

CHOICE BASED CREDIT SYSTEM SYLLABUS (CBCS)

Post Graduate Department of Zoology



M.Sc. Syllabus (2023-2025)

**SHAILABALA WOMEN'S AUTONOMOUS COLLEGE
CUTTACK**

Curriculum Overview (M.Sc.)

Distribution of Course (Semester wise)

SEMESTER-I								
SL. NO.	NATURE OF COURSE	COURSE CODE	PAPER TITLE	UNITS	CREDITS	MARKS		
						MID-SEM	END SEM	TOTAL
1	Hard core	HC-101	Theory	5	5	30	70	100
2	Hard core	HC-102	Theory	5	5	30	70	100
3	Hard core	HC-103	Theory	5	5	30	70	100
4	Hard core	HC-104	Practical	--	5	30	70	100
5	Allied Core	AC-101	Computer Application Course by e-learning centre	3	3	Mid-sem 10+Practical 10=20 marks	30	50
Total					23	140	310	450

SEMESTER-II								
SL. NO.	NATURE OF COURSE	COURSE CODE	PAPER TITLE	UNITS	CREDITS	MARKS		
						MID-SEM	END SEM	TOTAL
1	Hard core	HC-201	Theory	5	5	30	70	100
2	Hard core	HC-202	Theory	5	5	30	70	100
3	Hard core	HC-203	Theory	5	5	30	70	100
4	Hard core	HC-204	Practical	--	5	30	70	100
5	Core Elective	CE-201	Theory (Options will be given to choose any one out of two)	5	5	30	70	100
6	Open Elective	OE-201	Theory (Open for other PG students) or MOOCs (from SWAYAM/NPTEL etc.)	--	4	--	50	50
Total					29	150	400	550

SEMESTER-III								
SL. NO.	NATURE OF COURSE	COURSE CODE	PAPER TITLE	UNITS	CREDITS	MARKS		
						MID-SEM	END SEM	TOTAL
1	Hard core	HC-301	Theory	5	5	30	70	100
2	Hard core	HC-302	Theory	5	5	30	70	100
3	Hard core	HC-303	Practical	--	5	30	70	100
4	Core Elective	CE-301	Theory (Options will be given to choose any one out of two)	5	5	30	70	100
5	Core Elective	CE-302	Theory (Options will be given to choose any one out of two)	5	5	30	70	100
6	Field Internship	FI-301	Field Internship	--	4	--	50	50
	Total				29	150	400	550

SEMESTER-IV								
SL. NO.	NATURE OF COURSE	COURSE CODE	PAPER TITLE	UNITS	CREDITS	MARKS		
						MID-SEM	END SEM	TOTAL
1	Hard core	HC-401	Theory	5	5	30	70	100
2	Hard core	HC-402	Practical	--	5	30	70	100
3	Hard core	HC-403	Dissertation	--	5	--	100	100
4	Core Elective	CE-401	Theory (Options will be given to choose any one out of two)	5	5	30	70	100
5	Allied Core	AC-401	Theory (Women & Society)(For all PG subjects/programs)	3	3	15	35	50
	Total				23	105	345	450

SUMMARY		
HC- Hard core	14 x 100	1400
CE-Core Elective	04 x 100	400
OE-Open Elective	01 x 50	50
AC-Allied Core	02 x 50	100
FI-Field Internship	01 x 50	50
Total Marks		2000

Program Specific Outcomes (PSO) of M.Sc. Zoology

PSO1: Developing **deeper understanding** of key concepts of biology at biochemical, molecular and cellular level, physiology and reproduction at organismal level, and ecological impact on animal behavior.

PSO2: Elucidation of animal-animal, animal-plant, animal-microbe interactions and their consequences to animals, humans and the environment.

PSO3: Strengthening of genetics and cytogenetics principle in light of advancements in understanding human genome and genomes of other model organisms.

PSO4: Description of expression of genome revealing multiple levels of regulation and strategies to manipulate the same in the benefit of the mankind.

PSO5: Learning handling DNA sequence data and its analysis which equip students to get employed in R&D in the industry involved in DNA sequencing services, diagnostics, and microbiome analysis.

PSO6: Understanding relationships of variations in phenotypic expression of genomes and their genomewide interaction with other organisms.

PSO 7: Development of an understanding of zoological science for its application in today's modern world

PSO 8: Development of theoretical and practical knowledge in handling the animals and using them as model organism

PSO9: Maintenance of high standards of learning in animal sciences

M.Sc. Zoology General Course Framework & Structure

S.No	Paper No	Title	Credits	Proposed Marks
SEMESTER ONE				
1	HC-101	Biology of Non-Chordates	5	100
2	HC-102	Cytology and Genetics	5	100
3	HC-103	Biosystematics, Conservation Biology, Evolution and Ecology	5	100
4	HC-104	Practical	5	100
5	AC-101	Computer Application Course by e-learning centre	3	50
TOTAL			23	450
SEMESTER TWO				
1	HC-201	Biology of Chordates	5	100
2	HC-202	Molecular Biology	5	100
3	HC-203	Physiology, Endocrinology and Histology	5	100
4	HC-204	Practical	5	100
5	CE-201	Ethology, Applied Ecology and Microbiology/Biochemistry	5	100
6	OE-201	Food, Nutrition and Health/ MOOCs (from SWAYAM/NPTEL etc.)	4	50
TOTAL			29	550
SEMESTER THREE				
1	HC-301	Immunology and Animal Biotechnology	5	100
2	HC-302	Developmental Biology and Radiation Biology	5	100
3	HC-303	Practical	5	100
4	CE-301	Bioinstrumentation and Biostatistics/ Bioinformatics, Biosafety and Bioethics	5	100
5	CE-302	Epigenetics and Cancer Biology / Entomology	5	100
6	FI-301	Field Internship	3	50
TOTAL			28	550
SEMESTER FOUR				
1	HC-401	Conservation Biology	5	100
2	HC-402	Practical	5	100
3	HC-403	Dissertation	5	100
4	CE-401	Cytogenetics and Stress Physiology and Metabolic disorders / Applied Biology	5	100
5	AC-401	Women and Society	3	50
TOTAL			23	450
			103	2000

SEMESTER-I

Semester-One

HC 101

Biology of Non-Chordates

Credits: 5

Course Objectives: Objective of the paper is to provide brief idea about each taxon of the non-chordates with some important biological features.

Student Learning Outcomes: Students after completion of this course are expected to know about the non-chordate diversity, evolutionary relationship, and some basic aspects parasitism.

