

The logo of Sacred Heart College, Chalakudy, is a circular emblem. It features a central shield with a red background. Inside the shield, there is a white cross, a pair of white hands holding a white book, and a white quill pen. The shield is surrounded by a yellow border containing the text "SACRED HEART COLLEGE" at the top and "CHALAKUDY" at the bottom. Below the shield is a yellow ribbon with the motto "LIGHT SHINES IN DARKNESS".

Syllabi of Courses which Address Crosscutting Issues
(Zoology)

1.3.1 Courses which address cross cutting issues relevant to Gender, Environment and Sustainability, Human Values and Professional Ethics into the Curriculum

Sl.No	Name of the Course	Course Code	Name of the Programme	Specify the issue(s) dealing with
1.	Conservation Biology	ZOL1C03	MSc.Zoology	Environment and sustainability
2.	Behavioral Studies	ZOL1C03	MSc.Zoology	Deals with the biological aspects of Gender
3.	Ethics In Taxonomy	ZOL2C06	MSc.Zoology	Deals with the professional Ethics in Taxonomy
4.	Gender Development-Genetic and Environmental Basis	ZOL3C08	MSc.Zoology	Factors affecting Gender Development
5.	Environmental Biotechnology	ZOL4C10	Msc.Zoology	Environment and Sustainability
6.	Ethics in Biotechnology	ZOL4C10	Msc.Zoology	Deals with the professional Ethics in Biotechnology
7.	Genetic basis of Gender	ZOL5B06T	BSc.Zoology	Discuss the genetic aspects of Gender
8.	Ethics in Science and Animal Ethics	ZOL5B09T	BSc.Zoology	Professional Ethics in Zoology
9.	Sex Education	ZOL5D01T	BSc.Zoology	Helps understanding Gender roles ,Human Values
10.	Environmental and Conservation biology	ZOL6B12T	Bsc.Zoology	Environment and Sustainability

1.3.1 Courses which address cross cutting issues relevant to Gender, Environment and Sustainability, Human Values and Professional Ethics into the Curriculum

Syllabus –MSc.Zoology

ZOL1C03 - ECOLOGY AND ETHOLOGY (90 Hours)

Part-A-Ecology (54 hrs)

1. Introduction (3hrs)

1.1. Habitat and niche

1.1.1. Concept of habitat and niche

1.1.2. Niche width and overlap

1.1.3. Fundamental and realized niche

1.1.4. Resource partitioning

1.1.5. Character displacement

2. Ecosystem (9 hrs)

2.1. Structure and function

2.2. Ecosystem energetics

2.3. Primary production

2.4. Energy flow models

2.5. Mineral cycling (CNP)

2.6. Trophic levels, Food chain, food web and secondary production

2.7. Decomposers and detritivores

3. Population Ecology (7 hrs)

3.1. Characteristics of a population

3.2. Methods of estimating population density of animals, ranging patterns through direct, In direct and remote observations

3.3 Sampling methods in the study of behaviour, habitat characterization

3.4. Ground and remote sensing methods

3.5. Population growth curves, Life tables, survivorship curves, population regulation, Life history strategies, r and k selection, Demes and dispersal, interdemec extinctions, age structure of populations.

3.6. Growth and regulation of human population

4. Species interaction (5 hrs)

4.1. Types of interactions, interspecific competition

4.2. Herbivory, Carnivory, Pollination, Symbiosis; mutualism, commensalisms and proto cooperation

5. Community Ecology (4 hrs)

5.1. Nature of communities.

5.2. Characteristics of a biotic community.

5.3. Species diversity and latitudinal gradients in diversity.

5.4 Edges and ecotones.

6. Ecological succession (4 hrs)

6.1. Types, mechanisms , changes involved in succession .

6.2 Concept of climax

7. Biogeography (6 hrs)

7.1. Major terrestrial biomes: (a) Tropical rain Forest (b) Grassland (c) Desert (d) Chaparral (e) Temperate deciduous Forest (f) temperate boreal forest (g) Tundra (h) Savanna

8. Biogeographical zones of India (4 hrs)

(a) Trans Himalayan zone; (b) Himalayan zone; (c) Desert zone; (d) Semiarid zone; (e) Western Ghats zone; (f) Deccan plateau zone; (g) Gangetic plain zone; (h) North east zone. (i) Coastal zone; (j) Islands present near the shore line.

