein structure and shape. Structural organization of proteins. Protein purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. Proteins as mediators of all physiological and behavioural processes. Proteins as inter-cellular communication signals and signal recognition mediators

UNIT-III

Carbohydrate & Lipid metabolism- Concept of metabolic pathways. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. Metabolism of fats. β -oxidation and synthesis of fatty acids

UNIT-IV

Nucleic acids: Double helical model of DNA structure and forces responsible for A, B & Z-DNA, Denaturation and renaturation of DNA. Structure, folding motifs, conformational flexibility and supercoiling, DNA replication, DNA polymerases, Origin of replication and formation of primosome, Replication fork and replisome, Termination of replication, Transcription unit, split genes, Mechanism of transcription, RNA polymerases, Formation of pre-initiation complex at RNA pol II promoter, Processing of hnRNA Capping, Poly(A) tailing, Splicing, Mechanism of translation, Role of ribosomes and tRNAs, Formation of initiation complex, Elongation and termination

UNIT-V

Enzymes: Nomenclature and classification of Enzymes, monomeric & oligomeric enzymes. Activation energy and transition stage, enzyme activity, specific activity, common features of active sites, Enzyme specificity: types & theories, Derivation of Michaelis-Menten equation, related calculations and MM & LB plots. Biocatalysts from extreme thermophilic and hyper thermophilic archaeobacteria. Role of NAD⁺, NADP, FMN/FAD, coenzyme A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

SEMESTER – VIII

CC-21: HUMAN PHYSIOLOGY

Credit: 4

Course Code: ICZOL8C007T

UNIT-I

Physiology of Nutrition and Digestion: The essential nutrients, vitamins, minerals, water. The concept of 'balanced diet'. Carbohydrate, lipid and protein metabolism, An overview of human digestive tract. Digestion and absorption of carbohydrates, proteins and fats, Neural and endocrine regulation of gastro-intestinal movement and secretion, obesity, starvation and stimulation of hunger and thirst.

UNIT-II

Physiology of Respiration and Circulation: An overview of human respiratory system, Respiratory movements and the exchange of respiratory gases at pulmonary surfaces, Neural and humoral control of respiration. Transport of respiratory gases in blood, Respiratory 'acidosis' and 'alkalosis' The concept of 'alkali- reserve' and regulation of blood pH. Respiratory disorders: hypoxia and oxygen therapy, dyspnea, high altitude respiration. An overview of human circulatory system: The Myogenic heart, Pacemaker system and conducting fibers, Neural, humoral and pharmacological regulation of cardiac amplitude and frequency. Cardiac cycle, cardiac output, blood pressure and its regulation, Blood components and their functional significance. Blood coagulation and factors involved in coagulation. Haemopoiesis and blood groups, Lymph- composition and dynamics, Disorders of circulatory system: coagulation disorders, hypertension, atherosclerosis and anemia.

UNIT-III

Physiology of Human Nervous system - Structure and types of neurons, neuralgia, myelination. Electrical signals and signal transmission. Membrane channels, resting and action potentials, propagation of nerve impulses, synapses and types, synaptic knobs and synaptic potentials. Neurotransmitters: Physiological role of acetyl choline, aminoacids, GABA, catecholamines, nitric oxide and neuropeptides. Disorders of the nervous system: multiple sclerosis, epilepsy, neuropathy, Guillain-Barre syndrome. Neurotoxicity: neurotoxins, anaesthetics, neurotransmission inhibitors. General properties of sensory receptors-chemical, hearing and vision.

UNIT-IV

Physiology of Human Muscular System- An overview of the muscular tissue: Types of muscle tissue, properties and functions of the muscle tissues. Skeletal muscle tissue and types. Contraction and relaxation processes and metabolism of skeletal muscle fibers. Physiology of smooth muscle. Disorders of muscular system: Myasthenia Gravis, muscular dystrophy, fibromyalgia, muscular atrophy and hypertrophy Rigor Mortis.

UNIT-V

Physiology of Human Urinary and Reproductive system. An overview of human urinary system. The functional anatomy of human kidney and the functional units. Ultrafiltration, reabsorption and secretion as transport mechanisms involved in urine formation. Control of urinary concentrations of glucose, urea, sodium and potassium ions and hydrogen ions and pH of urine. Role of kidney in body water, electrolyte and acid-base balance. Physiological roles of aldosterone, anti-diuretic hormone and rennin-angiotensin system in renal functions. Renal malfunctions and hemodialysis. An overview of organization of human male and female reproductive systems. Histological features of male and female gonads. The process of gametogenesis (spermatogenesis and oogenesis). Phases and hormonal regulation of female

reproductive cycles. Birth control: Physiology of birth control methods. Disorders of reproductive systems: testicular cancer, prostate disorders, cryptorchidism and hernias, PMS, PMDD, ovarian and cervical cancers.

SEMESTER – VIII

CC-22: AQUATIC BIOLOGY

Credit: 4

Course Code: ICZOL8C008T

UNIT – I

Aquatic Biomes - Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT – II

Abiotic factors: Physico-chemical Characteristics: Light, Temperature, Turbidity. Thermal stratification, dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates,; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in aquatic system- Nitrogen, Sulphur and Phosphorus. BOD, COD. Biotic Factors.

UNIT – III

Freshwater Biology: Lakes - Origin and classification, Lakes as an Ecosystem, Lake morphometry.

Streams: Different stages of stream development. Fish adaptations in different aquatic environment.

UNIT – IV

Marine biology: salinity and density of sea water, Continental shelf, Adaptations of deep sea organisms, Corals reefs, Sea weeds.