Unit I Lower Invertebrates	<ol style="list-style-type: none">1. Locomotion, nutrition and reproduction in Protozoa2. Parasitic Protozoans with special reference to human host3. Origin of Metazoa4. Canal system in Porifera
Unit II Lower & Higher Invertebrates	<ol style="list-style-type: none">1. Polymorphism in Coelenterates2. Ctenophora and its affinities3. Host-parasite interactions4. Coelom, metamerism and segmental organs of Annelida
Unit III Higher Invertebrates	<ol style="list-style-type: none">1. Parasitic adaptations in helminths2. Life cycle of <i>Fasciola hepatica</i>3. Life cycle of <i>Wuchereria bancrofti</i>4. Excretory structures and functions in annelids
Unit IV Higher Invertebrates	<ol style="list-style-type: none">1. Structural organization and phylogenetic status of <i>Limulus</i>2. Parasitic castration with reference to the life cycle of <i>Sacculina</i>3. Larval forms in Crustaceans4. Structural organization and phylogenetic status of Peripatus
Unit V Higher Invertebrates	<ol style="list-style-type: none">1. Respiration in Molluscs2. Torsion and de-torsion in Gastropoda3. Water vascular system of Echinoderms4. Larval forms in Echinodermata
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Invertebrate Zoology, R.D. Barnes2. The invertebrates, L.H. Hyman, Vol I to VI3. Invertebrate structure, Barrington, Nelson4. Invertebrate Zoology, R.L. Kotpal5. The Invertebrates: Function and Form, W. Sherman, V.G. Sherman6. A Text Book of Zoology, T.J. Parker, W.A. Haswell, Vol-I and II

Semester-One

HC 102

Cytology and Genetics

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea about cell biology and inheritance pattern.

Student Learning Outcomes: Students after completion of this course are expected to know different cellular organelles and their functions, cell cycle regulations, basic inheritance pattern and basic gene mapping

Unit I Cytology-I	<ol style="list-style-type: none">1. Molecular organization of Cell membrane2. Membrane transporter: Structure and function3. Mechanism of membrane transports4. Cell-cell interactions
Unit II Cytology-II	<ol style="list-style-type: none">1. Structure and function of Cytoskeleton and its role in motility2. Structure, Biogenesis and function of Lysosome and Peroxisomes3. Endoplasmic Reticulum and compartmentalization of Golgi4. Structure and function of Mitochondria, protein targeting
Unit III Cytology-III	<ol style="list-style-type: none">1. Nucleus and nuclear transport2. Concept and organization of Gene and Chromosome3. Cell cycle and its regulations4. Cell Division and it's regulation
Unit IV Mendelism & Neo-Mendelism	<ol style="list-style-type: none">1. Mendelian Genetics2. Neo-Mendelism, Pleiotropy, genomic imprinting, penetrance and expressivity3. Linkage and crossing over4. Extra-chromosomal Inheritance, Pedigree analysis, Complementation tests
Unit V Extensions of Mendelian principles	<ol style="list-style-type: none">1. Multiple Alleles2. Codominance, incomplete dominance3. Epistasis4. Sex linkage, sex limited and sex influenced characters
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Molecular Cell Biology, Lodish, Berk, Kaiser, Krieger, Bretscher, Ploegh, Amon, Martin2. Molecular Biology of the Cell, Alberts <i>et al.</i>, (2008), Garland Science, New York, USA3. The cell: A molecular approach, Geoffrey, M. Cooper, R.E. Hausman (2004) ASM Press4. Cell and Molecular biology, Gerald Karp (2015) John Wiley and sons5. Principles of Genetics, Snustad and Simmons, (4th Ed. 2005), John Wiley & Sons, USA6. Genetics, J. Russell, Benjamin-Cummings Publishing Company, California, USA

Semester-One

HC 103

Biosystematics, Conservation Biology, Evolution, and Ecology

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea about classical and modern taxonomic approaches, Biodiversity and conservation of bio-resources, makes student aware about the evolutionary process and various components of ecosystem and their importance.

Student Learning Outcomes: Students after completion of this course are expected to get a holistic understanding of taxonomy, inculcate the value of natural environment and develop compassion toward bio-resources. Students are also expected to know the principle of evolutionary process and its application.

<p>Unit I Biosystematics</p>	<ol style="list-style-type: none"> 1. History of taxonomy and development of systematic, importance and application of systematic in biology, International code of zoological nomenclature (ICZN), concept of keys, type specimens 2. Morpho-taxonomy, cyto-taxonomy, molecular-taxonomy, DNA barcoding 3. Species concept, IUCN red list of threatened species, Invasive species, Alien species, Indicator species, Keystone species, Umbrella species, Flagship species, Charismatic species 4. Modes of collection and preservation of animals, Outline classification of animals
<p>Unit II Bioconservation</p>	<ol style="list-style-type: none"> 1. Biodiversity (genetic diversity, species diversity, ecosystem diversity) and its use, biodiversity hotspot in India. 2. Measuring Biodiversity: alpha, beta and gamma diversity, Species Richness(S), Evenness(E), Simpson index(D), Shannon-Weiner Index (H') 3. National Act and International Act related to Biodiversity Conservation 4. In-situ conservation (Indian context) (Sanctuaries, National and Biosphere reserves) and Ex-situ conservation (Indian context) (Botanical gardens, zoos, cryopreservation, gene bank).
<p>Unit III Evolution</p>	<ol style="list-style-type: none"> 1. Theories of organic evolution (Lamarckism and Darwinism) and the Modern synthetic theory. 2. Phylogenetic tree, molecular phylogeny inference using DNA and protein sequences 3. Hardy-Weinberg Law 4. Isolating mechanisms, and Speciation
<p>Unit IV Ecology</p>	<ol style="list-style-type: none"> 1. Ecosystem structure and characteristics 2. Species Interactions 3. Population characteristics 4. Gause's Principle
<p>Unit V Ecology</p>	<ol style="list-style-type: none"> 1. Community Ecology: Nature of communities 2. Community structure and attributes 3. Ecotone and Edge effect 4. Ecological Succession
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none"> 1. Principle of Animal Taxonomy; G.G. Simpson. Oxford IBH Publishing Company. 2. Elements of Taxonomy. E. Mayer. 3. Theory and Practice of Animal Taxonomy. V.C. Kapoor, Oxford & IBH Publishing Co. 4. Evolution : Strickberger 5. Evolutionary analysis : Herron and freeman 6. Campbell Biology: Reece, Urry, Cain <i>et al.</i> 7. Essential of Ecology: Miller and Spoolman

Semester-One

HC-104

Practical

Credits: 5

Course Objectives: Objectives of the paper is to provide 1) hands on exposure in collection, preservation and identification of invertebrates using basic taxonomic key, 2) observation and preparation of different slides related to cell biology 3) solving different problem related to inheritance biology,4) construction of phylogenetic tree, and 5) Hand on experience on ecological adaptation and performing different biochemical experiments.

