List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Zoology*

Programme Name : *M. Sc.*

Academic Year : 2024-25

List of Courses Focus on Employability/Entrepreneurship/Skill

Sr. No.	Course Code	Name of the Course
1.	ZOPALT2	Cell Biology and Genetics (Lab courses)
2.	ZOPALT3	Biochemistry and Molecular Biology (Lab courses)
3.	ZOPALT4	Basic Mammalian Physiology (Lab courses)
4.	ZOPBLT1	Animal Behaviour (Lab courses)
5.	ZOPBLT2	Developmental Biology (Lab courses)
6.	ZOPBLT3	Endocrinology (Lab courses)
7.	ZOPCLT4	Regulatory Mammalian Physiology (Lab courses)
8.	ZOPCLO1	Fundamental of Public Health (Lab courses)
9.	ZOPCLO2	Brain function and Mental Awareness (Lab courses)
10.	ZOPCLD1	Evolution, Environmental Biology and Sustainable Development (Lab courses)
11.	ZOPCTD2	Biotechniques
12.	ZOPCTD2	Biotechniques (Lab courses)
13.	ZOPDTA1	Research Methodology
14.	ZOPDLD1	Biochemistry of Intermediary Metabolism and Enzymology (Lab courses)
15.	ZOPDTD2	Molecular Biology of Information Pathway: Nucleic acids
16.	ZOPDLD2	Molecular Biology of Information Pathway: Nucleic acids (Lab courses)
17.	ZOPDLD5	Fish Anatomy, Physiology and Biotechnology
18.	ZOPDTD6	Fish Culture, Capture Fishery and Fish Pathology
19.	ZOPDLD6	Fish Culture, Capture Fishery and Fish Pathology (Lab courses)
20.	ZOPDLD7	Mechanism of Toxicity (Lab courses)
21.	ZOPDLD8	Reactive Metabolites and Defense System in Biology (Lab courses)

Prof. S K Prasad (External Expert)

Dr. Rohit Seth (Member)

Dr. S K Verma (Member)

Prof. LVKS Bhaskar (HOD)

Scheme and Syllabus

Semester-wise Theory Papers/ Practical
Masters of Science in Zoology (CBCS)
Department of Zoology, School of Life Science

Course Opted	Course Code	Name of the Course	T-L-D /Week	Credits	CCA	ESE	Total
		Semester – Ist					
CC 1	**ZOPATT1**	Comparative Anatomy of Vertebrates	T-4	4	40	60	100
CC 1	**ZOPALT1**	Comparative Anatomy of Vertebrates	L-2	1	20	30	50
CC 2	**ZOPATT2**	Cell Biology and Genetics	T-4	4	40	60	100
CC 2	**ZOPALT2**	Cell Biology and Genetics	L-2	1	20	30	50
CC 3	**ZOPATT3**	Biochemistry and Molecular Biology	T-4	4	40	60	100
CC 3	**ZOPALT3**	Biochemistry and Molecular Biology	L-2	1	20	30	50
CC 4	**ZOPATT4**	Basic Mammalian Physiology	T-4	4	40	60	100
CC 4	**ZOPALT4**	Basic Mammalian Physiology	L-2	1	20	30	50
			24H/W	**20**	**240**	**360**	**600**
		Semester IInd					
CC 5	**ZOPBTT1**	Animal behaviour	T-4	4	40	60	100
CC 5	**ZOPBLT1**	Animal behaviour	L-2	1	20	30	50
CC 6	**ZOPBTT2**	Developmental Biology	T-4	4	40	60	100
CC 6	**ZOPBLT2**	Developmental Biology	L-2	1	20	30	50
CC 7	**ZOPBTT3**	Endocrinology	T-4	4	40	60	100
CC 7	**ZOPBLT3**	Endocrinology	L-2	1	20	30	50
CC 8	**ZOPCTT4**	Regulatory Mammalian Physiology	T-4	4	40	60	100
CC 8	**ZOPCLT4**	Regulatory Mammalian Physiology	L-2	1	20	30	50
			24H/W	**20**	**240**	**360**	**600**
		Semester IIIrd					
OE1	**ZOPCTO1**	Fundamental of Public Health	T-4	4	40	60	100
OE1	**ZOPCLO1**	Fundamental of Public Health	L-2	1	20	30	50
OE 2	**ZOPCTO2**	Brain function and Mental Awareness	T-4	4	40	60	100
OE 2	**ZOPCLO2**	Brain function and Mental Awareness	L-2	1	20	30	50
DSE: 1	**ZOPCTD1**	Evolution, Environmental Biology and Sustainable Development	T-4	4	40	60	100
DSE: 1	**ZOPCLD1**	Evolution, Environmental Biology and Sustainable Development	L-2	1	20	30	50
DSE: 2	**ZOPCTD2**	Biotechniques	T-4	4	40	60	100
DSE: 2	**ZOPCTD2**	Biotechniques	L-2	1	20	30	50
			24H/W	**20**	**240**	**360**	**600**
		Semester IVth					
RM	**ZOPDTA1**	Research Methodology	T-4	4	40	60	100
DSE: A	**ZOPDTD1**	Biochemistry of Intermediary Metabolism and Enzymology	T-4	4	40	60	100
DSE: A	**ZOPDLD1**	Biochemistry of Intermediary Metabolism and Enzymology	L-2	1	20	30	50
DSE: A	**ZOPDTD2**	Molecular Biology of Information Pathway: Nucleic Acids	T-4	4	40	60	100
DSE: A	**ZOPDLD1**	Molecular Biology of Information Pathway: Nucleic Acids	L-2	1	20	30	50