UNIT – V

Management of Aquatic Resources Causes of Pollution: Agricultural, industrial, Sewage, Thermal and Oil spills, Eutrophication. Conservation of Aquatic Resources. Sewage treatment,

SEMESTER – VIII

CC-23: CHORDATE BIOLOGY

Credit: 4

Course Code: ICZOL8C009T

UNIT-I

Origin of chordates - Interrelationship of Hemichordata, Urochordata, Cephalochordate and their relationship with other Deuterostomes. Evolutionary significance of notochord and endostyle

UNIT-II

Origin evolution and general characters of agnatha with respect to Ostracoderms and Cyclostomes, An account of early Gnathostomes with reference to their origin. Origin and evolution of Elasmobranchii, Holocephali, Dipnoi and Crossoptergii. Origin, evolution and adaptive radiation of bony fishes. Evolution of air/swim bladders

UNIT-III

Origin, evolution and adaptive radiation of amphibians. Conquest of land, origin of Seymouria and Cotylosauria. Origin, evolution and adaptive radiation of Reptilia. Origin of Dinosaurs. Living reptiles with respect to Rhyncocephalia, chelonia, Squamata and Crocodilia . evolution of skull, heart, visceral arches and sensory organs in reptiles, Evolution of cleidoic egg with its structural and physiological adaptations. Evolution of amniotic sac

UNIT-IV

Origin of Aves. Connecting link between reptiles and birds with its general characters of ancestors Origin and evolution of birds. Origin of flight, flight mechanism. & flight adaptation in birds. modifications of beak, feet and palate in birds. Adaptive radiation in birds

UNIT-V

Origin of Mammals. Origin, evolution and adaptive radiation of mammals - origin and evolution of Prototheria, Metatherian, Eutheria,

SEMESTER – VIII

PRACTICAL Based on CC-20, CC-21 and CC-22

Credit: 6

Course Code: ICZOL8C006L, ICZOL8C007L and ICZOL8C008L

CC-20 (2)	<ol style="list-style-type: none">5. To study the effect of pH, temperature on the activity of salivary amylase enzyme.6. Preparation of buffers.7. Qualitative tests for carbohydrates, lipids and proteins.8. Estimation of blood glucose by glucose oxidase method.9. Separation of Amino acids by paper chromatography.10. Demonstration of dialysis
CC-21 (2)	<ol style="list-style-type: none">1. Observe and compare the inherent rhythmicity of the different parts of the heart.2. Determine the effects of application of parasympathetic or sympathetic agonists/ antagonists.3. Determine the response of the heart to direct electrical stimulation / vagal stimulation.4. Effects of drugs and hormones on contraction of smooth muscles.5. To examine the relative activity of enzymes in the fore, mid, and hindgut of a typical insect and to correlate the enzyme activity with gut regions.6. To determine the median threshold concentration of sucrose for housefly population.
CC-22 (2)	<ol style="list-style-type: none">1. Methods of Sterilization, Preparation of culture media and agar slants2. Estimation of microflora of milk by MBR and Resazurin, C.S. of stem and Root nodule of leguminous plants3. Conn's direct microscope count of soil microbial population4. Standard plant count, Antibiotic Assay-Streptomycin, Purification of Bacteria5. Agarose gel Electrophoresis, Study of Biogas plant

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified subjected to availability of resources*

SEMESTER – VIII

PRACTICAL Based on CC-23 and EC-9)

Credit: 6

Course Code: ICZOL8C009L

CC-23	<ol style="list-style-type: none">1. Comparative anatomy of integument and their derivatives in chordates2. Comparative osteology3. Comparative account of structure of Heart, Kidney, Brain
EC-9	<ol style="list-style-type: none">1. Understand types of sampling methods in Life Sciences2. Collection of data for bio statistical analysis3. Representation of collected data following diagrams4. Representation of collected data following graphs5. Calculate Mean from the given data set6. Calculate Mode from the data set7. Calculate Median from the given data set8. Compute Mean Deviation from the given data set9. Compute Standard Deviation from the given data set10. Calculate correlation coefficient from the given data set11. Identify regression from the given data set12. Understand and compute from the given data set:<ol style="list-style-type: none">a. Student's t Testb. Paired t testc. Chi square testd. F teste. One way ANOVAf. Two-way ANOVA13. Various types of statistical analysis software used for data analysis in Life Sciences

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified subjected to availability of resources*

SEMESTER – VIII

EC - 9: BIostatistical Methods

Credit: 4

Course Code: ICZOL8E001T

UNIT – I

Basic concepts of sample and sampling - Simple random sample, Stratified sample, Systematic sampling. Sampling distribution and standard error. Nature of biological and clinical experiments and data. Collection of data in experiments-Primary and Secondary data, Methods of Data collection. Classification of data, Frequency distributions and Tabulation of data

UNIT – II

Diagrams and graphs of data, Bar diagrams, Pie diagram, Frequency curve, Histogram, Ogive

UNIT – III

Tests of significance based large samples. Test for mean, different of means, proportion and equality of proportions. Measure of Averages-Mean, Median and mode. Use of these measures in biological studies. Measures of Dispersion for biological characters-Quartile Deviation. Mean Deviation. Standard Deviation. Coefficient of variation. Measures of skewness and Kurtosis.

UNIT – IV

Correlation and Regression theory, Correlation coefficient-Rank, regression equations. Simple problems based on biochemical data

UNIT – V

Small sample Tests -Student 't' test for mean, difference of two means. Paired t-test. Test for correlation and regression coefficients. Chi-square test for goodness of fit and independence of attributes. F test for equality of variances, Analysis of variance-one way and two way classification.

SEMESTER – IX

1. Core Courses (CC):

CC-24: Research Methodology in Life Sciences (4+2)

CC-25: Evolutionary Biology (4)

CC-26: Endocrinology (4)

2. Elective Course (EC) (4+2):

Group A:

(EC -10) Set I - Applied Entomology

(EC -11) Set II - Fish Biology

(EC -12) Set III - Neurobiology of Brain Diseases and Aging

(EC -13) Set IV- Animal Systematics and Taxonomy

Group B:

(EC -14) Set I- Integrated Pest Management

(EC -15) Set II- Limnology

(EC -16) Set III - Cognitive Neuroscience

(EC -17) Set IV - Wildlife Biology

SEMESTER – IX

CC-24: RESEARCH METHODOLOGY IN LIFE SCIENCES

Credit:04

Course Code: ICZOL9C006T

UNIT-I

Research area and literature search: Basic versus applied; Narrowing down to a sub area. Importance and methods (including choice of key words). Learning to distinguish between regional work, repetitive work and validation study

UNIT-II

Research question and strategy framing: Identification of lacuna in the research area of interest. Hypothesis generation; defining the aims/objectives; Revising objectives at a later date. Study design, Importance of inclusion of negative and positive experimental controls, biological and technical replicates, single- and double-blind studies. Coding/anonymisation of samples, statistics-based sample size determination prior to finalization of study design

UNIT-III

Observation, Analysis, and Presentation of work: Importance. Methods of transparent and systematic record keeping; Maintenance of laboratory work books-hard and soft copies; Storage of data including taking regular backups. Hypothesis testing; hypothesis generation, unbiased analysis, importance of looking beyond the obvious, serendipitous findings. Independent cross validation of data; interpretation of data. Raw and analysed data; Methods-Graphic, pictorial, tabular, oral, poster.