Student Learning Outcomes: Students will be able to know about collection, preservation, identification and drawing phylogenetic tree of organisms.

Biology of Non-Chordate, Cellular Biology & Inheritance Biology, Biosystematics, conservation Biology, Evolution and Ecology

1. Invertebrate Anatomy of preserved animals available in the market
 - a) Prawn (Nervous system & Statocyst)
 - b) Cockroach (Nervous, reproductive & salivary systems)
 - c) Squilla (Nervous system)
 - d) Sepia (Nervous system)
 - e) Loligo (Nervous system)
 - f) Unio (Nervous system)
2. Preparation of permanent slides (Specimen available)
3. Identification with comments upon
 - a) Museum specimens
 - b) Whole mount Specimens
 - c) Permanent slides-Invertebrates
4. Cytological preparations of chromosomes from onion root tip and grasshopper testes
5. Demonstration of mitochondria by supravital staining in buccal epithelium
6. Demonstration of Barr body in hair root and buccal epithelial cells
7. Problem related to following aspect of genetics
 - a) law of independent assortment
 - b) Complementation test
 - c) Sex linked inheritance
 - d) Pedigree analysis
 - e) linkage map
8. Collecting different local animals/ photographs (least concern category) and their classification using taxonomic keys
9. Construction of phylogenetic tree using basic morphological features
10. Construction of phylogenetic tree using 16s rRNA gene sequences retrieved from NCBI database
11. Construction of phylogenetic tree using COI (Cytochrome c oxidase) gene sequences retrieved from NCBI database
12. Practical related to evaluation of diversity indices: Species Richness(S), Evenness (E), Simpson index (D), Shannon-Weiner Index (H')

SEMESTER-II

Semester-Two

HC-201

Biology of Chordates

Credits: 5

Course Objectives: Objective of the paper is to provide brief idea about each taxon of chordates with some important biological features.

Student Learning Outcomes: Students after completion of this course are expected to know the chordate diversity and some of the important features with respect to their evolutionary relationship.

Unit I Protochordates	<ol style="list-style-type: none">1. Biology and evolutionary significance of Hemichordates, Cephalochordates and Urochordates2. General organization, classification and affinities of Cyclostomata3. Structural organization of Petromyzon and its comparison with Myxine4. Origin of chordates
Unit II Superclass: Pisces	<ol style="list-style-type: none">1. Biology and affinities of Dipnoi and Latimeria2. Swim bladder and lateral line system in fishes3. Parental care in amphibian4. Neoteny and metamorphosis in amphibian
Unit III Class: Reptilia	<ol style="list-style-type: none">1. Structural organization and phylogenetic significance of Sphenodon2. Adaptive radiation in reptiles3. Skull in reptiles
Unit IV Class: Aves	<ol style="list-style-type: none">1. Origin and evolution in birds2. Flight adaptation in birds3. Migration in birds
Unit V Class: Mammalia	<ol style="list-style-type: none">1. Origin of mammal2. Aquatic mammals3. Prototheria and metatheria4. Dentition in Mammals
	Recommended Textbooks and References: <ol style="list-style-type: none">1. Phylum Chordata, H. Newman2. The Life of Vertebrates, J.Z. Youn3. A Text Book of Zoology, T.J. Parker and W.A. Haswell, Vol. I and II

Semester-Two

HC-202

Molecular Biology

Credits: 5

Course Objectives: The objectives of this paper is to provide comprehensive idea about the structure and function of nucleic acid and regulations of gene expression.

Student Learning Outcomes: Students after attending the course will understand role of bio-molecule involved in control and expression of genetic information and gene regulation at the level of transcription and translation in a better way.

Unit I Nucleic Acids	<ol style="list-style-type: none">1. Structure of Nucleic acids2. DNA replication3. DNA damage and repair mechanism4. Recombination: Homologous and site-specific recombination
Unit II Molecular Synthesis	<ol style="list-style-type: none">1. Mechanism of Transcription2. RNA Processing, RNA editing, splicing, and polyadenylation3. RNA Interference4. Structure and function of different types of RNA, RNA transport
Unit III Molecular Synthesis	<ol style="list-style-type: none">1. Genetic code2. Protein translation3. Post- translational modification of proteins4. Translational inhibitor
Unit IV Gene Regulation	<ol style="list-style-type: none">1. Prokaryotic gene regulation2. Eukaryotic gene regulations3. Topoisomerase, its role during replication and transcription4. Gene regulation and expression in viruses
Unit V Gene Regulation	<ol style="list-style-type: none">1. Hormones and their receptors, cell surface receptor,2. General principles of cell communication, Signaling through G-protein coupled receptors,3. Second messengers signaling pathway4. Quorum sensing
	Recommended Textbooks and References: <ol style="list-style-type: none">1. Molecular Cell Biology, Lodish, Berk, Kaiser, Krieger, Bretscher, Ploegh, Amon, Martin2. Cell Biology, G. Karp3. Cell and Molecular Biology, De Robertis4. Molecular Biology of the Cell, Alberts <i>et al.</i>, Garland Science, New York, USA

Semester- Two

HC-203

Physiology, Endocrinology and Histology

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea about various physiological processes, endocrine system and basic aspect of Histology.

Student Learning Outcomes: Students after completion of this course are expected to learn basic histological features of important organ, the role of physiological processes and hormones involved in maintaining homeostasis.