DSE: B	**ZOPDTD3**	Neuroendocrinology, Non-Classical Hormones and Signaling	T-4	4	40	60	100
DSE: B	**ZOPDLD3**	Neuroendocrinology, Non-Classical Hormones and Signaling	L-2	1	20	30	50
DSE: B	**ZOPDTD4**	Mammalian Reproduction, Fertility and Sterility	T-4	4	40	60	100
DSE: B	**ZOPDLD4**	Mammalian Reproduction, Fertility and Sterility	L-2	1	20	30	50
DSE: C	**ZOPDTD5**	Fish Anatomy, Physiology and Biotechnology	T-4	4	40	60	100
DSE: C	**ZOPDLD5**	Fish Anatomy, Physiology and Biotechnology	L-2	1	20	30	50
DSE: C	**ZOPDTD6**	Fish Culture, Capture Fishery and Fish Pathology	T-4	4	40	60	100
DSE: C	**ZOPDLD6**	Fish Culture, Capture Fishery and Fish Pathology	L-2	1	20	30	50
DSE: D	**ZOPDTD7**	Mechanism of Toxicity	T-4	4	40	60	100
DSE: D	**ZOPDLD7**	Mechanism of Toxicity	L-2	1	20	30	50
DSE: D	**ZOPDTD8**	Reactive Metabolites and Defense System in Biology	T-4	4	40	60	100
DSE: D	**ZOPDLD8**	Reactive Metabolites and Defense System in Biology	L-2	1	20	30	50
Dissert-ation	**ZOPDDD1**	Based on DSE Elected (I/II/III/IV)	D-12	6	80	120	200
			28H/W	**20**	**240**	**360**	**600**

1. Discipline Specific Electives (DSE) in forth semester for each session will be offered to students on the basis of availability of faculty and infrastructure.
2. Offering of DSE in any particular session will be decided after a formal meeting of all faculty members of Department of Zoology.
3. Each student may study any one out of the given electives (I, II, III and IV).
4. Elective papers will be distributed among the students on the basis of merit/choice.
5. The project work/dissertation will be carried out only in the field of respective elective papers (I, II, III and IV) opted by the students.

Abbreviations:

CC= Core Course
OE= Open Elective
DSE= Discipline Specific Electives
DSE: I= **Biochemistry and Molecular Biology**
DSE: II = **Mammalian Reproductive Physiology and Endocrinology**
DSE: III= **Fish Biology**
DSE: IV= **Toxicology**
CCA= Continuous Comprehensive Assessment
ESE= End-Semester Examinations

Prof. S K Prasad	**Dr. Rohit Seth**	**Dr. S K Verma**	**Prof. LVKS Bhaskar**
(External Expert)	**(Member)**	**(Member)**	**(HOD)**

SEMESTER I
CORE 2

ZOPATT2: CELL BIOLOGY AND GENETICS

Unit 1: Basic structure of prokaryotic and eukaryotic cell: Ultrastructure of cell membrane (Fluid mosaic model), membrane proteins and lipids, mitochondria, Golgi complex, endoplasmic reticulum and lysosome; structure and functions of centrosome; Cell junctions: Tight and gap junctions, Desmosomes. Cell interactions; Chromatin organization; Biogenesis of ribosomes.

Unit 2: Cell division and cell cycle Mitotic and Meiotic cell divisions and their significance, spindle apparatus and synaptonemal complex, cell cycle and its regulation, labeling index and cell cycle duration measurement, cell synchronization and cell cycle inhibitors; Apoptosis and necrosis; Molecular basis of cancer.

Unit 3: Classical genetics: Properties and evolution of genetic material flow of genetic information; Mendel's laws and their chromosomal basis of inheritance; Extensions of Mendelian principles: Dominance relationships, epistasis, pleiotropy, expressivity andpenetrance; Linkage and crossing over; Sex linked, sex-limited and sex influenced character; Sex determination; dosage compensation in *Drosophila.*

Unit 4: Modern gene concept: Concepts of transcriptome and proteome, gene duplication–gene families, interrupted gene, pseudogenes and transposable genetic element; Regulation of gene activity in *lac* and *trp*operons of *E. coli*; Introduction to gene regulation in eukaryotes; Organization of a typical eukaryotic gene; Manipulation of genes, site-specific mutagenesis, genomic expression profiling; Gene mapping in human by linkage analysis in pedigrees, ordered and unordered tetrad analysis.

Unit 5: Applications and implications of genetic engineering: Restriction enzymes, cloning vectors; production of recombinant DNA molecules; Preparation and screening of cDNA library; DNA sequencing: PCR and RT PCR; Gene transfer and transfection methods, transgenic animal production-DNA integration; Use of cre/loxp in transgenic animal production; Somatic cloning.

Books Recommended

1. Alberts et al. (2008) Molecular Biology of the Cell, 5th Ed. Garland Publishing House.
2. Lodishet al (2016) Molecular Cell Biology. 8th Ed. W.H. Freeman.
3. Tamarin RH (2004) Principles of Genetics. Tata McGraw-Hill Publishing Comp. Ltd.
4. Brown (2006) Genomes, 3rdEd. Garland Science.
5. Gardner et al (2006) Principles of Genetics, John Wiley
6. Cooper GM (2004) The Cell, 3rdEd. ASM Press.
7. Hardin et al. (2012) Becker's World of the Cell, 8th Ed. Pearson Benjamin Cummings.
8. Karp (2008) Cell and Molecular Biology-Concepts and Application, 5th Ed. John Wiley.
9. Krebs et al (2011) Lewin's Genes X, Jones and Barlett.