UNIT-IV

Scientific writing, Research Ethics and Issues in applied Research: Abstract, synopsis, concept note, full length research proposal, research paper, thesis writing, Importance and styles of citing literature/references. Honesty, acknowledgement of contribution, authorship issues, plagiarism, fraud. Genetically modified food; ethical, legal and social issues in biomedical research.

UNIT-V

Safety in research, Regulatory bodies and IPR issues: Handling of bio hazardous substances, disposal of bio hazards waste. Bio safety issues-Chemical, radiation, recombinant DNA, biological material. Institutional ethics committee, Institutional biosafety committee, Animal ethics committee. History and Philosophy of Intellectual Property, Understanding Copyright, Understanding Patents, Understanding Trademarks, Other IP

SEMESTER – IX

CC-25: EVOLUTIONARY BIOLOGY

Credit: 4

Course Code: ICZOL9C007T

UNIT-I

Introduction to Evolutionary Biology. Classification, Phylogeny & the tree of life. Patterns of evolution; Evolution & fossil record; Origin of cells and unicellular evolution. Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; the first cell; Evolution of: Unicellular eukaryotes; prokaryotic and eukaryotic cells

UNIT-II

Emergence of evolutionary thoughts and mechanisms: Lamarck; Darwin's concepts of variation, Adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis

UNIT-III

Population genetics and Evolution- Two locus and multilocus genetics- Linkage disequilibrium- Balanced theory of evolution. Genome and Evolution- Genes and gene clusters- Origin of new genes by gene duplication (Ohno's concept)-Selfish DNA- Karyotypic evolution (*Drosophila*)

UNIT-IV

Paleontology and evolutionary history: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multicellular organisms; Stages in primate evolution.

UNIT-V

Molecular Evolution: Concepts of neutral evolution, Molecular divergence and molecular clocks. Molecular tools in phylogeny, classification and identification. Protein and nucleotide sequence analysis; Origin of new genes and proteins; micro and macro evolution

SEMESTER – IX

CC-26: ENDOCRINOLOGY

Credit: 4

Course Code: ICZOL9C008T

UNIT – I

Concept of Endocrinology, Introduction to the endocrine system, Classes of hormones, Modes of hormone secretion. Evolution of endocrine system and its physiology - in Nemertean, Annelids, Molluscs: Neurohemal organ and its function. In Insects: Types of hormones and their release sites, Prothoracicotropic hormone, Ecdysteroids, Juvenile hormone, Neuropeptides, Vertebrate-type hormones, Endocrine physiology of Arthropods. In Crustaceans: X-organ, Y-organ and associated neurohemal organs. Endocrine physiology of Echinodermata: Neuropeptides and reproduction.

UNIT – II

Comparative aspects of endocrine physiology in vertebrates, Evolution of pituitary gland. Physiological actions of pituitary hormones. Adenohypophysial hormones: Somatotropin and prolactin, Glycoprotein hormones (FSH, LH, and TSH), Pro-opiomelanocortin. Neurohypophysial hormones: Oxytocin and vasopressin, Urophysis (fishes): Urotensin

UNIT – III

Evolution of discrete adrenal gland - Synthesis of corticosteroid, Structural diversity of glucocorticoids among vertebrates, Role of glucocorticoid in gluconeogenesis. Evolution of renin-angiotensin system - Hormonal control of water and electrolyte balance. Catecholamine biosynthesis, its storage and release mechanism, Importance of adrenocortical and adrenomedullary interaction, Physiological actions of adrenal medullary hormones

UNIT – IV

Evolution of thyroid gland – Thyroid hormone synthesis and its regulation. Paradigms of thyroid hormone action in poikilotherms and homeotherms. A comparative account of parathyroid gland and ultimobranchial body/C cells. Synthesis of parathyroid hormone. Calcitonin and vitamin D₃, Benthic organisms and source of vitamin D. Hormonal regulation of calcium and phosphate homeostasis.

UNIT – V

Hormonal control of feeding behaviour and gastrointestinal tract functioning including acid release, gall bladder contraction, relaxation, pancreatic enzyme secretion. GI tract motility. Pancreatic hormones and glucose homeostasis. Environmental pollutants and endocrine physiology

SEMESTER – IX

PRACTICAL Based on Research Methodology and Evolutionary Biology Credit: 2

Course Code: ICZOL9C006L

Practical:

1. Study of fossil evidences from plaster cast models /pictures
2. Study of homology and analogy
3. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
4. Darwin's Finches evolution
5. Study of fossils from models/ pictures.
6. Study and verification of Hardy-Weinberg Law
7. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies

Note:

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified subjected to availability of resources*

SEMESTER – IX

EC Group – A

APPLIED ENTOMOLOGY

Credit: 4+2

Course Code: ICZOL9E001T

Unit - I

Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insects, mite pests and vectors. Insect pests of cereals and millets, vegetables, fruit crops and their management.

Unit – II

Pests of Plantation crop- coffee, tea, rubber, coconut, and their management. Pests of Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger . Ornamental, medicinal and aromatic plants and pests in polyhouses/protected cultivation. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.).

UNIT – III

Significance of Stored grain pests: post-harvest losses total production of food grains in India. Scientific and socio –economic factors responsible for grain losses. Importance of rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products.