9. Applied Ecology (8 hrs)

9.1 Carbon credit, Carbon trading, Blue Carbon

- 9.2 Green building technology and its ecological importance.
- 9.3 Discuss the benefits and disadvantages of the idea of (brief)
- Inter linking of major rivers of India,
 - Sethusamudram ship canal project.
 - Biodiversity with special reference to India-status monitoring and documentation, major Drivers of biodiversity change.

10. Conservation Biology (4 hrs)

- 10.1 Principles of conservation.
- 10.2 Major approaches to management,
- 10.3 Indian case studies on conservation & management strategy (concepts of project tiger, Biosphere reserves).

Part B. Ethology (36 hrs)

1. Introduction (1 hr)

2. Concepts of Ethology (4 hrs)

- 2.1. Ethology as different from the other schools studying animal behavior like behaviourism.
- 2.2. Behaviour as a reaction to stimuli - sign stimuli, social releasers, Ethograms, super normal stimuli, stimulus filtering.
- 2.3. Concepts of Fixed Action Patterns (FAP), Innate Releasing Mechanism(IRM), Action Specific Energy(ASE), Concepts of Learning and Imprinting.

3. Motivating factors (3 hrs)

- 3.1. General factors in motivation; Studies of motivation in guppies;

3.2. Mating systems-parental investment and reproductive success

4. Conflict behaviour- stress-displacement activities- Ritualization. (2 hrs)

5. Instinctive behaviour & reflex action, neural basis of sleep and arousal. (2hrs)

6. Learning- Neural basis of learning, memory, cognition, sleep and arousal (3hrs)

Biological clocks

7. Adaptiveness of behaviour (3 hrs)

JP Scott's categories of behaviour.

8. External stimulus - circadian rhythms (3 hrs)

8.1- Proximate and Ultimate factors.

8.2- Types of orientation- refference theory of Von Holst & Mittel Steadt.

8.3-Navigation & migration

9. Parental care – (6 hrs)

9.1. Mating systems, Parental investment and Reproductive Success.

9.2. Development of behavior.

9.3. Social communication; Social dominance; Use of space and territoriality; domestication and behavioural changes; Social behaviour of termites & Primates;

10. Evolution and adaptiveness of behaviour (4 hrs)

Altruism, Kin selection, inclusive fitness, selfish gene theory, cultural transmission of behaviour.

11. Hormones and Behaviour- (5 hrs)

Hormones of gonads, adrenal gland, Pituitary gland,-Hormonal effects on different behavioural patterns, Maternal behaviour- mechanism of hormonal action.

ZOL2C06 - SYSTEMATICS AND EVOLUTION (90 Hours)

Part –A: Systematics (54 Hrs)

I. Introduction (1 hr)

2. Definition and basic concepts in Systematics and Taxonomy (4 hrs)

2.1 Levels of Taxonomy

(a) Alpha, Beta and Gamma taxonomy

2.2 Importance and applications of taxonomy

2.3 Goals of taxonomy

2.4 Definition of systematics

2.5 Definition of classification

3. Species (4 hrs)

3.1 Monotypic species

3.2 Polytypic species

3.3 Ecospecies and Cenospecies

3.4 Morphospecies

3.5 Super species

3.6 Species as a Population Complex

4. Species Concepts (6 hrs)

4.1 Typological Species Concept

4.2 Nominalistic Species Concept

4.3 Biological Species Concept

4.4 Evolutionary Species Concept

4.5 Difficulties in the application of the biological species concept

5. Classification (7 hrs)

5.1 Uses of Classification

5.2 Purpose of Classification

5.3 Theories of Classification

(a) Essentialism (b) Nominalism (c) Empiricism (d) Cladism (e) Evolutionary Classification

5.4 Hierarchy of Categories

5.5 The objectives of classification

6. Taxonomic Collections and the Process of identification (8 hrs)

6.1 Taxonomic collections: Types of collections, Value of Collection

6.2 Purpose of scientific collection

6.3 Preservation of Specimens

6.4 Labeling

6.5 Curating of collections

6.6 Curating of types

6.7 Identification- Methods of identification

6.8 Use of keys, types of keys.

6.9 Merits and demerits of different keys

6.9.1 Description and publication

7. Taxonomic Characters (6 hrs)

7.1 Nature of taxonomic characters

7.2 Taxonomic characters and adaptation

7.3 Kinds of taxonomic characters

(a) Morphological (b) Physiological (c) Ecological (d) Ethological and (e) Geographical characters