Unit I Digestion, Excretion	<ol style="list-style-type: none">1. Digestive System: Secretory function of alimentary canal,2. Digestion and absorption3. Excretory System: Nephron4. Mechanism of Urine formation
Unit II Nerve Conduction and Sense Organs, Respiration, and Thermoregulation	<ol style="list-style-type: none">1. Respiratory System: Mechanism of breathing, exchange of gases and its regulation2. Nervous System: Neurons, synapse and synaptic transmission and mechanism of nerve conduction.3. Sense Organs: Vision, hearing and taste4. Types of muscle and mechanism of muscle contraction.
Unit III Circulation	<ol style="list-style-type: none">1. Cardiovascular System: Double circulation, cardiac cycle2. Physiology and Biochemistry of Blood coagulation3. Blood pressure, Blood group and Hemoglobin4. ECG – its principle and significance
Unit IV Endocrinology	<ol style="list-style-type: none">1. Structure, chemistry and function of Pituitary gland2. Structure, chemistry and function of Thyroid and para-thyroid gland3. Structure, chemistry and function of Pancreas and Adrenal gland4. Mechanism of hormone action
Unit V Histology	<ol style="list-style-type: none">1. Structure and function of epithelial tissue and connective tissue2. Cell adhesion and cell adhesion molecules3. Histological details and functions of liver4. Histological details and functions of Spleen & Kidney
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Endocrinology, Hadley2. Endocrinology, Turner and Bagnora3. Comparative Vertebrate Endocrinology, P.J. Bentley4. Text Book of Comparative Endocrinology, H.A. Bern5. Animal Physiology: Adaptation and Environmental, K.S. Nelson (ed) Cambridge University Press, Cambridge, UK6. Medical physiology, Guyton and Hall7. Histology, H.R. Michael

Semester- Two

HC-204

Practical

Credits: 5

Course Objectives: Objectives of the paper is to provide 1) hand on exposure in collection, preservation and identification of vertebrates using basic taxonomic key, 2) observation and preparation of different slides related to histology 3) experiment related to human physiology, 4) practical related to animal behaviour, 5) performing different ecological experiments and basic microbiological experiments.

Student Learning Outcomes: On completion of this course, students are expected to learn collection, preservation, identification of vertebrates, blood physiology, histological details of important organs, experience animal behavior, physicochemical analysis of water and soil, media preparation for microbial growth and basic staining methods.

Biology of Chordates, Molecular Biology, Physiology, Endocrinology and Histology, Ethology, Applied Ecology, Biogeography and Palaeontology	<ol style="list-style-type: none">1. Vertebrate Anatomy of preserved animals locally available:-<ol style="list-style-type: none">a) Scoliodon (Afferent and Efferent blood vessels, cranial nerves, internal ear)b) Ampulla of Lorenzini, placoid scalec) Cycloid and ctenoid scales of bony fishes.d) <i>Calotes</i> (Blood vascular system, and hyoid apparatus)e) Pigeon (Blood vascular system, brain, air sacs, pecten, flight and perching muscles)f) Rat (Neck nerves, brain and vascular system)2. Identification and Comments upon<ol style="list-style-type: none">a) Museum specimensb) Bonesc) Permanent histological slides3. Ecological experiments to determine-<ol style="list-style-type: none">a) Acidity, alkalinity and chlorinity of water samplesb) Dissolved oxygen content of waterc) pH of soil and water samples4. Identification with comments upon animals with ecological adaptation and of evolutionary importance5. Collecting different local animals/ photographs (least concern category) and their classification using taxonomic keys6. Physiological experiments-<ol style="list-style-type: none">a) Haemin crystals, hemoglobin concentration, RBC and WBC countingb) Oxygen consumption in insects and rats7. Construction of Ethogram-available animal found in and around SBWAC campus8. Habituation in Annelid, Arthropod and Mollusc9. Demonstration of Chemical communication in ants10. Preparation of culture media11. Gram staining12. Biochemical test (Catalase, oxidase, carbohydrate)13. Practical related to preparation of solution, buffer and measurement of pH14. Demonstration and handling of micropipette15. Biochemical (Qualitative) tests for-a. Protein, glycogen, ascorbic acid, phosphorus, nucleic acid b. Tests for salivary amylase and invertase
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Semester- Two

CE-201

Ethology, Applied Ecology, and Microbiology

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea about different aspects of animal behaviour, applied ecology and microbial world.

Student Learning Outcomes: Students after completion of this course are expected to learn social organisation and their impotence in animals, pollution and its causative agents, bacterial and viral diversity, their genetics and their implication.

Unit I Ethology	<ol style="list-style-type: none">1. Concept of animal behavior: Innate, Acquired; Social interaction in Insects and Primates2. Altruism and Kin selection3. Neural basis of learning and memory4. Hypothalamus and regulation of animal behaviour
Unit II Applied Ecology	<ol style="list-style-type: none">1. Pollution and abatement of land,2. Air and water Pollution3. Noise pollution4. Global warming and its consequences
Unit III Applied Ecology	<ol style="list-style-type: none">1. Ozone layer depletion2. Acid rain-causes & consequences3. Bioremediation4. Environmental Acts
Unit IV Microbiology-I	<ol style="list-style-type: none">1. Bacteria structure and morphology & Classification2. Structure and function of bacterial cell wall3. Genetic recombination in bacteria4. Antibiotics classification and mode of action
Unit V Microbiology-II	<ol style="list-style-type: none">1. Characteristics and classification of viruses2. Life cycle of Bacteriophages3. Pathophysiology of CoV, H₁N₁ and HIV4. Bioterrorism
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Ecology, E.P. Odum, R. Holt, Winston Inc., USA,2. C.S. Binoda, M.P. Nayar, River Pollution In India. APH Publ. Corpn., New Delhi.3. Campbell Biology, Reece, Urry, Cain <i>et al</i>4. Essential of Ecology, Miller, Spoolman5. Animal Behaviour, J. Alcock6. Principles of Animal Communications, J.W. Bradbury7. Microbiology Principles and Explorations, J.G. Black, L.J. Black, 9th Edition, Willey Publishers8. Prescott's Microbiology, J. Willey, K. Sandman, D. Wood, 11th Edition

CE-201

Biochemistry

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea about structure, and function of bio-molecules. The papers also focus on metabolism of Bio-molecules, basic idea about enzyme, its kinetics and regulation.