UNIT – IV

Traditional storage structures; Association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage and role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.

UNIT – V

Control Management: Important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Role of bird pests and their management., legal methods. Curative measures non-chemical control measures- ecological, mechanical, physical, cultural, biological. Chemical control- prophylactic and curative characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management.

SEMESTER – IX

EC Group – A

Credit: 4+2

FISH BIOLOGY

Course Code: ICZOL9E002T

Unit-I

Morphology and classification, Morphological studies. Distinctive characteristics of fishes. Body form and its diversity. Fins - Theories of origin of fins. Outline classification of fishes with special reference to distinctive features, geographical distributions, classification and typical examples of the following sub-divisions: Chondrichthyes, Actinopterygi, Crossopterygi, Dipnoi.

Unit- II

Sense organs and some special features. Scales: types, structure and functions of scales. Coloration: chromatophores, pigments and biological significance of coloration in fishes. Bioluminescence in fishes and its significance. Electric organs: their structure and use in fishes. Venomous and poisonous fishes. Sense organs. Eye, Lateral line, Internal ear.

Unit-III

Feeding and Respiration, Alimentary canal and its diversity in fishes. Food, feeding habits and feeding adaptations. Respiratory organs. Structure, modifications and functions of gills. Structure and development of air breathing organs in fishes. Structure and function of swim bladder.

Unit-IV

Reproduction and Development, Reproductive organs and Accessory sex organs. Secondary sexual characters. Oviparity, viviparity (Aplacental and Placental). Nest building and parental Care. Types of eggs. Hatching. Metamorphosis

Unit-V

Adaptations to special conditions of life - Deep sea fishes, Hill stream fishes, Cave dwelling fishes, Arctic and Antarctic fishes (avoidance of freezing). Migration in fishes. Osmoregulation in fishes.

SEMESTER – IX

EC Group – A

Credit: 4+2

NEUROBIOLOGY OF BRAIN DISEASES AND AGING

Course Code: ICZOL9E003T

UNIT-I

Brain disease and dysfunction: Alzheimer's Disease, Mild Cognitive Impairment, Cerebrovascular Disease and White Matter Disorders. Movement Disorders, Affective (Mood) Disorders, Encephalopathy, Sleep Disorders

UNIT-II

Mechanisms underlying epilepsy: The Role of Sprouting and Plasticity in Epileptogenesis. Regulation of Neuronal Excitability in the Amygdala and Disturbances in Emotional Behaviour. Computer Simulation of Epilepsy: Implications for Seizure Spread. Memory Impairment and Its Cognitive Context in Epilepsy. Epilepsy and Anxiety.

UNIT-III

Theories of ageing: Somatic mutations and DNA damage. Protein errors, Protein modifications. Oxygen free radicals and mitochondria. Immunological theory. Dedifferentiation and epigenetic theory. Toxicity. Endocrine and programme theories.

UNIT-IV

Cellular ageing: The finite lifespan of cells in culture. Transplantation experiments. Stem cells and commitment to senescence. Mechanisms of cellular ageing. The immortalisation of somatic cells. Non-dividing cells. Apoptosis.

UNIT-V

The aging mind and brain. Theoretical, Animal Models, Social, and Humanistic Perspectives overview. Social Networks, Social Relationships, and their effects on the Aging Mind and Brain Aging. Animal Models of Pathological Aging. Humanistic Perspectives: Arts and the Aging Mind.

SEMESTER – IX

EC Group – A

Credit: 4+2

ANIMAL SYSTEMATICS AND TAXONOMY

Course Code: ICZOL9E004T

UNIT-I

Animal Systematics and Taxonomy Overview - Basic concepts, principles and methods. Historical resume of systematic, Animal Systematics, overview, principles and methods; Principles of classification; Linnean System of classification; Binomial Nomenclature. Taxonomy, Types of Taxonomy, Alpha Taxonomy, Beta Taxonomy, Pre-Linnean Taxonomy, Linnean Taxonomy

UNIT-II

Taxonomic procedures: collection, preservation, curation, Identification process. Taxonomic keys- types, merits and demerits. Systematic publications and different kinds of publication Taxonomic.

UNIT-III

Taxonomic Characters, types of lineages, lineage change, artificial lineage. Theories of biological classification

UNIT-IV

International Code of Zoological Nomenclature (ICZN), interpretation and application of important rules of zoological nomenclature. Formation of scientific names of various taxa,

UNIT-V

Modern trends in systematic and taxonomy - Numerical taxonomy, cytotaxonomy, chemotaxonomy, molecular taxonomy, cryotaxonomy, neo taxonomy, behavioural taxonomy. Importance of biosystematics and taxonomy in biology. Applications of biosystematics and taxonomy in biology

SEMESTER – IX

EC Group – B

Credit: 4+2

INTEGRATED PEST MANAGEMENT

Course Code: ICZOL9E005T

UNIT-I

Classification of insecticides on the basis of their chemical nature, mode of entry and mode of action. An introduction of Acaricides, Rodenticides, Weedicidies etc. Pesticides resistance and precautions, Antidotes.

UNIT-II

Definition of pest Management ; Use of chemicals, legislative, cultural methods, the use of farm practices, mechanical, physical and bioecological methods. The introduction and encouragement of natural enemies and integrated pest management

UNIT-III

Insecticides: Definition, Formulation of insecticide, dusts, wettable powders, suspensions, emulsions, special formulations with wax; shampoo and capsules, Fumigants: Different types of fumigants. Selection and applications of insecticides on different crops. Efficiency of different spray schedules against insects pests, Poison bait. The procedures to be adopted for control operations of household and public health pests.

UNIT-IV

Appliances; All Kinds of plant protection equipments; power and hand operated. Power dusters, power sprayers, rocker sprayers, compressure sprayers, foot sprayers. Other equipments: Soil injectors, cyanogas foot pump, aerosol projects.