7.4 Taxonomic characters and classification

7.5 Taxonomic characters and evolution

7.6 Functions of taxonomic characters

8. Zoological Nomenclature (6 hrs)

8.1 Brief History of nomenclature

8.2 International Code of Zoological Nomenclature

8.3 The nature of scientific names

8.4 Species and infraspecies names

8.5 Gender of generic names

8.6 Synonyms and Homonyms

8.7 The Law of Priority

8.8 Rejection of names

8.9 Type method and different kinds of types

9. Newer trends in systematics (4 hrs)

9.1 DNA Bar coding

9.2 Molecular systematics

9.3 Chemo taxonomy and serotaxonomy

9.4 Cytotaxonomy

9.5 Numerical taxonomy

9.6 Cladistics

10. Ethics related to taxonomic publications (4 hrs)

10.1 Authorship of taxonomic papers

10.2 Correspondence

10.3 Suppression of data

10.4 Undesirable features of taxonomic papers

10.5 Taxonomist and user communities

11. Taxonomic impediments (4 hrs)

11.1 Impediments in taxonomic collections and maintenance

11.2 Shortage of man power

11.3 Lack of funding for taxonomic research

11.4 Lack of training and library facilities

11-5 Impediments in publishing taxonomic work

11.6 Solutions to overcome the impediments

(a) Improve international co-operation (b) Development of taxonomic centers

(c) Need for efficient international networking (d) the desired end product

ZOL3C08–DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY (90 Hours)

Part- A - DEVELOPMENTAL BIOLOGY (54hrs)

1. Introduction: Basic concepts of development (6 hrs)

1.1. Cell fate, potency, determination and differentiation.

1.2 Commitment

1.3. Specification - autonomous, conditional, syncytial .

1.4. Genomic equivalence and cytoplasmic determinants

1.5. Morphogenetic gradients

1.6. Genomic Imprinting

1.7. The stem cell concept- Progenitor cells, Adult stem cells, Mesenchymal stem cells, Multipotent adult stem cells, Pluripotent Embryonic stem cells, Stem cell therapy.

2. Gametogenesis, fertilization and early development (10 hrs)

2.1. Production of gametes- Spermatogenesis and Oogenesis, Ultra structure of gamates

2.2 Cell surface molecules in sperm-egg recognition in animals (sea urchin and mammals)

2.3 Zygote formation-

2.3.1. Encounter of sperm and egg

2.3.2. Capacitation

2.3.3. Acrosome reaction

2.3.4. Activation of ovum

2.3.5 Amphimixis

2.3.6. Prevention of Polyspermy (Fast block and Slow block)

2.4 Cleavage and blastula formation

2.5 Gastrulation and formation of germ layers in amphibia

2.6 Embryonic fields

3. Embryogenesis and Organogenesis (10 hrs)

- 3.1 Axis formation in amphibians - The phenomenon of the Organizer- Nieuwkoop center, primary embryonic induction, mechanism of axis formation
- 3.2 Anterior posterior patterning in Amphibians - Hox code hypothesis
- 3.3 Anterior posterior patterning in *Drosophila* – anterior forming genes (bicoid, hunchback), posterior forming genes (nanos, caudal), terminal forming gene (torso), segmentation genes- gap genes, pair rule genes, segmentation polarity genes, homeotic selector genes, realtor genes
- 3.4 Dorso- ventral patterning in *Drosophila*- dorsal protein gradient
- 3.5 Limb development in chick- Formation of the Limb Bud, Generating the Proximal-Distal Axis of the Limb, Specification of the Anterior-Posterior Limb Axis, Generation of the Dorsal-Ventral Axis
- 3.6 Insect wings and legs formation
- 3.7 Vulva formation in *Caenorhabditis elegans*.
- 3.8 Eye lens induction.

4. Cellular and Molecular basis of development (7 hrs)

- 4.1. Induction and competence- cascade of induction- reciprocal and sequential inductive events, instructive and permissive interactions.
- 4.2. Epithelial- Mesenchymal interactions- paracrine factors - The Hedhog family, The Wnt family, Juxtacrine signaling and cell patterning, notch pathway.
- 4.3. Cellular interactions concerned in fertilization, blastulation, gastrulation and organogenesis.
- 4.5. Molecular basis of cellular differentiation – Cadherins.