Percent Change From Previous Syllabus: 50 %

Department of Zoology, GGV, Bilaspur (CG)

SEMESTER I
CORE 2

ZOPALT2: CELL BIOLOGY AND GENETICS

Cell Biology

1. Preparation of permanent slide to demonstrate DNA by Feulgen reaction
2. Preparation of permanent slide to demonstrate DNA and RNA by MGP
3. Preparation of permanent slide to demonstrate muco-polysaccharides by PAS reaction
4. Preparation of permanent slide to demonstrate proteins by mercuro-bromophenol blue/Fast green
5. Study of mitosis in onion root tip
6. Study of meiosis in grasshopper testis
7. Study of permanent slides: Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.
8. Study of permanent slides: Prophase, Metaphase, Anaphase and Telophase; Barr body.

Genetics

1. Basic principle of experimental animal handling and ethical issues and bio safety for molecular biology work.
2. Identification of different embryonic stages of *Drosophila.*
3. Extraction of DNA from animal tissue/blood.
4. Extraction of RNA from animal tissue.
5. Study of sex chromatin in human female from buccal epithelial and hair bud cells
6. Examination of wild type (males and females) and mutants of *Drosophila*
7. Sex linked inheritance in *Drosophila melanogaster*
8. Separation of protein on native and /denaturation gel (PAGE) / western blotting
9. Temporary squash preparation of polytene chromosomes from salivary glands of *Drosophila* larvae

Course Objective:
To study the structure and function of various prokaryotic and eukaryotic cell components, as well as their regulation and implications. To study the classical and modern concepts of genetics, as well as the techniques used in genetic engineering.

Course Outcomes:
Students will gain an understanding of how a cell works at the molecular level. Develop a thorough understanding of cell components and their functions. Students will learn about genetic engineering techniques and the basis of inheritance through Mendelian genetics.

Percent Change From Previous Syllabus: 50 %

SEMESTER I
CORE COURSE 3

ZOPALT3: BIOCHEMISTRY AND MOLECULAR BIOLOGY

1. Preparation of extract for enzyme assay (alkaline phosphatase)
2. Study of alkaline phosphatase activity
3. Standard curve preparation
4. Effect of enzyme concentration and determination of total and specific activity
5. Effect of temperature on enzyme activity
6. Effect of time on enzyme activity
7. Effect of substrate concentration on enzyme activity
8. Determination of Km and Vmax by Michaelis-Menten and Lineweaver-Burk Plot
9. DNA isolation
10. RNA isolation
11. Reverse transcriptase polymerase chain reaction
12. Western blotting
13. Northen blotting

Course Objective:
To build comprehensive working knowledge of biomolecules and their role in specific molecular transformations.To enable the students to develop an integrated approach for understanding the various life science problem at the molecular level.

Course Outcomes:
Students will recognize and interpret the structural and functional aspects of molecules and their interactions that give rise to the supramolecular complexes such as organelles and cells.Students will have the ability to perform laboratory techniques used in molecular biology and biochemistry.

Percent Change From Previous Syllabus: 05.00 %

SEMESTER I
CORE COURSE 4

ZOPALT4: BASIC MAMMALIAN PHYSIOLOGY

1. Study of histological slides: Salivary gland, Liver, Pancreas, Stomach and Intestine.
2. Glucose estimation
3. Amylase assay in the given sample
4. Determination of blood groups (ABO and Rh factor)
5. Erythrocyte counting
6. Total leucocytes counting in blood
7. Study of histological slides: Kidney, Heart and Lungs
8. Study of Kidney, Heart and Lungs with models/PPT
9. Assessment of kidney function test

Course Objective:
To study morphological, structural, functional and metabolic aspects of mammals.
To create awareness among students about their health.

Course Outcomes:
Students will understand the physiochemical basis of how each system operates and build also they will understand the functioning of each system. The knowledge can be applied to the understanding of everyday activities of human body.

Percent Change From Previous Syllabus: 05.00 %

Department of Zoology, GGV, Bilaspur (CG)

SEMESTER II
CORE COURSE 5

ZOPBLT1: ANIMAL BEHAVIOUR

1. Study of individual and social behavioral patterns of a troop of monkeys.
2. Courtship behavior in the fruit fly.
3. Study the different behavior of laboratory rats.
4. Nest making behavior of birds.
5. Habitat preference behavior in insects.
6. Habituation in earthworms/mosquito larvae.
7. Locomotory behavior of dipteran larvae (fruit fly): Locomotion on different types of substrata (writing paper, plastic sheet and sand paper) & Effects of light intensity and light quality on the rate of locomotion.
8. Study of interspecific association between cattle and egrets.
9. Territorial behavior in stray dogs.

Course Objective:
Ethology focuses on behavior under natural conditions, and viewing behavior as an evolutionarily adaptive trait. Understanding how genes and the environment come together to shape animal behavior is also an important underpinning of the field. Genes capture the evolutionary responses of prior populations to selection on behavior.

Course Outcomes:
Students will understand the ways how animal interact with other organisms and the physical environment.