UNIT-V

Collection and preservation of insects, Recent technique of insects collection, collection through nets, suction bottle, killing bottles and other collection methods. Explain relaxing theory, pinning, spreading, stretching and labelling of collected material specimen

SEMESTER – IX

EC Group – B

Credit: 4+2

LIMNOLOGY

Course Code: ICZOL9E006T

UNIT -I

Limnology - History and scope, Limnology in India . Ponds: Origin & Classification. Lakes - Origin & Classification, Eutrophication and its restoration. Rivers- Origin & Classification,

UNIT- II

Estuaries - Origin and classification. Bogs - Origin & types, abiotic and biotic characteristics. Marshes - Origin and characteristics. Bottom: Composition, sources and diversity. Vernal pools and their significance

UNIT-III

Plankton: Definition & Classification. Phytoplankton - composition & Distribution in aquatic ecosystem, Role of Organic nutrients in Phytoplanktonic growth, floating adaptation. Zooplankton - Composition & distribution, Cyclomorphosis, Role of Plankton and in aquaculture. Benthos: Macrophytes, Composition & Distribution and its Role in Aquatic ecosystems

UNIT-IV

Physical Characteristics – Light, Turbidity, Currents. Chemical characteristics – pH, DO, FCO₂, BOD, COD. Thermal stratification

UNIT-V

Wetland - Introduction of Ramsar Sites & Characteristics of Wetlands and their management techniques. Translocations. Acidification. Dwindling freshwater Resources their conservation & Management.

SEMESTER – IX

EC Group – B

Credit:

4+2

COGNITIVE NEUROSCIENCE

Course Code: ICZOL9E007T

UNIT-I

The biology of cognition: Cognitive development, Spatial Cognition and Attention. Language and Communication. The Prefrontal Cortex and Executive Brain Functions, The Neuroscience of Consciousness.

UNIT-II

Cognitive Functions, Hemisphere Control, Lateralization and Language, Split Brain. McGurk Effect. Wernicke-Geschwind Model. Attention Deficit Disorder.

UNIT-III

Learning, Memory and Cognition: Biology of Learning, Localized Representations of Memory. Memory and Forgetting. The Hippocampus and the Striatum. Learning and Memory Loss after Damage to the Hippocampus. Theories of the Function of the Hippocampus.

UNIT-IV

Sleep and Cognition: Sleep, REM Sleep, Dreams, Functions of Sleep. Sleep and Energy Conservation. Sleep and Memory. Functions of REM Sleep. Biological Perspectives on Dreaming. The Neurocognitive Hypothesis.

UNIT-V

Memory - Types of Memory, Short-Term and Long-Term Memory. Working Memory and Memory Loss. Pattern recognition. Word association. Verbal dexterity and memory test. Number and shape recognition.

SEMESTER – IX

EC Group – B
4+2

Credit:

WLDLIFE BIOLOGY

Course Code: ICZOL9E008T

UNIT – I

Concept of Wildlife, Biogeography, bio-geographical realms and bio-geographic classification with special reference to India, conservation importance of bio-geographic zones of India, bio-geographical barriers, faunal interchange.

UNIT – II

Invertebrates wildlife biology, composition and their role in ecosystem. Diversity and distribution of major invertebrate faunal components.

UNIT – III

Batrachology- Taxonomy of amphibians, their role in nature, threats to their existence and conservation measures. Herpetology: Taxonomy of reptilian (Fresh water and marine turtles, lizards, snakes and crocodilians) Trampling, Zoo-phobia, etc. Thermoregulation, its role, aestivation, Hibernation and other eco-physiological adaptations. Role of temperature in sex determination in reptiles. Identification of venomous and non venomous snakes. Snake bites, Venom, Anti-venom, First Aid and Management of snake bite cases.

UNIT – IV

Ornithology- Avian classification and distribution with special reference to Indian birds morphological adaptations in bills and claws. Development of feathers, flight adaptations, plumage and moult, camouflage, mimicry, diurnal and nocturnal adaptations; Activities of birds: roosting, calls and songs; methods of analyzing and recording calls and songs. Bird Migration, Impact of migrants on resident species of birds. Economic importance of birds, Threats faced by the avian community, causes of decline of common birds and their control measures. Concept of IBA, SBA and EBAs and bird census techniques.

UNIT – V

Mammalogy- Mammalian characteristics and origin of mammals. Classification of mammal with detailed treatment of different orders represented in Indian sub-continent. Zoogeography of Indian mammals. Morphological and physiological adaptations in mammals. Hibernation, Torpor, Aestivation, locomotion and water regulation. Body size variation in mammals and its influence on life history, metabolic rate, weight constraints. Digestive system of herbivores and carnivores. Mammalian skin and its derivatives.

SEMESTER – IX

PRACTICAL Based on EC- 10 TO 17

Credit: 2 each

Course Code:

Group A (ICZOL9E001L, ICZOL9E002L, ICZOL9E003L, ICZOL9E004L) and

Group B (ICZOL9E005L, ICZOL9E006L, ICZOL9E007L, ICZOL9E008L)

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

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SEMESTER – X

1. Elective Course (EC)

Stream – A

- EC-18: Insect Physiology (4)
- EC-19: Medical Entomology (4)
- EC-20: Insect Toxicology (4)
- CC-27: Dissertation (10)

Stream – B

- EC-21: Fisheries and Aqua Culture (4)
- EC-22: Environmental Toxicology (4)
- EC-23: Ecology and Environment (4)
- CC-27: Dissertation (10)

Stream – C

- EC-24: Advanced Neuroscience (4)
- EC-25: Behavioural Neuroscience (4)
- EC-26: Principles of Neuroscience (4)
- CC-27: Dissertation (10)

Stream – D

- EC-27: Conservation Biology (4)
- EC-28: Wildlife Studies: Tools and Techniques (4)
- EC-29: Wildlife Management and Practices (4)
- CC- 27: Dissertation (10)

SEMESTER – X

STREAM-A

EC-18: INSECT PHYSIOLOGY

Credit: 4+2

Course Code: ICZOL10E006T

UNIT-I

Integumentary system: Structure, function & formation, Growth, Moulting and Metamorphic development, hormonal influence, Sclerotization.