Student Learning Outcomes: Students after completion of this course are expected to know different bio-molecules, their biological functions and role of enzymes in cellular metabolism

Unit I Biochemistry	<ol style="list-style-type: none">1. Composition, structure, types and function of carbohydrates2. Composition, structure, types and function of lipids and steroids3. Composition, structure, types and function of amino acids and proteins4. Conformation of proteins (Ramachandran plot, secondary structure)
Unit II Biochemistry	<ol style="list-style-type: none">1. Glycolysis and TCA cycle2. Oxidative phosphorylation, ETC and ATP synthesis3. Glycogenesis4. Glycogenolysis
Unit III Biochemistry	<ol style="list-style-type: none">1. Beta – Oxidation and omega oxidation of saturated Fatty acids with odd and even number of carbon atoms2. Biosynthesis of palmitic acids3. Ketogenesis
Unit IV Biochemistry	<ol style="list-style-type: none">1. Alternative metabolism of carbohydrates (Gluconeogenesis and HMP Shunt)2. Metabolism of amino acids and Urea cycle3. Biosynthesis of Cholesterol4. Vitamins
Unit V Enzymology	<ol style="list-style-type: none">1. Enzyme structure and classification2. Principles of catalysis, enzyme kinetics, Michaelis-Menten Equation, Line-Weaver-Burke Equation3. Mechanism of enzyme action with special references to lysozyme4. Regulation of Enzyme action
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Lehinger Principles of Biochemistry, D.L. Nelson, M.M. Cox, 07th Edition2. Biochemistry, J.M. Berg, L. Stryer, J.L. Tymoczko, G.J. Gatto, 08th Edition3. Harper's Illustrated Biochemistry, V.L. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennely, P.A. Weil, 31st Edition4. Principles of Biochemistry, Voet and Voet5. Biochemistry, Campbell

OE-201

Food, Nutrition and Health

Credits

Course Objectives: Objective of the paper is to provide brief idea about the human nutrition and nutrients.

Student Learning Outcomes: Students, after completion of this course, are expected to know about different essential nutrients, their role in human health and abnormalities associated with their deficiencies.

Unit I Basic concepts of Food and Nutrition	<ol style="list-style-type: none">1. Concept of balanced diet2. Nutrient Needs and Dietary pattern for Adults, Pregnant and Nursing mothers, infants, school children, adolescents and elderly
Unit II Health	<ol style="list-style-type: none">1. Concept of health2. Major Nutritional Deficiency diseases3. Life style related diseases4. Social Health problems5. Common ailments
Unit III Food Hygiene	<ol style="list-style-type: none">1. Potable Water2. Infections3. Brief account of food spoilage
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. G. Biswal, C. Lenka, Food Nutrition and Health, Kalyani Publishers2. SA Lanham-New, TR Hill, AM Gallagher, HH Vorster, Introduction to human nutrition, 3rd Ed, Willey Blackwell3. MJ Gibney, HH Vorster, FJ Kok, Introduction to human nutrition, Willey Blackwell Publishing4. SR Mudambi, MV Rajagopal, Fundamental Food Nutrition and Diet Therapy, New Age International Publishers5. AA Agrawal, SA Udipi, Textbook of human nutrition, Jeypee Publishers.6. T Rekhi, H Yadav, Fundamentals of food and nutrition, Elite publishing House.7. C. Gopalan, BVR Sastri, SC Balasubramanian, Nutritive values of Indian Food, ICMR, NIN

SEMESTER-III

Semester- Three

HC-301

Immunology and Animal Biotechnology

Credits:5

Course Objectives: Objective of the paper is to provide comprehensive idea about human immunology with special emphasis on the types of immunity and immune cells, maturation and activation of B and T-cells, antibody diversity and interaction with antigens. The paper also deals with Histochemical techniques

Student Learning Outcomes: Students after completion of this course are expected to know in details about human immune system and mechanism of immunity. The histochemical technique shall help the students in development of their research skills.

Unit I Basic Immunology	<ol style="list-style-type: none">1. Innate & Adaptive Immunity2. Active & Passive Immunity3. Generation of antibody diversity4. Antigen-Antibody Interactions
Unit II Components of Immune System	<ol style="list-style-type: none">1. MHC2. Cytokines3. Complement System4. Hypersensitivity
Unit III Biotechnology-I	<ol style="list-style-type: none">1. Cloning Vectors2. Restriction Enzymes3. PCR4. DNA Finger printing
Unit IV Biotechnology-II (Molecular Techniques)	<ol style="list-style-type: none">1. DNA sequencing2. Blotting Techniques3. DNA microarray4. Animal cell culture
Unit V Biotechnology-III	<ol style="list-style-type: none">1. Transgenic Animals2. Application of Transgenic animals3. Recombinant DNA in medicine4. Vaccine Technology and Monoclonal Antibodies5. Gene therapy6. Top 10 Biotechnology Inventions
	Recommended Textbooks and References: <ol style="list-style-type: none">1. Kuby Immunology, J. Punt, S. Stanford, P. Jones, J.A. Owen, 8th Edition2. Understanding Immunology, P. Wood, 02nd Edition3. Basic Immunology, A.K. Abbas, A.H. Lichtman, 3rd Edition4. Clinical Immunology Principles and Practices, R.R. Rich, 04th Edition, Elsevier Publisher5. Essential Clinical Immunology, J.B. Jabrskie, Cambridge6. Biotechnology: Expanding Horizons, Kalyani Publishers7. Biotechnology, U. Satyanarayan and U. Chakrapani, Books and Allied Ltd.8. Gene Cloning and DNA Analysis, Brown, T.A., Academic Press