5. Genetic basis of development (8 hrs)

- 5.1. Differential gene transcription –Promoters and Enhancers, DNA methylation, Transcription factors, Silencers and Insulators.
- 5.2. Differential RNA processing- X chromosome inactivation- dosage compensation.
- 5.3. Control of gene expression at the level of translation-Differential mRNA longevity, selective inhibition of mRNA translation, Selective activation of mRNA translation, micro RNAs, Control of RNA expression by cytoplasmic localization.
- 5.4. Post translational regulation of gene expression.
- 5.5. Models of cell differentiation- hematopoiesis, myogenesis, differentiation of neural crest cells.
- 5.6. Reversibility of patterns of gene activity-cell fusion, transdifferentiation.

6. Metamorphosis, Regeneration and Ageing (7 hrs)

- 6.1. Metamorphosis in Amphibians and Insects and their hormonal control
- 6.2. Types of regeneration - Super, Hetero, Epimorphic, Morphallactic and Compensatory regeneration, Histological process during regeneration
- 6.3. Ageing – The biology of senescence, cellular and extra cellular ageing, Genes and ageing, DNA repair enzymes, Ageing and the insulin signaling cascade, The mTOR pathway, Chromatin modification, Wear and tear, Oxidative damage, Mitochondrial genome damage, genetically programmed ageing .

7. Environmental regulation of animal development (4 hrs)

7.1 Environmental regulation of normal development - types of polyphenism

- 7.2 Environmental disruptions of normal development (Teratogenesis) Teratogenic agents - Alcohol, retinoic acid, Bisphenol A(BPA), heavy metals, pathogen, Testicular Dysgenesis Syndrome, DES as an endocrine disruptor, Endocrine disruptors as obesogens

7.3. Environmental oestrogens.

- 7.4. Impact of pesticide on development.

8. Developmental Mechanisms of Evolutionary change- (2hrs)

Heterotopy, Heterochrony, Heterometry, Heterotypy. (Brief

Part B- ENDOCRINOLOGY (36 hrs)

1. Endocrine glands and their Hormones (Brief account) (5 hrs)

- 1.1. Hormone secreting organs and tissues -skin, liver, kidney, heart.
- 1.2. General classes of chemical messengers- Peptide, thyroid, steroid hormones, neurotransmitters and pheromones
- 1.3. Synthesis and delivery of hormones- storage, secretion and transportation
- 1.4. Control of hormone secretion.
- 1.5. Physical characteristics of hormones - latency, post-secretory modification and half- life

2. General mechanisms of Hormonal action (5 hrs)

- 2.1. Hormone Receptors and transducers;
 - 2.1.1. Types of receptors- g protein coupled receptors, steroid receptors and nitric oxide receptors,
 - 2.1.2. Regulation of receptor number, receptor activation
- 2.2. Second messengers of hormone action- cAMP, cGMP, inositol triphosphate, diacylglycerol ,
- 2.3. Receptor signal transduction
- 2.4. Eicosanoids and hormone action

3. Anatomy of endocrine glands; structure, physiological functions, and control of secretion of their hormones and pathophysiology (13 hrs)

- 3.1. Hypothalamus
- 3.2. Hypophysis
- 3.3. Thyroid
- 3.4. Parathyroid
- 3.5. Adrenal
- 3.6. Pancreas

4. Hormones and male reproductive physiology (7 hrs)

- 4.1. Synthesis, chemistry, and metabolism of androgens
- 4.2. Endocrine control of testicular function
- 4.3. Physiological roles of androgens and estrogens
- 4.4. Pathophysiology

5. Hormones and female reproductive physiology (3 hrs)

- 5.1. Synthesis, chemistry, and metabolism of Ovarian steroid hormones
- 5.2. Physiological roles of Ovarian steroid hormones
- 5.3. Hormonal regulation of female monthly rhythm
- 5.4. Hormonal factors in pregnancy, parturition and lactation

6. Neurohormones (3 hrs)

- 6.1. Gases as neural messengers
- 6.2. Endorphins- physiological roles, mechanism of action and pathophysiology
- 6.3. Brain hormones and behaviour
- 6.4. Neuroendocrine pathophysiology

ZOL4C10- BIOTECHNOLOGY & MICROBIOLOGY (90 hours)

Part - A. BIOTECHNOLOGY (54 Hrs)