UNIT-II

Digestive, Circulatory & Respiratory system: Alimentary tract, digestive physiology , Open circulatory system, hemolymph, hemocytes, Immunity and thermoregulation. : Tracheal system and physiology of gas exchange

UNIT-III

Endocrine system & excretory physiology: Insect hormones- with reference to metamorphosis & reproduction Malpighian tubules, osmoregulation: Insect hormones- with reference to metamorphosis & reproduction

UNIT-IV

Nervous system: Components of the nervous system, Sensing the environment - Sensory receptors, vision & acoustics. Role of Stimulus in location of food and prey

UNIT-V

Reproductive system: Female & Male reproductive systems; Usual and unusual modes of reproduction Comparative account of reproductive system in different orders of insects. Hormones related to reproduction , Mode of fertilization and post embryonic development

SEMESTER – X

STREAM-A

EC-19: MEDICAL ENTOMOLOGY

Credit: 4+2

Course Code: ICZOL10E007T

UNIT- I

Phyletic studies & Clasification of phylum Arthropoda - Vector borne diseases -mechanisms of transmission in human beings - types of vectors and their identification - Groups of medical importance- life history of Acarina - Hard Ticks - Soft tickes - Dust mite - Itch mite, Harvest mite diseases spread through Hard and Soft tick, trombiculid mite, Itch mite and Cyclops - Class insecta - Mention of groups of Insect vectors.

UNIT- II

Vectors of medical importance : Life cycle - epidemiology, and management- of mosquitoes - houseflies - sand flies - Human lice - Tsetse flies - Human lice of different types - fleas and reduviid bug.

UNIT –III

Vector borne diseases : Filaria-viral encephalitis, viral fever, dengue, yellow fever. , diseases spread through sandfly - kala-azar , oriental sore, tsetsefly - sleeping sickness.

UNIT- IV

Vector - borne diseases spread : louse - epidemics - typhus relapsing fever - trenchfever - Rat flea - Bubanic plague and endemic typhus.

UNIT –V

Vector control – Physical methods. Chemical Insecticides - Use and consequences - Use of bio-control agents and biopesticides - Use of Bacillus, Predatory fish and other bio-control agents

SEMESTER – X

STREAM-A

EC-20: INSECT TOXICOLOGY

Credit: 4+2

Course Code: ICZOL10E008T

UNIT- I

Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.

UNIT- II

Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrazoles, new promising compounds, etc.

UNIT- III

Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides-synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.

UNIT- IV

Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence

UNIT- V

Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning. Practical Insecticide formulations and mixtures; quality control of pesticide formulations; laboratory and field evaluation of bioefficacy of insecticides; bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action. Toxicity to beneficial insects. Pesticide appliances. Working out doses and concentrations of pesticides; visit to toxicology laboratories. Good laboratory practices.

SEMESTER – X

STREAM-B

EC-21: FISHERIES AND AQUA CULTURE

Credit: 4+2

Course Code: ICZOL10E009T

UNIT – I

Basics of Aquaculture- Definition, history, importance and status of aquaculture. Forms of Aquaculture. Aquaculture practices

UNIT – II

Fish feeding & breeding technology. Nutritional requirement of fish viz. protein, lipids, vitamins & minerals. Formulation & preparation of supplementary / artificial feed, feed ingredients, types of feed. Feed preparation technology

UNIT – III

Techniques in Aquaculture: Induced Breeding Techniques in fishes Selection of cultivable fish species IMC, Chinese carps and Cat fish and Shell fish. Culture of Fresh water prawn, Trout Culture, Sea weed Culture, Pearl culture , Biofloc Technology

UNIT – IV

Marine Bioresources - Bioactive compounds from the sea. Marine natural products and metabolites- Microbes, Cyanobacteria and allied seaweeds, Micro and macro algae, Diatoms, Echinoderms, Bryozoans, Soft corals, Sponges

UNIT – V

Fishing Methods. Traditional fishing methods used in inland and marine fisheries. Recent advances in fishing methods, Light fishing, Electric Fishing, Sonar/Echosounders

SEMESTER – X

STREAM-B

EC-22: ENVIRONMENTAL TOXICOLOGY

Credit: 4+2

Course Code: ICZOL10E0010T

UNIT-I

Principles in toxicology; Definition of Xenobiotic. Animal management in toxicological evaluation.

UNIT-II

Animal toxicity tests; Statistical concepts of LD50, LC50; Dose-effect and dose response relationship; Frequency response and cumulative response; Biological and chemical factors that influence toxicity.

UNIT-III

Bio-transformation and bio-accumulation - Influence of ecological factors on the effects of toxicity; Concept of green chemistry.

UNIT-IV

Pollution of the ecosphere by industries; Global dispersion of toxic substance; Dispersion and circulating mechanisms of pollutants; degradable and non-degradable toxic substances; food chain.

UNIT-V

Eco-system influence on the fate and transport of toxicants. Aquatic toxicity tests; Statistical tests; Response of planktons to toxicants; EC49; Photosynthetic bacteria Bioabsorption of heavy metals. Information management system in eco-toxicology.

SEMESTER – X

STREAM-B

EC-23: ECOLOGY AND ENVIRONMENT

Credit: 4+2

Course Code: ICZOL10E0011T

UNIT – I

Organizational level of ecological systems, Abiotic and biotic environment, limiting factors, adaptation, habitat and niche, holocoenotic nature of environment, concept of biosphere, population parameters, structure, growth regulation, interactions between populations, life history strategies (r and k species), the concept of carrying capacity. Synecological principles, ecological succession, succession models, concept of climax. Structure and function of ecosystems, productivity, decomposition, energy flow, ecological efficiencies, global pattern of productivity, nutrient cycling (Carbon, Nitrogen and Phosphorus), major biomes of India and the world.

UNIT - II

Biodiversity -Definition & assessment, Management. Natural resources - Wild life, Minerals, Conservation Biology – Principles, Keystone species, Protected Areas, Acts & Related International Conventions

UNIT – III

Energy Resources and Conservation - Renewable and non-renewable energy resources, growing energy need, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, composition. Energy content of coal, petroleum and natural gas. Principle of generation and conservation of conventional and non-conventional energy. Energy from biomass and biogas, anaerobic digestion, energy use pattern and future need projection in different parts of the world, energy conservation policies.