Percent Change From Previous Syllabus: 50.0 %

SEMESTER I
CORE 6

ZOPBLT2: DEVELOPMENTAL BIOLOGY

1. Study of frog embryonic development through models
2. Collection of frog spawns and observation of different developmental stages
3. Study of spiral cleavage in eggs of snail
4. Effect of vitamin A in tadpole tail regeneration
5. Study of embryonic development in chick through slides
6. Window preparation to study chick embryo development
7. Study of expression of developmental genes in larval imaginal discs
8. Preparation of Sperm slide.

Course Objective:
Major objective is to provide student with a sound coverage of mammalian reproductive biology with in framework of human biology. Study will be achieved by learning fundamental of structure and function of male and female reproductive tract, gametogenesis, fertilization early embryonic fetal development till birth of young one.

Course Outcomes:
It will provide important function to consider sexual differentiation and development, infertility and current reproductive technology.

Percent Change From Previous Syllabus: 10.0 %

Department of Zoology, GGV, Bilaspur (CG)

SEMESTER II
CORE COURSE 7

ZOPBLT3: ENDOCRINOLOGY

1. Handling, sexing, numbering and maintenance of rat
2. General survey of endocrine glands in rat
3. Study of vaginal smear preparation in rat
4. Study of the following using permanent slides:
   a. Endocrine glands and reproductive organs of rat
   b. Gonads (testis and ovary from fish to birds)
   c. Thyroid of fish (pharyngeal and ectopic) and reptile
   d. Adrenal homologues (interrenal and chromaffin tissues) in fish and reptile
   e. Cell types pituitary
   f. Hypothalamo-neurohypophsial system
5. Demonstration of frog metamorphosis by models and charts
6. Demonstration of ELISA-based hormone assay

Course Objective:
To explain new hormones are synthesized, secreted and different from other physiological secretion. Their role in regulation of homeostasis of all physiological process via autocrine, paracrine, and endocrine modes of delivery, following negative and positive feedback mechanism. It also explains molecular mechanism of hormonal action based on the types of receptor.

Course Outcomes:
It will explain various endocrinological principle which helps in determination of pathophysiological basis and consequences of specific endocrine disorder.

Percent Change From Previous Syllabus: 20.0 %

SEMESTER II
CORE COURSE 8

ZOPBLT4: REGULATORY MAMMALIAN PHYSIOLOGY

1. Study of skin with the help of chart and models
2. Study of muscle with the help of chart and models
3. Study of appendicular skeleton system with the help of model
4. Study of axial skeleton system with the help of model
5. Total and differential leucocytes counting in blood
6. Study of histological slides
7. Study of brain by model/chart
8. To study functioning of brain by rotarod
9. To study functioning of brain by light and dark chamber

Course Objective:
To study physiological and metabolic aspects of systems and their regulations.
To study the interaction between immune systems and their components with various systems of the body.

Course Objective:
To explain new hormones are synthesized, secreted and different from other physiological secretion. Their role in regulation of homeostasis of all physiological process via autocrine, paracrine, and endocrine modes of delivery, following negative and positive feedback mechanism. It also explains molecular mechanism of hormonal action based on the types of receptor.

Course Outcomes:
It will explain various endocrinological principle which helps in determination of pathophysiological basis and consequences of specific endocrine disorder.

Course Outcomes:
Students acquire knowledge about how immune system communicates with different systems of the body. Different sensory systems works and how they affect behavior.

Percent Change From Previous Syllabus: 10.00 %

SEMESTER III
OPEN ELECTIVE 1

ZOPCLO1: FUNDAMENTALS OF PUBLIC HEALTH

1. Questionnaire design for epidemiological studies
2. The Michigan Alcohol Screening Test (MAST)
3. AUDIT questionnaire: screen for alcohol misuse
4. Calculation of risk ratio
5. Estimation of disease prevalence
6. Calculation of incidence
7. Calculating the sample size for surveys
8. Analysis and interpretation of epidemiological data

Course Objectives:
Students will be introduced to the field of public health. To provide an overview of prevention and health promotion methods. To comprehend the causes and consequences of disease and health-related states. To comprehend the state of health and disease on a global and national level.

Course Outcomes:
Students will gain sufficient knowledge and skills in a variety of public health topics. Develop a workforce to take on public health responsibilities in specific geographic areas. Develop a comprehensive understanding of the epidemiological transitions of programs specific to each region of the country in order to prioritize public health challenges for policymaking.

Percent Change From Previous Syllabus: 100 % (Newly introduced)

SEMESTER III
OPEN ELECTIVE 2

ZOPCLO2: BRAIN FUNCTION AND MENTAL AWAREMESS

1. Comparative study of brain of lower and higher vertebrates.
2. Dissection of Chicken Brain
3. Dissection of Goat Brain
4. Histology and sectioning of major areas in the brain.
5. Brief introduction of the staining techniques and stains used in brain Histology.
6. Anatomical mapping of major hypothalamic centers.
7. Study of pituitary and pineal cell types through prepared slides.
8. Hands on training in Electrophysiology: Understanding of electrophysiological techniques from microelectrodes to devices and from recording modes to data analysis; Brain slice electrophysiology (field recordings and patch clamp).
9. Some important behavioural techniques in neuroscience:
   (a). Rotarod (b). Morris water maze (c). 8 Arm radial maze or T – Maze
10. Study of MRI and CT-SCAN images for diagnosis of various neurological conditions

Course Objectives:
This hands-on laboratory exercises is designed to engage the students in common techniques used in neuroscience research. Chicken and Goat brain dissections will be done to explore the anatomy of the brain, enabling students to understand the brain circuitry. Students will learn histological techniques as well. Neurophysiological experiments will be done to study brain function and behavior.