1. Introduction (1 hr)

Definition, branches, scope and importance

2. Vectors (5 hrs)

- 2.1. Cloning vectors –
 - 2.1.1. Plasmids: pBR322 and pUC
 - 2.1.2. Phages: λ gt10 and M13 vector
 - 2.1.3. Cosmids: general features
 - 2.1.4. Phagemids: general features
 - 2.1.5. Viruses: SV40 and CaMV
 - 2.1.6. Transposones; Ac transposon and Ds transposon of Maize, P-element of

Drosophila

2.1.7. Artificial chromosomes: BAC, YAC and MAC.

2.2. Shuttle vectors: applications and example

2.3. Expression vectors: mention commonly used promoters in expression vectors (Nopaline synthase (*nos*) promoter from T-DNA, 35 S RNA promoter of CaMV, Polyhedrin promoter from Baculovirus)

3. Different steps involved in *in vivo* cloning (3hrs)

3.1. Construction of chimeric DNA (Blunt end ligation, cohesive end ligation, homopolymer tailing, use of linkers)

3.2. Selection of transformed cells –blue white selection method, colony hybridization, Plaque hybridization

3.3. Amplification – Multiplication, Expression, and integration of the DNA insert in host genome

4. Molecular probes (3 hrs)

4.1. Production

4.2. Labelling

4.3. Applications

4.4. FISH, McFISH and GISH

5. Genomic and cDNA library (4 hrs)

5.1. Construction

5.2. Screening –By DNA hybridization, Screening by immunological assay, and screening by protein activity.(Refer unit 4-Molecular Biotechnology by Glick and Pasternak-ASM press)

5.3. Blotting techniques- Southern blot, Northern blot, Western blot, Dot blot and Slot blot.

5.4. Chromosome walking

6. Polymerase Chain Reaction (3 hrs)

6.1. Basic PCR – raw materials and steps involved

6.2. Inverse PCR, Anchored PCR, Asymmetric PCR, PCR for mutagenesis and Real Time PCR

6.3. Applications of PCR in Biotechnology and genetic engineering

7. Molecular markers: detection and applications (3 hrs)

7.1. RFLP

7.2. AFLP

7.3. RAPD

7.4. Minisatellites (VNTR)

7.5. Microsatellites (SSR)

7.6. SNPs

8. Isolation, sequencing and synthesis of genes (3 hrs)

8.1. Isolation (for specific proteins and tissue specific proteins)

8.2. DNA sequencing – Maxam and Gilbert's chemical degradation method, Sanger's dideoxynucleotide synthetic method.

8.3. Synthesis of gene-Chemical synthesis of tRNA gene, Synthesis of gene from mRNA, Gene synthesis machines

9. Transfection methods and transgenic animals (3 hrs)

9.1. Definition, Methods - Electroporation, DNA micro injection, Calcium phosphate precipitation, Dextran mediated transfer, shot gun method, virus mediated, lipofection method, engineered embryonic stem cell method

9.2. Transgenic animals for human welfare

10. Biotechnology - Animal and human health care (4 hrs)

10.1. Vaccines

10.2. Disease diagnosis

10.3. Gene therapy

10.4. Transplantation of bone marrow, artificial skin,

10.5. Antenatal diagnosis

10.6. DNA finger printing

10.7. Forensic medicine

11. *In vitro* fertilization (3 hrs)

11.1. *In vitro* fertilization and embryo transfer in human

11.2. *In vitro* fertilization and embryo transfer in live stock

12. Animal cell and tissue culture (3 hrs)

12.1. Culture media – natural and artificial

12.2. Culture methods – primary explantation techniques, various methods of cell and tissue culture

12.3. Tissue and organ culture

13. Gene Silencing techniques (2 hrs)

13.1. Antisense RNA

13.2. RNAi

13.3. Gene knockouts and Knock out mouse

14. Cloning- (2 hrs)

14.1. Cloning procedures

15. Environmental biotechnology (3 hrs)

15.1. Pollution control – cleaner technologies, toxic site reclamation, removal of oil spill, reducing of pesticides and fertilizers, biosensors, biomonitoring.