UNIT – IV

Environmental Pollution Types and major sources of air pollutants - effects of air pollutants on physico-chemical and biological properties surrounding atmosphere, air born diseases and their effects on health. Types and major sources of water pollutants - effects of water pollutants on physico-chemical and biological properties of water bodies, water born diseases with special reference to water pollution. Types and major sources of soil pollutants - effects of soil pollutants on physico-chemical and biological properties of soil. Air, drinking water and waste water quality standard. Major sources of noise pollution - effects of noise pollution on health, noise level standard in industrial, commercial, residential and silence zones. Radioactive and thermal pollution sources and their effects on surrounding environment. Solid waste disposal and its effects on surrounding environment.

UNIT – V

Environmental Management - Introduction and scope of environmental management, basic concepts of sustainable development, industrial ecology and recycling industry. Role of natural products and bio-diversity in international trade, fundamentals of fossil fuels use, energy production and trade, energy balance and energy audit. Eco-marketing. Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS), scope and types of environmental audit, cost benefit analysis, environmental

management plan (EMP), international organization for standardization (ISO), ISO 14000 standards and certification, environmental clearance for establishing industry, environmental safety, risk management and emergency preparedness, international summit and treaties, important dates dedicated to environmental management.

SEMESTER – X

STREAM-C

EC-24: ADVANCED NEUROSCIENCE

Credit: 4+2

Course Code: ICZOL10E0012T

UNIT-I

Nervous system development: Neural Induction and Pattern Formation, Cellular Determination. Neurogenesis and Migration. Growth Cones and Axon Path finding. Target Selection, Topographic Maps, and Synapse Formation. Programmed Cell Death and Neurotrophic Factors. Synapse Elimination. Dendritic Development.

UNIT-II

Neural signalling, Electrical Signals of Nerve Cells. Voltage-Dependent Membrane Permeability. Ion Channels and Transporters. Synaptic Transmission, Neurotransmitters and their Receptors. Molecular Signaling within Neurons. Synaptic Plasticity

UNIT-III

Systems neurobiology: Somatosensory System. Tactile Discrimination and Position Sense. Nociception, Thermal Sense, and Touch. Viscerosensory Pathways. Motor System, control of movement. The Basal Nuclei. The Limbic System.

UNIT-IV

The higher brain centers: Broadmann's maps of the cerebral cortex. Cortical association areas. Brain laterality, Brain language centers. Neural processing of language.

UNIT-V

Complex brain functions: Cortex and Cognition, Speech and Language. Sleep and Wakefulness. Emotions. Gender and the Brain.

SEMESTER – X

STREAM-C

EC-25: BEHAVIOURAL NEUROSCIENCE

Credit: 4+2

Course Code: ICZOL10E0013T

UNIT-I

The Biology of Behavior. Human Brain Evolution , Visual Perception of Objects. Learning and Memory: Basic Mechanisms, Brain Systems. Language and Communication. The Prefrontal Cortex and Executive Brain Functions.

UNIT-II

The Brain and Behavior, Chemical Control of the Brain and Behavior, Motivation Brain Rhythms and Sleep. Attention. COVID19 and Behavioural changes.

UNIT-III

Emotional Behaviors: Facial Analysis, Amygdala and Fear Conditioning. GABA Receptors, CNS Depressants, Health and Stress.

UNIT-IV

Reproductive Behaviors: Organizing Effects of Sex Hormones. Sex Differences in the Brain. Activating Effects of Sex Hormones-Males and Females. Effects of Sex Hormones on Nonsexual Characteristics. Parental Behavior.

UNIT-V

Emotional Intelligence: Anxious and relaxed. Extrovert and introvert. Optimist and pessimist, Self-confidence, Tough and tender.

SEMESTER – X

STREAM-C

EC-26: PRINCIPLES OF NEUROSCIENCE

Credit: 4+2

Course Code: ICZOL10E0014T

UNIT-I

General concepts in evolution of the nervous system. General concepts and approaches in evolutionary analysis. Phylogenetic trees of organisms in a historical context. Cladistic analysis distinguishes processes of evolutionary change. Gene duplication, diversification, loss, and shuffling. Altering patterns of gene expression is an important mechanism for evolutionary change. Natural selection effect on multiple levels in the developing and adult nervous systems.

UNIT-II

Evolution of neuronal communication. Ion channels and electrical signalling. Myelination in vertebrates and large invertebrates. Synapses in early metazoans. Neurotransmitter release mechanisms in secretory process.

UNIT-III

Anatomical techniques, recording and manipulating neuronal activity. Histological analyses of the nervous system. Visualizing individual neurons opens of the nervous system. Mapping neuronal projections. Mapping synaptic connections. Extracellular recordings. Intracellular and whole-cell patch recordings. Optical imaging. Optogenetics.

UNIT-IV

Animal models in neuroscience research. Some invertebrates provide large, identifiable neurons for electrophysiological investigations. *Drosophila* and *C. elegans* allow sophisticated genetic manipulations. Diverse vertebrate animals offer technical ease or special faculties. Mice, rats, and nonhuman primates are important models for mammalian neurobiology research. Human studies are facilitated by a long history of medicine and experimental psychology and by the recent genomic revolution

UNIT-V

Mental illness and the Brain- Psychosocial Approaches to Mental Illness. Biological Approaches to Mental Illness. The Promise and Challenge of Molecular Medicine in Psychiatry. A Description of Anxiety Disorders. Biological Bases of Anxiety Disorders. A Description of Affective Disorders. A Description of Schizophrenia.