Semester-Three

HC-302

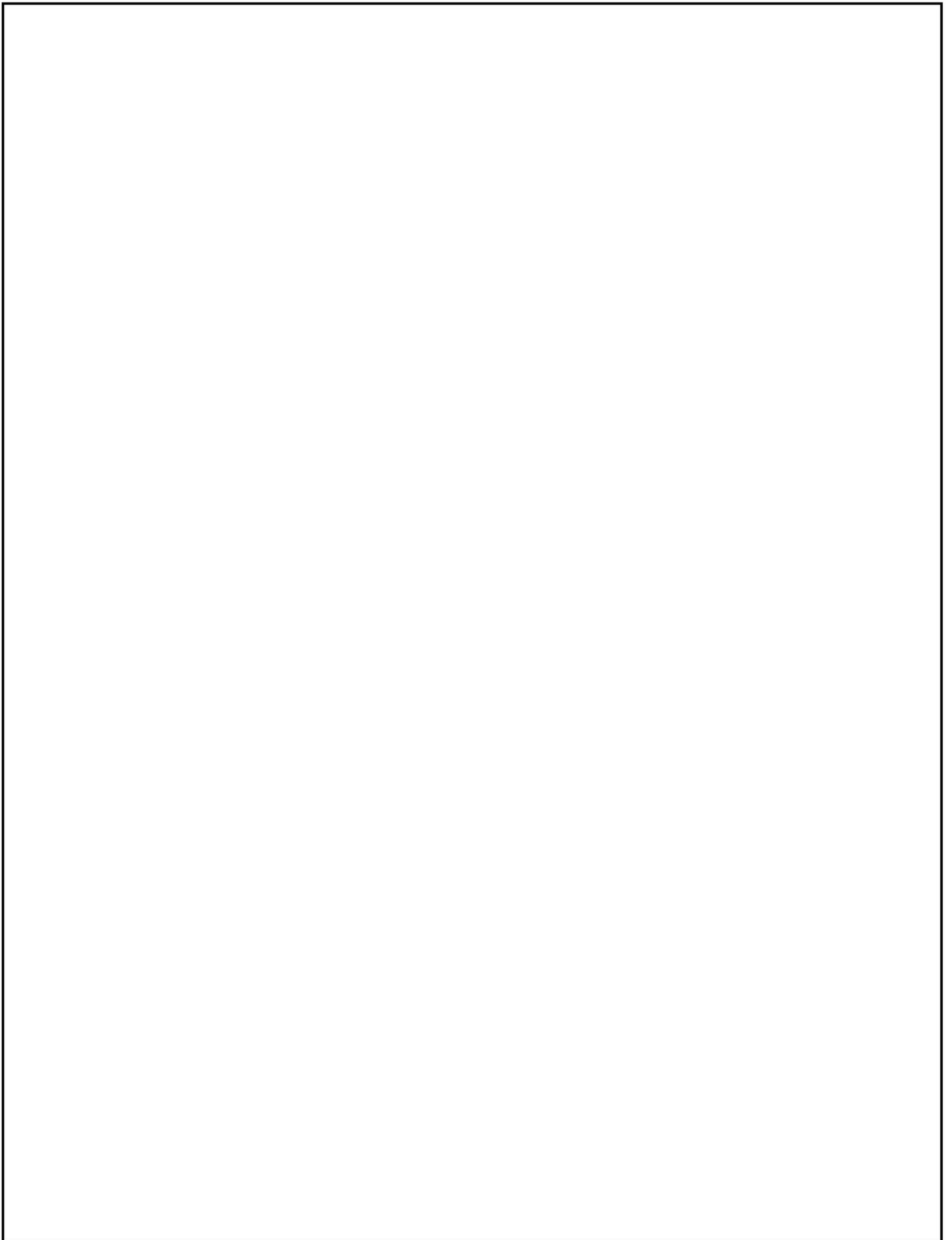
Developmental Biology and Radiation Biology

Credits: 5

Course Objectives: The main objective of Developmental Biology course is to make students understand the patterns and process of embryonic development, body plan, fate map, induction, competence, regulative and mosaic development, molecular and genetic approach for the study of developing embryo which is not necessarily shared with any other disciplines in the biological sciences. This paper also deals with Radiation Biology with special emphasis on different radiation sources, its health impact, use of radiation in controlling pest and its role in inherited diseases.

Student Learning Outcomes: Students are expected to learn the basic principle and process of developmental biology and Radiation Biology and able to make themselves aware to deleterious effects radiation too

Unit I Developmental Biology-I	<ol style="list-style-type: none">1. Structure of Gonads (Testis and Ovary)2. Synthesis and action of male hormones3. Synthesis and action of female hormones4. Female reproductive/gonadal cycle
Unit II Developmental Biology-II	<ol style="list-style-type: none">1. Structure of gametes (Male and Female)2. Gametogenesis3. Molecular mechanism of fertilization4. Cleavage and its pattern
Unit III Developmental Biology-III	<ol style="list-style-type: none">1. Basic experiments of developmental biology2. Axes and pattern formation in <i>Drosophila</i>3. Vulva formation in <i>Caenorhabditis elegans</i>4. Limb development and regeneration in vertebrates
Unit IV Radiation Biology-I	<ol style="list-style-type: none">1. Definition, scope and significance of radiation biology2. Classification of radiation3. Ionizing radiation, types of electromagnetic radiation4. Radiation dose and units
Unit V Radiation Biology -II	<ol style="list-style-type: none">1. Electromagnetic radiation and its interaction with living matter with special reference to UV and Visible light2. Radiation in insect pest management: Types of radiation used, radiation induced dominant lethal mutation3. Sterile insect technique, F₁ sterility technique4. Radiation induced heritable diseases
	Recommended Textbooks and References: <ol style="list-style-type: none">1. Developmental Biology, S.F. Gilbert2. Introduction to Embryology, B.L. Balinsky3. The Logic of Scientific discovery, K. Popper4. Understanding Radiation Biology from DNA Damage to Cancer and Radiation Risk, K.H. Chadwick5. Essentials of Radiation Biology and Protection, S. Foshier



Semester-Three

HC-303

Practical

Credits:5

Course Objectives: Objectives of the paper is to provide a hand on exposure of different instruments used in biological sciences, basic practical on methods in biology, application of statistics in presentation of biological data and solving biological problems, basic embryological and immunological experiments.

Student Learning Outcomes: Students are expected to learn instrumentation and their operation, statistical analysis of data, identification of various stages of chick embryo and blood grouping

Immunology,
Biotechnology,
Developmental
Biology &
Radiation
Biology

1. Demonstrations of Electrophoresis
2. Demonstrations of PCR
3. Demonstration of Chromatography
4. Demonstration of Centrifugation
5. Demonstration of Spectrophotometer and Quantification of protein using Biuret method, lowry method
6. Quantitative measurement of Biomolecules using Spectroscopy
7. Demonstration of Blood group and Rh Antigen
8. Permanent Slide of thymus and spleen

Semester- Three

CE-301

Bioinstrumentation and Biostatistics

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea about working principles and application of different instruments and methods used in biological sciences. The course also designed to give statistical analysis of biological data.

Student Learning Outcomes: Students after completion of this course are expected to handle and operate basic instruments for experimental purposes. The students also have clear understanding of data and its analysis that will help them in pursuing higher studies.