15.2. Restoration of degraded lands - reforestation using micro propagation, development of stress tolerant plants

16. Agricultural Biotechnology (3 hrs)

16.1. Biofertilizers

16.2. Insect pest control (Pheromones, hormone mimics & analogues)

16.3. Biopesticides (Baculovirus, *Bacillus thuringiensis*, NPV)

16. Intellectual property rights (3 hr)

16.1. Intellectual property protection,

16.2. Patents, copy right, trade secrets, trademark

16.3. GATT and TRIPS, patenting of biological materials,

16.4. International co-operation, obligation with patent applications, implications of patenting current issues

17. The ethical and social implications - (3 hrs)

17.1. Ethics of Genetic engineering - Social impacts - Human safety-Virus resistant plants- Animals and ethics-

17.2. Release of GEOs-Use of herbicide resistant plants-Human genome alterations by biotechnology

17.3. Social acceptance of biotechnology-Transgenic crops - Social acceptance of medical biotechnology- Acceptance of GM crops for food and pharmaceutical production, Social acceptance of Industrial biotechnology

Syllabus- BSc.Zoology

CELL BIOLOGY AND GENETICS

Code: ZOL5B06T

Section B: GENETICS (27 hrs)

MODULE 6. Interaction of genes (5 hrs)

Allelic interactions: incomplete dominance and co-dominance with examples. Nonallelic interactions: epistasis (inheritance of plumage colour in poultry), mention dominant and recessive epistasis. Supplementary genes (example: inheritance of comb pattern in poultry). Complementary genes, mention any one example. Polymeric genes, mention one example. Linkage and Recombination (8 hrs) Definition and characteristics of linkage groups, Morgan's work on *Drosophila*. Types of linkage: complete and incomplete - examples; Linkage groups. Crossing over and recombination, Calculation of Recombination Frequency and Percentage; Linkage map, Map Distance; Mitotic Recombination (brief). Sex-Linked Characteristics: Types of sex-linkage - X linked characters - Colour blindness and haemophilia in humans, holandric genes – hypertrichosis. Dosage compensation – Barr body – Lyon hypothesis. Sex-Influenced and Sex-Limited Characteristics Duplicate genes, mention one example. Modifying genes. Atavism, Penetrance and Expressivity. Polygenic (quantitative) inheritance (example: skin colour in man).

MODULE 7. Multiple alleles (4 hrs)

Definition and characteristics; example: coat colour in rabbits. Blood group genetics: ABO blood group system; MN blood group and Bombay phenotype. Inheritance of Rh factor; mention erythroblastosis foetalis. Problems related to blood group inheritance (5 problems). Isoalleles, mention any one example.

MODULE 8. (8hrs)

Definition and characteristics of linkage groups, Morgan's work on *Drosophila*. Types of linkage: complete and incomplete - examples; Linkage groups. Crossing over and recombination, Calculation of Recombination Frequency and Percentage; Linkage map, Map Distance; Mitotic Recombination (brief). Sex-Linked Characteristics: Types of sex-linkage - X linked characters - Colour blindness and haemophilia in humans, holandric genes – hypertrichosis. Dosage compensation – Barr body – Lyon hypothesis. Sex-Influenced and Sex-Limited Characteristics. Sex Differentiation: Testis-determining factor (TDF), Müllerian inhibition factor. Disorders of Sexual Development (short notes) - XX males and XY females, Point mutations in the SRY gene and testicular feminization.

MODULE 9. Sex determination (3 hrs) Chromosomal mechanism of Sex-Determination: Male heterogametic and female heterogametic mechanism of sex determination. Genic Sex Determining Systems - Genic balance (ratio) theory of Bridges. Haploid-diploid mechanism of sex determination, honey bee as example. Environmental Sex Determination: Example – *Bonellia*, Crocodile. Hormonal influence on sex determination: Example - sex reversal in fowl and free martin in cattle; Gynandromorphism – types and causes. Intersex (brief)

METHODOLOGY IN SCIENCE, BIOSTATISTICS AND BIOINFORMATICS

Code: ZOL5B09T

Section A: METHODOLOGY IN SCIENCE (15 hrs) MODULE 1. Science, Scientific Studies and Methods (6 hrs) Science and Scientific Studies Science as a human activity; scientific attitude; Empiricism; Science disciplines; Interdisciplinary approach. Scientific Methods Major steps: Observation, Defining the problem, Collection of information, Formulation of a hypothesis, Experimentation, Analysis of the results and Conclusion based on interpretation of the results. Methods in scientific enquiry: Inductive and deductive reasoning. Hypothesis: Formulation of a hypothesis, different thought processes in developing hypothesis (analogy, induction, deduction and intuition), hypothetico-deductive model, testing hypothesis, auxiliary hypothesis, adhoc hypothesis. Theories and laws in science; peer review; importance of models, simulations and virtual testing (brief account).