SEMESTER – X

STREAM-D

EC-27: CONSERVATION BIOLOGY

Credit: 4+2

Course Code: ICZOL10E0015T

UNIT – I

Foundations of Conservation Biology, Introduction of concept, Rise of Conservation Biology, Biological diversity concepts, types and measurement, Global patterns and drivers of biological diversity. Biological sampling, census techniques and application

UNIT – II

Biodiversity hot spots, Climatic and vegetational zones, Zones of faunal distribution, Biodiversity loss, Causes and consequences, Threatened species, Habitat loss, habitat fragmentation and degradation. Anthropogenic threats to biodiversity, Climate change impact, Wildlife habitat evaluation

UNIT – III

Restoration of wildlife population, Captive breeding, Soft and hard release, Reintroduction, Restoring keystone species and ecological process. Mitigation and replacement, Creating an artificial ecosystem

UNIT – IV

Biodiversity conservation methods at global and nation level. Natural Recourse conservation strategies at global and national level. Approaches, ethics and values. Conservation priorities, Strategic species conservation planning, Conservation genetics, Application of genetics for wildlife conservation.

UNIT – V

Biological conservation strategies. Wildlife protection legislation acts and laws. Conservation ethics

SEMESTER – X

STREAM-D

EC-28: WILDLIFE STUDIES: TOOLS AND TECHNIQUES

Credit: 4+2

Course Code: ICZOL10E0016T

UNIT – I

Introduction to various wildlife study techniques and their use in wildlife conservation. Study Designing; Consideration, Sample Consideration, Habitat Utilization study review by species groups; Amphibians, Reptiles, Small mammals, Large Carnivores. Introduction to sampling theory, various types of sampling techniques. Concept of sampling effort and species area curve. Wildlife Census and Indices. Population distribution.

UNIT – II

Status, abundance and distribution assessment techniques for fauna. Concept of direct and indirect methods of abundance estimation. Various techniques for mammals, birds, reptiles and amphibians. Counting methods-Total count, Camera trap, Direct methods, indirect methods, pugmark analysis. Transects-Line transects, Belt Transect, Quadrates, Mark Capture Recapture methods, Aerial census methods. Modern GIS based techniques for wildlife studies. Data summarization, analysis and interpretation

UNIT – III

Introduction to Vegetation analysis and habitat analysis. Plot and plot less techniques for estimation of plant abundance, frequency, dominance and Importance value Index. Preparation of vegetation profile. Various techniques for assessment of vegetation cover. Techniques for assessment of vertical structure and horizontal heterogeneity. Data summarization,

UNIT – IV

Introduction to Wildlife telemetry: Transmitters (Antenna, Power source) Transmitter attachments (General protocol, collars etc.), Radio tagging, Receivers, Relocating wildlife. Conservation genetics

UNIT – V

Introduction to Wildlife Forensic Science, History of Wildlife Forensics and important landmarks. Wildlife Forensic research and its significance. Importance of statistical analysis in wildlife forensics. Wildlife Forensics techniques based on morphology, comparative anatomy and genetics. Dimensions of Wildlife Forensics. Emerging techniques in Wildlife Forensics Analysis. Illegal Wildlife Trade- past and present scenario. Drivers of Illegal Wildlife Trade. Consequences of Illegal wildlife trade. Wildlife Crime Scene. Wildlife Crime Scene investigation and importance of wildlife crime Wildlife crime scene management and best practices.

SEMESTER – X

STREAM-D

EC-29: WILDLIFE MANAGEMENT AND PRACTICES

Credit: 4

Course Code: ICZOL10E0017T

UNIT – I

Introduction to Wildlife, Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies: WCS, CBD, Agenda 21

UNIT – II

Evaluation and management of Wildlife, Habitat analysis. Physical parameters- Topography, Geology, Soil and water. Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

UNIT – III

Habitat management. Setting back succession. Grazing logging, Mechanical treatment, Advancing of the succession process. Cover construction, Preservation of general genetic diversity. Restoration of degraded habitats. . Habitat analysis and Evaluation.

UNIT – IV

Management planning of wild life in protected areas. Estimation of carrying capacity; Human-wildlife conflict; Eco tourism / wild life tourism in forests; Climax communities: characteristics and theories; Ecology of perturbation.

UNIT – V

Population management. Bio- telemetry. Health management of wildlife. Care of injured and diseased animal; Quarantine; Common diseases of wild animals: Zoonosis (Ebola and Salmonellosis), Rabies, Foot and Mouth Disease, Mycobacterium TB, Bovine and Avian Flu. Protected Areas - National parks and Wildlife Sanctuaries; Biosphere Reserves; Conservation Reserves and Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India and Management challenges in Tiger reserve. Ex-situ conservation.

SEMESTER – X

FOR ALL STREAMA (A-D)

PRACTICAL Based on EC- 18 TO 29

Credit: 2 each

Course Code:

Stream A (ICZOL10E006L, ICZOL10E007L, ICZOL10E008L)

Stream B (ICZOL10E009L, ICZOL10E010L, ICZOL10E011L)

Stream C (ICZOL10E012L, ICZOL10E013L, ICZOL10E014L)

Stream D (ICZOL10E015L, ICZOL10E016L, ICZOL10E017L)

With the reference to study of museum specimens/whole mounts/anatomy/microscopic slides and dissections, the same may be substituted with diagrams / photographs / models / microphotographs / charts / multimedia computer-based simulations including Computer Assisted Learning (CAL) and virtual labs.

**This is a tentative list of practical exercises that can be done. Exercises related to the concerned theory paper may be modified subjected to availability of resources*

SEMESTER – X

FOR ALL STREAMA (A-D)

CC – 27: DISSERTATION - II

Credit: 10

Dissertation will be practical in nature including field/laboratory-based research work. Dissertation work will be submitted in the form of M.Sc. Dissertation. Evaluation will on the basis of presentation made by the candidate in presence of external examiner and faculty members at the end of the semester.

Prerequisites for the course	As per the norms applicable for Dissertation
Objective	This module provide initialization of independent thinking and applications in research field
Content	Chosen Scientific Area
Pedagogy	Designing of research work/ Formulation of research methodology/Discussion/Experimental work/field study/ self-study
References/readings	1. Scientific Journals 2. Reference Books 3. Any other authentic source
Learning outcomes	1. Methods implementation and gathering of research data and application of statistics. 2. Research result formulation and interpretation.