Course Outcomes:
Students will understand anatomical parts of the brain and relate structure with the functioning of the brain. Students will develop a deep knowledge of behavioral neuroscience through lectures, laboratory exercises, and readings on numerous and diverse behavioral neuroscience topics. They will also develop an understanding of various neurological defects by reading MRI and CT-SCAN from normal and persons suffering from neurological defects.

Percent Change From Previous Syllabus: 100 % (Newly introduced)

SEMESTER III
DISCIPLINE SPECIFIC ELECTIVE 1

ZOPCLD1: EVOLUTION, ENVIRONMENTAL BIOLOGY AND SUSTAINABLE DEVELOPMENT

1. Study of quantitative inheritance in *Drosophila*: sternopleural bristle phenotypes in *D. melanogaster*
2. Demonstration of natural selection under laboratory conditions by making competition between red eyed and white eyed *D. melanogaster*
3. Demonstration of Hardy-Weinberg equilibrium in human populations by taking examples of MN and ABO blood group systems
4. Study of inversion polymorphism in *Drosophila*
5. Study of sexual isolation between two closely related and sympatric species of *Drosophila*: *D. bipectinata and D. malerkotliana.*
6. Study of Zoo and Phytoplanktons in pond water
7. Preparation of temporary slides of Zooplanktons
8. Calculation of biodiversity indices
9. Physiochemical analysis of water
10. Estimation of aquatic: primary productivity using dark and light bottles
11. Study of species interactions

Course Objective:
To study how evolution progresses and affects population in individual level.

Course Outcomes:
Students will develop understanding about how evolution affects natural selection.
Students will develop understanding about how speciation occurs due to evolution.
Students will develop understanding about population genetics.

Percent Change From Previous Syllabus: 05.00 %

SEMESTER III
DISCIPLINE SPECIFIC ELECTIVE: 2

ZOPCTD2: BIOTECHNIQUES

Unit 1: Microscopy: Property of light, image formation, types of objectives, numerical aperture, limit of resolution, magnification; Structure, function and application of light (Bright-field and dark field) microscope, phase contrast microscope, fluorescence microscope, confocal microscope, transmission and scanning electron microscope.

Unit 2: Spectroscopy: Principle, structure, functioning and applications of colorimetry, UV-visible spectrophotometry, fluorimetry and atomic absorption spectrophotometry; ELISA.

Unit 3: Centrifugation: Principle of centrifugation, types of centrifuges and their applications, types and caring of rotors; determination of centrifugal force, sedimentation of cellular organelles.

Unit 4: Electrophoresis and Chromatography: Electrophoresis: Principle, types of electrophoresis, factors affecting migration, isoelectric focusing of proteins; PAGE and agarose gel electrophoresis; Blot techniques: Southern, Northern and Western.
Chromatography: Basic principle and application; Planar chromatography, Gas chromatography, High performance liquid chromatography, Ion exchange and affinity chromatography.

Unit 5: Microtomy: Basic principle of fixation, types and chemistry of fixation; Tissue processing: Dehydration, clearing, embedding and block preparation; Types of microtome; Histological stains: hematoxylin and eosin.

Books Recommended

1 Bancroft and Stevens (2002) Theory and Practice of Histological Techniques, Churchill-Livingstone.
2 Boyer (1993) Modern Experimental Biochemistry and Molecular Biology, 2nd Ed. Benjamin/Cumin.
3 Karp (2007) Cell and Molecular Biology, Wiley.
4 Lodish et al (2007) Molecular Cell Biology, Freeman.
5 Plummer (1990)An Introduction to Practical Biochemistry, 3rd Ed. Tata-McGrawHill.
6 Pollard andEarnshaw (2002) Cell Biology, Saunders.
7 Ruthman (1970) Methods in Cell Research, Bell and Sons.
8 Wilson and Walker (2006) Principles of Biochemical and Molecular Biological Techniques, 6th Ed. Cambridge University Press.

Percent Change From Previous Syllabus: 50.0 %

SEMESTER III
DISCIPLINE SPECIFIC ELECTIVE: 2

ZOPCLD2: BIOTECHNIQUES

Biotechniques

1. Principle and working of centrifuges using yeast cells.
2. Principle and working of paper chromatography
3. Principle and working of spectrophotometer
4. Cell counting using hemocytometer (by using suitable stain)
5. Demonstration of agarose gel electrophoresis for DNA.
6. Fixation, block preparation, staining and identification of given samples.
7. Demonstration of ELISA for hormonal assay
8. Study and interpretation of electron micrographs/ photographs showing
   a) DNA replication
   b) Transcription
   c) Split genes

Course Objective:
The aim of this course is to provide an advanced understanding of standard methodologies in biology that are commonly used in life science research.

Course Outcomes:
Student will get acquired with common laboratory techniques and can comfortably handle the instruments. Biotechniques are in high demand in academics, research and industry and play prominent role in biomedical and clinical research.