MODULE 2. Experimentation (4 hrs) Types of experiments; design of an experiment: principles and procedures; necessity of units and dimensions; repeatability and replications; documentation of experiments; Planning of Experiments: design, selection of controls, observational and instrumental requirements; Test animals used in experiments.

MODULE 3. Ethics in Science and Animal Ethics (5 hrs) Scientific information: Depositories of scientific information – primary, secondary and digital sources; Sharing of knowledge: transparency and honesty, Publications, Patents, Plagiarism. Constitution of India Article 51A (g); Prevention of cruelty to animals Act of 1960 - Section 17.1(d), Committee for the purpose of control and supervision of experiments on animals (CPCSEA)

REPRODUCTIVE HEALTH AND SEX EDUCATION

Code: ZOL5D01T

MODULE 1. Introduction (2 hrs) Definition; Reproductive health - problems and strategies; reproductive rights; importance of sex education for teen and youth. [

MODULE 2. Sex determination and Chromosomal anomalies (3 hrs) Chromosomal mechanism of sex determination; Barr body; twin studies; sex reversal; Sex chromosomal anomalies: Turner's syndrome and Klinefelter's syndrome.

MODULE 3. Human Reproduction (17 hrs) Male reproductive system: Structure of testis, male accessory organs; Semen production and composition; ejaculation. Spermatogenesis. Female reproductive system: Structure of human ovary; development of primary follicle; structure of graafian follicle; fallopian tubes; uterus; external genitalia; mammary glands. Oogenesis. Menstrual cycle and hormonal control; brief account of fertilization, implantation, pregnancy, gestation, placenta, parturition and lactation (Brief account on hormonal control of lactation

MODULE 4. Infertility and Assisted reproductive technologies (10 hrs) Infertility: Causes and problems in male and female. Infertility management: semen collection, preservation and storage, artificial insemination, surrogacy. Cryopreservation and embryo transfer: Collection, care and preservation of embryos. In vitro fertilization (IVF) and embryo transfer: Major steps; Test tube babies. Assisted Reproductive Techniques (ART): GIFT, ZIFT, ICSI, oocyte donation and embryo donation

MODULE 5. Prenatal Diagnosis (4 hrs) Different methods: Ultrasonography, amniocentesis, chorionic villus sampling and alpha-fetoprotein estimation; female foeticide: ethical issues and laws (Mention– PNDT Act).

MODULE 6. Fertility Control (4 hrs) Natural methods; artificial methods; chemical methods; hormonal methods; contraceptive devices; surgical contraception; abortion, legal termination of pregnancy.

MODULE 7. Sexually transmitted infectious diseases (7 hrs) Symptoms, mode of transmission, diagnosis, treatment and prophylaxis of AIDS, syphilis, gonorrhoea, herpes (genital), human papilloma virus and genital warts, hepatitis, gonococcal vulvo vaginitis, Trichomonal vaginitis. Mention the term venereal disease. Socio economic dimensions of STD.

MODULE 8. Sexual orientation, sexual abuse and myths (5 hrs) Homosexuality and bisexuality (mention LGBT), oral sex, animal sex, cyber sex, sexual abuse, premarital and extramarital sex, sexual perversions, paraphilia, child abuse, prostitution, sexual hygiene, protection of children from sexual offences (POCSO) Act, 2012 (brief account only), sexual myths.

MODULE 9. Ethical aspects of sex (2 hrs) Healthy relationship with opposite sex, role of counseling, gender discrimination in family and society

ENVIRONMENTAL AND CONSERVATION BIOLOGY

Code: ZOL6B12T

Section A: ENVIRONMENTAL BIOLOGY (36 hrs)

MODULE 1. Introduction, Ecosystem and Energetics (6 hrs) Introduction to Environmental biology: Definition, divisions of ecology, modern branches and scope. Ecosystem-Structure and functions: Concept of ecosystem, characteristics; Structure (components) of ecosystem (pond as an example); Mention kinds of ecosystems. Ecosystem Energetics: Photosynthetic production and energy fixation; Energy flow in the ecosystem, Energy flow and laws of thermodynamics, Energy transfer and energy transformations [Trophic dynamics or community dynamics (Lindeman's model of energy flow)]; Ecological efficiency. Productivity of ecosystem: Concept of productivity- standing crops, material removed and production rate; Kinds of productivity: a) Primary productivity (GPP, NPP, NCP) b) Secondary productivity). [Short answer/Paragraph/Essays]

MODULE 2. Biogeochemical Cycles and Limiting factors (5 hrs) Biogeochemical Cycles: Basic types of biogeochemical cycles: Gaseous cycles (Carbon and nitrogen cycles) Sedimentary cycle (Phosphorous cycle). Limiting factors: Basic concepts. Leibig's law of minimum; Shelford's law of tolerance and combined concept of limiting factors. Ecological indicators.