Unit I Microscopy, Centrifugation, Chromatography	<ol style="list-style-type: none">1. Light and Electron microscopy2. Centrifugation3. Affinity chromatography (Paper and TLC)4. Adsorption chromatography (Ion exchange and Gel)
Unit II Spectroscopy and Radioisotope techniques	<ol style="list-style-type: none">1. UV/Vis Spectrophotometry2. Autoradiography3. Immunodiffusion4. Application of Radioisotopes in Biology
Unit III Biostatistics-I	<ol style="list-style-type: none">1. Introduction and scope of Biostatistics, Levels of Measurements: Variables Nominal scale, ordinal scale, interval and ratio scale of measurements2. Tabular and graphical representation of data3. Descriptive statistics: Point estimates (Mean, Mode, Median, Percentile)4. Interval Estimates (Range, IQR, MAD, Variance, Standard Deviation, SEM, CV and CD); Error bars- various methods to calculate error bar: Standard Deviation (SD)
Unit IV Biostatistics-II	<ol style="list-style-type: none">1. Standard Error of the Mean (SEM), 95% Confidence Intervals (CI), Median, Range and Quartiles.2. Moments, Skewness and Kurtosis3. Confidence Intervals4. Statistical Hypothesis Testing, significance level, p value, Relationship between Confidence Intervals and Statistical Significance, difference between parametric and non parametric test
Unit V Biostatistics- III	<ol style="list-style-type: none">1. Student's t test, F test2. ANOVA test (one way and two way), Chi- square test3. Probability distributions- Normal, Binomial and Poisson4. Simple correlation and Regression
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Modern Spectroscopy, JM Hollas, Willey Publication2. Molecular Structure and Spectroscopy, G. Aruldash3. Experimental Biochemistry, Wilson and Walker4. Fundamental of light microscopy and electronic Imaging, Douglas Murphy5. Introductory biostatistics, C.T. Le, L.E. Eberly, John Wiley & Sons6. Biostatistics: A methodology for the health sciences, G. van Belle, L.D. Fisher, P.J. Heagerty, T. Lumley, Vol. 519, John Wiley & Sons7. Intuitive biostatistics: A nonmathematical guide to statistical thinking, H. Motulsky, Oxford University Press, USA

Semester-Three

CE-301

Bioinformatics, Biosafety and Bioethics

Credits: 5

Course Objectives: The objectives of this course is to provide theory and practical experience to analyze different biological data using common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts in Bioinformatics. The objectives of this course are to educate students about the fundamental concepts of bioprocess technology and its related applications, thus preparing them to meet the challenges of the new and emerging areas of biotechnology industry. To become familiar with India's IPR Policy; To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products.

Student Learning Outcomes: Student should be able to develop an understanding of basic theory of these computational tools; to gain working knowledge of these computational tools and methods; appreciate their relevance for investigating specific contemporary biological questions and to critically analyse and interpret results of their study. Students should be able to appreciate relevance of microorganisms from industrial context; to carry out stoichiometric calculations and specify models of their growth; to give an account of design and operations of various fermenters; to calculate yield and production rates in a biological production process, and also interpret data etc.

Unit I Bioinformatics-I	<ol style="list-style-type: none">1. Introduction to Bioinformatics2. DNA and protein databsae3. Searching for sequence database like FASTA
Unit II Bioinformatics-II	<ol style="list-style-type: none">1. BLAST algorithm2. Structural viewers of protein (PyMOL)3. Multiple sequence alignment using CLUSTALW
Unit III Bioinformatics - III	<ol style="list-style-type: none">1. Multiple sequence alignment using CLUSTALX2. Basic ideal about MEGA3. Construction of phylogenetic tree
Unit IV Biosafety	<ol style="list-style-type: none">1. Introduction to Biological safety2. Biosafety guideline-Govt of India, Basic biosafety practices in the laboratory3. Biological hazards4. Basic idea on GMO and LMO
Unit V Bioethics	<ol style="list-style-type: none">1. IPR and genetic resources2. Patent, Trade, Copyright and trade mark3. Indain patent Act, filing of patent application4. Biopiracy
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Ganguli, P. (2001). <i>Intellectual Property Rights: Unleashing the Knowledge Economy</i>. New Delhi: Tata McGraw-Hill Pub.2. Mount, D. W. (2001). <i>Bioinformatics: Sequence and Genome Analysis</i>. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.3. Bourne, P. E., & Gu, J. (2009). <i>Structural Bioinformatics</i>. Hoboken, NJ: Wiley-Liss.4. Lesk, A. M. (2004). <i>Introduction to Protein Science: Architecture, Function, and Genomics</i>. Oxford: Oxford University Press.5. Lesk, A.M. (2002). <i>Introduction to Bioinformatics</i>. Oxford University Press6. Mount, D. W. (2001). <i>Bioinformatics: Sequence and Genome analysis</i>. Cold Spring Harbor, NY: Cold Spring Harbour Laboratory Press.7. Wayne W. Daniel, <i>Biostatistics: A foundation for analysis in the Health Sciences</i>.8. Rosner, B. (2000). <i>Fundamentals of Biostatistics</i>. Boston, MA: Duxbury Press.9. Daniel, W. W. (1987). <i>Biostatistics, a Foundation for Analysis in the Health Sciences</i>. New York: Wiley.

Semester-Three

CE-302

Epigenetics and Cancer Biology

Credits: 5

Course Objectives: The objective of the course is to provide a comprehensive idea about epigenetic and its mechanism, and cancer cells biology

Student Learning Outcomes: The students are expected to learn epigenetic related disorders and their consequences, differences aspects of cell transformation from normal to cancer cells, different proteins and genes involved in different types of cancers, and treatment

Unit I Epigenetics-I	<ol style="list-style-type: none">1. Epigenetics- chromatin modifications and their mechanism of action2. Mechanism of chromatin remodeling3. Epigenetics and genome imprinting - DNA methylation in mammals, genomic imprinting in mammals4. Epigenetics in <i>Saccharomyces cerevisiae</i>5. Gene silencing
Unit II Epigenetics-II	<ol style="list-style-type: none">1. Epigenetic regulation of chromosome inheritance2. Epigenetic regulation of the X chromosomes in <i>C.elegans</i>3. Dosage compensation in <i>Drosophila</i>4. Dosage compensation in mammals
Unit III Cancer Biology-I	<ol style="list-style-type: none">1. Difference between normal cells and cancerous cell2. Proto-oncogene, tumor suppressor genes and care taker genes3. Loss of function and gain of function mutation,4. Cancer stem cells and its possible origin
Unit IV Cancer Biology-II	<ol style="list-style-type: none">1. Brief idea on different genes/proteins related to cancer: p53, APC, src, ras, Rb, BRCA1 and BRCA2, P²¹ and P16.2. Limitless replicating potential: Metastasis, and Angiogenesis3. Apoptosis and Evasion of Apoptosis
Unit-V Cancer Biology-III	<ol style="list-style-type: none">1. Self sufficiency in growth signal2. Insensitivity to antigrowth signals3. Possible treatment of cancer: Radiation and chemotherapy
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Lewin's Genes X, J.E. Krebs, E.S. Golstein, S.T. Kilpatrick, Volume 10, Jones and Bartlett Publishers2. Lehinger Principles of Biochemistry, D.L. Nelson, M.M. Cox, 07th Edition3. Biochemistry, J.M. Berg, L. Stryer, J.L. Tymoczko, G.J. Gatto, 08th Edition4. Harper's Illustrated Biochemistry, V.L. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennely, P.A. Weil, 31st Edition5. Principles of Cancer Biology, L.J. Kleinsmith6. Cancer Biology, R.J.B. King, M.W. Robins, 03rd Edition

Semester-Three

CE-302

Entomology

Credits: 5

Course Objectives: To enable the students to get acquainted with origin and classification of insects. It also give insight to commercial entomology, public health entomology, house hold pest, Integrated Pest Management modules for various important crops. They will also learn about the various management strategy especially eco- friendly means of control.