Percent Change From Previous Syllabus: 40.0 %

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE: A
Biochemistry and Molecular Biology

ZOPDLD1: BIOCHEMISTRY OF INTERMEDIARY METABOLISM AND ENZYMOLOGY

1. Estimation of blood glucose level using glucose oxidase method
2. Estimation of total cholesterol, HDL-cholesterol and triacyl glycerol
3. Estimation of amino acid concentration
4. Studies on quantitation of proteins by various methods: Biuret, Lowry, Bradford, Bromocresol and UV spectrophotometry
5. Studies on the expression of protein by western blotting
6. Tissue collection, storage and processing and preparation of enzyme extract
7. Standardization of the assay procedure
8. Determination of total enzyme activity and specific activity
9. Tissue distribution and sub-cellular distribution of enzyme activity.
10. Kinetic studies

Course Objective:
The course aims to provide an advanced understanding of the core principles and topics of protein structure and function. Emphasis is given to chemical structural and functional relationship of proteins and enzyme kinetics and its regulation.

Course Outcomes:
The principles of globular protein structure, as well as the techniques used for elucidation of structures and approaches to their prediction from sequence.The behavior of proteins in solution and the principles of molecular recognition.Intermediates in enzyme-catalyzed reactions and their investigations.

Percent Change From Previous Syllabus: 100 % (Newly introduced)

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE: A
Biochemistry and Molecular Biology

ZOPDTD2: MOLECULAR BIOLOGY OF INFORMATION PATHWAY: NUCLEIC ACIDS

Unit 1: Eukaryotic genome: Introduction to structural and functional genomics, Denaturation and renaturation of DNA, unique and repetitive DNA, sequences (LINEs, SINEs), Chromatin organization, Nucleosomes and higher order structures, Histones and non-histone chromosomal proteins, Telomere, Chromatin modifications; Human genome: mapping, characteristics and implications.

Unit 2: DNA replication, repair and recombination: DNA polymerases, ARS and initiation in yeast, Eukaryotic chromatin replication and regulation; DNA repair: Multiple DNA repair system: Mismatch repair, Base excision repair, Nucleotide excision repair, Direct repair; DNA recombination: Homologous genetic recombination, site-specific recombination.

Unit 3: Transcription and its regulation: RNA polymerases in eukaryotes, Transcription factors: general and specific, Assembly of pre-initiation complex and initiation. Elongation and elongation factors, Enhanceosomes, Transcriptome, Promoter analysis and characterization, Expression system: transient and stable, Deletion mapping, S1/RNase mapping, Chromatin immunoprecipitation (ChIP), Electrophoretic mobility shift assay, DNase I footprinting.

Unit 4: Post transcriptional processing and regulation: Introns: types and mechanisms of splicing, RNA editing, Post transcriptional gene silencing (RNA interference); Catalytic RNA and its role.

Unit 5: Genetic engineering: Tools: Restriction enzymes and other enzymes for DNA manipulation, Vector types: cloning and expression, Probes; Cloning strategies: cDNA and genomic libraries, Positional cloning,; Screening of clones: Preparation of probes, Hybridization: Southern, Northern (colony/plaque), immuno-screening; Characterization of clones: Sequencing, Microarray; PCR and its applications, Application: transgenic organisms and genetically modified organisms (GMOs), animal cloning, site-directed mutagenesis, generation of knock-out animals, gene therapy, DNA drugs; Ethical and social issues.

Books Recommended

1. Malacinski: Freifelder's Essentials of Molecular Biology (4th ed 2005, Narosa)
2. Lewin: Genes IX (2008, Jones and Bartlett)
3. Brown: Genomes (3rd ed 2006, Garland Science)
4. Brown: Gene Cloning and DNA Analysis (2001, Blackwell)
5. Sambrook & Russell: Molecular Cloning (2001, Cold spring Harbor)
6. Primrose: Principles of Gene Manipulation (2001, Blackwell)
7. Asubel et al: Current Protocol in Molecular Biology (1994, Wiley)
8. Lodish et al: Molecular Cell Biology (6th ed 2007, Freeman)
9. Goldsby et al: Kubey Biochemistry (2001, Freeman)
10. Gesteland et al: RNA World (2nd ed 1999, Cold Spring Harbor)

Percent Change From Previous Syllabus: 100 % (Newly introduced)

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE: A
Biochemistry and Molecular Biology

ZOPDLD2: MOLECULAR BIOLOGY OF INFORMATION PATHWAY: NUCLEIC ACIDS

1. Sterilization techniques, media preparation and agar plate preparation
2. Measurement of growth curve of *E.coli*., calculation of its generation time and viable cell counting
3. Induction of β-galactosidase in *E.coli*
4. Rapid isolation of plasmid DNA (mini prep. alkaline lysis method)
5. Restriction digestion of plasmid and analysis by agarose gel electrophoresis, determination of insert size
6. Cloning of a DNA fragment
7. Preparation of competent cells, transformation and screening of colonies (blue-white selection)
8. Demonstration: Southern hybridization, PCR

Course Objective: The course intends to give basic knowledge about the population genetics as well as the importance of genetic, environmental and social determinants of origin of non-communicable and infectious diseases.

Course Outcome: On completion of the course, the students know and are able to use basic genetic concepts and identify Mendelian inheritance patterns. Further students become familiar with different genetic and environmental factors that are important for the origin of both communicable and noncommunicable diseases.