MODULE 3. Population, Community and Habitat Ecology (14 hrs) Population Ecology Properties of population: density, natality, mortality, age distribution, biotic potential, environmental resistance, migration, emigration, immigration and carrying capacity. Population growth forms, J and S shaped curves. Community Ecology Biotic community: Definition and kinds of communities. Characteristics: Species diversity, abundance, dominance, stratification, succession, growth forms, trophic structure, co-existence, interdependence and key stone species; Concept of ecotype, ecotone and edge effect. Habitat ecology a) Marine ecology: Biotic divisions of the marine habitat, their characteristics. Pelagic realm- planktonic and nektonic adaptations. Benthic realm – littoral and abyssal adaptations. Adaptations of animals of rocky, sandy and muddy sea shores. b) Fresh water ecology: Lentic and lotic habitats, their characteristics, faunal characteristics and adaptations. c) Terrestrial ecology: Tropical wet evergreen forests and Tropical dry deciduous forests, their characteristics, adaptations of animals of forests.

MODULE 4. Population Interactions (3 hrs) a) Intraspecific interactions b) Inter specific interactions: Positive interactions Mutualism, Commensalism and Proto-cooperation (with examples). Negative interactions- Competition, Predation and Parasitism (with examples).

MODULE 5. Social issues and Environment (4 hrs) Sustainable development; Joint Forest Management; Goals of United Nations; Environmental ethics: Issues and possible solutions, Habitat destruction and its consequences- socio-ecological concern: wetland, paddy fields, mangrove, river encroachment, sand and clay mining; Ecological impacts of tourism. Disaster management: Natural & Artificial - floods, drought, earthquake, cyclone and landslides.

MODULE 6. Ecological tools and Techniques (4 hrs) Commonly used techniques for study of animal populations: a) Sampling of animal populations b) Trapping and collecting various groups of organisms [insects, aquatic organisms, soil organisms, birds and mammals] c) Marking of animals d) Determination of age in animal groups d) Determination of home range and territory e) Estimation of number of animals in a population f) Indirect method of estimating wild animal populations g) Recent trends- Camera trapping, Radio collaring and Remote sensing

Section B: CONSERVATION BIOLOGY (14 hrs)

MODULE 7. Biodiversity (10 hrs) Introduction, Components of biodiversity: Genetic diversity, species diversity (mention Shannon diversity index and Simpson's dominance index), community diversity and

ecosystem diversity, landscape diversity; Levels of diversity in community and ecosystem diversity: Alpha, beta and gamma diversities. Hot spots of biodiversity. Mention hotspots in Indian region (Western Ghats and Sri Lanka, Himalayas, Indo Burma and Sundaland). Threats to biodiversity; Loss of biodiversity and its causes. Threatened species, Extinction of species, Red data book and IUCN Red list categories. Conservation of biodiversity and wildlife: conservation measures; Wild life (protection Act) 1972, Conservation projects: Project Tiger, Elephant, Lion, Crocodile, Gangetic Dolphins, Kashmir Red Deer and Brow-antlered Deer (Sangai). Biodiversity conservation strategies: Protection of endangered species- Ex situ conservation (conservation in Seed banks, Gene banks, Germ plasm banks, Zoo, Botanical gardens etc.). In situ conservation: Wildlife Sanctuaries -Thattekkad bird sanctuary, ParambikulamWLS, PeriyarWLS, Malabar WLS); National Parks- Eravikulam NP & Silent Valley NP; Biosphere Reserves - Nilgiri BR & Agasthyamalai BR; Community reserve- Kadalundy

MODULE 8. Global strategy for conservation (4 hrs) Brief notes on i) Stockholm conference/Declaration (1972), ii) IUCN, iii) WWF, iv) UNEP, v) CITES, vi) Rio Declaration vii) Rio convention on Biodiversity, 1992 (Rio Earth Summit, 1992), Rio (2012). viii) Kyoto Agreement (1997), Paris Agreement (2016) and Conference of the Parties (COP) on climate change (2018), ix) Ramsar convention (2018)