Percent Change From Previous Syllabus: 100 % (Newly introduced)

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE C
Fish and Fisheries

ZOPDLD5: FISH ANATOMY, PHYSIOLOGY AND BIOTECHNOLOGY

1. General anatomical observations of a bony fish.
2. Display of afferent and efferent branchial vessels.
3. Study of available histological slides of different structures/organs.
4. Study of haematological parameters- blood corpuscles, T.C, D.C and Hb content
5. Determination and comparison of hemoglobin content of water-breathing and air breathing fish.
6. Study of ventilation rate and surfacing activity of fish under different experimental conditions.
7. Determination of feeding habit of carps and catfishes by analyses of their gut contents
8. Preparation of permanent stained slides of different endocrine glands and kidney of a teleost.

Course Objectives:
To know about the vital systems in fishes and its physiology.
To know about the food and feeding activity of the fishes.
To get knowledge about the hormones related with reproduction like FSH, LH, etc.
To get knowledge about induced breeding like hypophysation and stripping.
To use various fish biotechnologies to improve the quality and quantity of fishes like gyanogenesis and androgenesis.
To know about the techniques used in cryopreservation of gametes and embryo for the further use.
To get knowledge about the transgenic fishes.

Course Outcomes:
This course work will provide the knowledge about complete biology of fishes. Generally, the carps do not breed in stagnant water; therefore artificial breeding is carried out. This course will provide basic knowledge of induced breeding in fishes. The course will also through light on the biotechniques like cryopreservation and production of transgenic fishes.

Percent Change From Previous Syllabus: 50.0 %

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE C
Fish and Fisheries

ZOPDTD6: FISH CULTURE, CAPTURE FISHERY AND FISH PATHOLOGY

Unit 1: Fish culture systems and Pond management: Pond culture, pen culture, cage culture, running water culture; Different ponds of a fish farm; Formulation and operation of different types of hatcheries; Composite fish farming; Fish culture in paddy fields; Sewage-fed fisheries; Physico-chemical properties of pond water and their maintenance; Manuring and liming; Larvivorous fishes; Weed fishes and their eradication; Aquatic vegetation and its control.

Unit 2: Fishery resources of India and Fishing methods: Inland fisheries- Lakesterine fishery; Riverine fishery; Marine fishery; Estuarine Fishery; Types of fishing gears, Fishing crafts; Modern techniques and equipments for finding and capturing fishes.

Unit 3: Fish nutrition: Food and feeding habits of freshwater fishes; Nutrients requirement for various growth stages of freshwater carps and their bioenergetics; Supplementary feed; Anti-nutritional factors.

Unit 4: Fish by-products, Fish spoilage and preservation: Fish by products: Liver oils, Fish meal, Fish silage, Fish protein, Shark fins and fin rays, Fish roes, Isinglass, Fish skin, Pearl essence; Ornamental fishes: Fish aquarium: Preparation and maintenance; Bacterial, chemical and enzymatic spoilage, Fish preservation: Drying, Salting, Smoking and Canning; Additives and Preservatives.

Unit 5:Fish pathology: Main causes of disease in farmed fish; Preventing diseases through proper management; Common disease symptoms in fish; Symptoms, treatment and control: common diseases caused by viruses, bacteria, fungi, protozoa and crustaceans in fishes; Nutritional diseases in fishes.

Books Recommended

1. Chakroff M (2015) Freshwater Fish Pond Culture and Management, Sci. Publishers.
2. Davis HS (1956) Culture and Diseases of Game Fishes, University of California Press.
3. Duijn CV (1967) Diseases of Fishes, London Iliffe Books Ltd.
4. Datta-Munshi and Hughes(1992) Air-breathing fishes of India, Oxford and IBH.
5. Hall CB (1994) Ponds and Fish Culture, Agro Botanical Publishers.
6. Hora SL and Pillay TVR (1962) Handbook on Fish Culture in the Indo-Pacific Region, Fisheries Division, Biology Branch, FAO.
7. Jhingran VG (1991) Fish and Fisheries of India. Hindustan Pub.Corporation, New Delhi.
8. Khanna SS and Singh HR (2003) A Textbook of Fish Biology and Fisheries, Narendra Publishing House.
9. Kreuzer R (1974) Fishery products, FAO, Fishing News (Books) Ltd., England.
10. Lagler et al. (2003) Ichthyology, John Wiley.
11. Ribelin WE and Migaki G (1975) The Pathology of Fishes, The Univ. of Wisconsin Press.

Percent Change From Previous Syllabus: 50.0 %

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE C
Fish and Fisheries

ZOPDLD6: FISH CULTURE, CAPTURE FISHERY AND FISH PATHOLOGY

1. Analysis of some important physical and chemical properties of water
2. Collection and identification of plankton, weeds and aquatic plants.
3. Study of weeds and aquatic plants.
4. Study of ornamental, exotic and larvicidal fishes.
5. Study of major carps.
6. Study on modern techniques of fishing.
7. Study of various types of fishing gears.
8. Visit to fish market/fish pond/fish farm/breeding centers.

Course Objectives:
To know about the basic types of fish culture systems.
To know about the pond management for fish culture, optimum conditions required for fish culture and modern techniques of culture and capture fisheries.
To know about the common fish diseases and its control measures.
To get the knowledge of fishery resources of India like freshwater, marine and brackish.
To know about indigenous and improved fishing gears and crafts
To get the basic idea of fish nutrition and supplementary food for fishes.
To know about the nutritional and anti-nutritional factors of the fishes
To get knowledge about additives and preservatives used to keep food items preserve for long time
To get idea about various fish byproducts used by human beings

Course Outcomes:
Students will be aware about the various fishery resources of India, from which we obtain fishes by culture and capture fishery. The fishes use many kinds of food. If scarcity of food is there then, artificial food is given. Students will also be familiar about nutrition and anti-nutritional factors present in the supplementary food provided to the fishes. This course will provide the knowledge about the additives and preservatives used in the food, and also about fish byproducts.
Since fish are the best source of our food, therefore we should increase their production by using improved techniques. The course will also highlight on the selection of species of fishes to get maximum benefit. The students will also get knowledge about the various diseases.

Percent Change From Previous Syllabus: 50.0 %

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE D
Toxicology

ZOPDLD7: MECHANISM OF TOXICITY

1. To study the structure and function of toxins.
2. Quantitative identification of functional groups in given sample.
3. Qualitative identification of functional groups in given sample.
4. Training on different routes of drug administration (Oral, I.M., I.P, SC.)
5. Calculation of LD_{50}/LC_{50} by given data.
6. Calculation of therapeutic index by given data.
7. Collection of blood samples from rats/mice.
8. Collection of urine and feces samples from rats/mice.
9. To study excretory ability of liver (Kit method).
10. To study synthesis ability of liver (Kit method).
11. Demonstration of choleretic activity of xenobiotics (virtual lab).
12. Assessment of Liver function tests (Kit method).
13. Assessment of Kidney function tests (Kit method).

Course Objective:
To study few molecular mechanisms involved in chemically induced toxicity and methods to evaluate general toxicity in laboratory.

Course Outcomes:
Students will gain appreciable knowledge and critical thinking to correlate mechanism of chemically induced toxicity in intact body at molecular level.Students will also gain understanding regarding methods to identify toxic responses in various testing models.

Percent Change From Previous Syllabus: 100 % (Newly introduced)

Department of Zoology, GGV, Bilaspur (CG)

SEMESTER IV
DISCIPLINE SPECIFIC ELECTIVE D
Toxicology

ZOPDLD8: REACTIVE METABOLITES AND DEFENSE SYSTEM IN BIOLOGY

1. Handling of laboratory animals.
2. Demonstration of toxic effects of given xenobiotic using computer simulation programs/virtual labs.
3. Assessment of antioxidant potential in given sample.
4. To study the structure and function of metal-ligand complexes.
5. Assessment of chelating effect of molecules against selected metals.
6. Assessment of metal induced hematotoxicity.
7. Biochemical assessment of glutathione.
8. Assessment of oxidative stress
9. Histopathological effects of metals on tissues
10. To observe toxic effects on cellular level using electron micrographs of tissues

Course Objective:
To be acquainted with the history and scope of toxicology, metal toxicity and occupational health hazards so that student may develop reasoning behind the effect of environment.

Course Outcomes:
Student will be able to understand toxicology and its scope in life, to identify different types of toxicants and create understanding about effects of toxic agents present in environment.

Percent Change From Previous Syllabus: 100 % (Newly introduced)

Department of Zoology, GGV, Bilaspur (CG)

SEMESTER IV
COMPULSORY PAPER

ZOPDTA1: RESEARCH METHODOLOGY

Unit 1: Introduction to research
Meaning of research, objectives of research, research process, criteria of good research, defining the research problem, basic principles of research design, developing a research plan, sample design, characteristics of good sampling procedure, types of data.

Unit 2: Basics of scientific communication
Types of scientific communication: research papers, review, letter to editor; Constituents of research paper: title, running title, authorships, abstracts, keywords, introduction, materials and methods, results, discussion, acknowledgements, referees, figures, table components, communication with the editors, handling referees comments, galley proofs; Intellectual Property Rights; Plagiarism.

Unit 3: Research ethics involving human participants or laboratory animals
Ethics and biomedical research: General principles on ethical considerations involving human subjects, ethical review procedures, Institutional ethics committee: its organization and functions, general ethical issues. Ethical guidelines for experimental animals: Sources of experimental animals, Laboratory animal husbandry and management, anesthesia and euthanasia, laboratory animal ethics, animal ethics committee, its organization and functions, ethical guidelines for use of animals for scientific research, CPCSEA guidelines.

Unit 4: Statistical analysis-I
Methods of data collection; Graphical representation of data; Measurement of central tendency: Definition, characteristics, types, merits and demerits; Measurement of dispersion: Range, Mean deviation, Standard deviation, Standard error

Unit 5: Statistical analysis-II
Variance, Coefficient of variation, Correlation and Regression and their coefficients; Test of significance: Student t- test, Chi-squire test; ANOVA; Elementary idea of probability.

Unit 6: Computer application
Fundamental of computer; MS Word: typing the script, inserting tables, figures and graphs, preparation of dissertation and research papers; MS Excel: application of formulae use of statistical tools, preparation of graphs, histograms and charts; MS power point: insertion of figures, graphs, charts in presentation; Preparation of posters for scientific presentations.

Suggested readings

1. National Ethical Guidelines for Biomedical and Health Research involving human participants ICMR, New Delhi 2017.
2. Guidelines for care and use of animals in scientific research. Indian National Science Academy, New Delhi.
3. Research Methodology, methods and techniques by C.R. Kothari (2009).
4. Biostatistics: A foundation for analysis in health sciences, 9th Ed. Wayne W Daniel (2008).
5. Computer fundamentals, Pradip K Singha and Priti Singha (BPB Publication).

Percent Change From Previous Syllabus: 100 % (Newly introduced)