Student Learning Outcomes: After the completion of the course the students will be acquainted with the different vectors, their characteristics and process of transmission and infection. The students will also learn about the management techniques of different vectors. Further, the students will also be acquainted with the different means of insect-pest management. They will also learn about the different application techniques of insecticides, and its management.

Unit I Origin and Classification of Insects	<ol style="list-style-type: none">1. Origin and Evolution of Insects2. Classification of insects up to order with examples.3. Growth development and metamorphosis of Insect4. Collection and preservation of insects
Unit II Economical Entomology	<ol style="list-style-type: none">1. Biology of honey bees and apiculture2. Lac insects and their management3. Prospects and status of Silk producing species - their distribution and life cycle4. Structure of the silk gland
Unit III Morphology and Bionomics of Insects	<ol style="list-style-type: none">1. Morphology, Bionomics and Management of important pests of Rice2. Morphology, Bionomics and Management of important pests of Sugarcane3. Predators, parasites and pathogens of Insects
Unit IV Morphology and Bionomics of Insects-II	<ol style="list-style-type: none">1. Morphology, Bionomics and Management of pests of Mango2. Morphology, Bionomics and Management of pests of Banana3. Morphology, Bionomics and Management of Mosquitoes4. Morphology, Bionomics and Management of Housefly
Unit V Social and Physiological Aspects of Insects	<ol style="list-style-type: none">1. Social behaviour in Insects2. Physiology and mechanism of Compound vision3. Insect Hormones with special reference to Pheromones4. Thermoregulation in Insects
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. The Insects: An Outline of Entomology, P.J. Gullan, P.S. Cranston2. General Text book of Entomology, O.W. Richard, R.G. Davies, Part I & II3. Insect Biology-A textbook of Entomology, H.E. Evans, Wesley Publ. Co..4. General Entomology. M.S. Mani, Oxford & IBH Publ. Co.5. Insects, M.S. Mani, National Book Trust, India6. A Textbook of Entomology, H.H. Ross, C.A. Ross, J.R.P. Ross, John Wiley & Sons

Semester-Three



FI-301

Field Internship

Credits: 3

SEMESTER-IV

Semester-Four

HC-401

Conservation Biology

Credits: 5

Course Objectives: Objectives of the paper is to provide basic idea on Biodiversity, measuring biodiversity, international and national efforts, molecular phylogeny and different conservation measures to conserve biodiversity.

Student Learning Outcomes: Students after completion of this course are expected to get a holistic understanding on biodiversity and its importance, phylogeny, inculcate the value of bio-resources and develop compassion toward bio-resources.

Unit I Basic Concepts	<ol style="list-style-type: none">1. Biodiversity (genetic diversity, species diversity, ecosystem diversity) and its use, Causes of biodiversity losses2. IUCN red list of threatened species, Invasive species, Alien species, Indicator specie3. Keystone species, Umbrella species, Flagship species, charismatic species
Unit II Measuring Biodiversity	<ol style="list-style-type: none">1. Alpha, Beta and Gamma diversity2. Species Richness(S), Evenness(E), Simpsonindex(D),3. Shannon-Weiner Index (H')4. Idea on biodiversity calculator software
Unit III International and National efforts for conserving biodiversity	<ol style="list-style-type: none">1. National Act and International Act related to Biodiversity Conservation2. Biological diversity Act 2002, National Biodiversity Authority, People Biodiversity Registrar,3. Convention on Biological diversity, Cartagena Protocol and Nagoya Protocol, Sustainable Development Goal and Biodiversity, Aichi Biodiversity Targets, CITES, WWF
Unit IV Conservation Measures	<ol style="list-style-type: none">1. In-situ conservation (Indian context) (Sanctuaries, National and Biosphere reserves)2. Ex-situ conservation (Indian context) (Botanical gardens, zoos, cryopreservation, gene bank)3. NCBI data base
Unit-V Molecular Phylogeny	<ol style="list-style-type: none">1. Basic idea on phylogenetic tree2. Construction and interpretation of molecular phylogeny tree based on COI3. 16s rRNA gene sequences using MEGA and other tools
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Fundamental of Ecology : O.P Odum2. Campbell Biology: Reece, Urry, Cain et al.3. Evolutionary analysis : Herron and freeman4. Convention of Biological diversity- https://www.cbd.int/5. Aichi Biodiversity Targets- https://www.cbd.int/sp/targets/6. IUCN-https://www.iucn.org/7. CITES-https://cites.org/eng8. https://sustainabledevelopment.un.org/topics/biodiversityandecosystems9. https://bch.cbd.int/protocol/10. https://www.cbd.int/abs/11. https://wwf.panda.org/12. http://moef.gov.in/13. http://nbaindia.org/

Semester-Four

HC-402

Practical

Credits:5

Course Objectives: Objectives of the paper is to provide hands on training and exposure to various processes related to conservation biology, cytogenetics and Applied Biology

Student Learning Outcomes: Students are expected to learn the concepts of biostatistics and Excel which would help them to understand and solve the basic problems related to the courses.

Conservation
Biology,
Cytogenetics,
Entomology,
Stress
Physiology,
Applied
Biology

1. Tabular and Graphical presentation of Data using Excel.
2. Hypothesis testing-student t-test, F-test, ANOVA test, Chi-Square test,
3. Practical related to simple correlation and regression analysis
4. External features of available field collected insects
5. Methods of collection and preservation of insects
6. Wing venation
7. Types of wings and wing coupling apparatus
8. Types of insect antennae, mouth parts and legs
9. Insecticidal efficacy test
10. Study of life tables and plotting of survivorship curves of different types from the hypothetical data provided
11. Determination of population density of a hypothetical community by quadrat method and calculation of Shannon-Weiner Diversity Index for the same community
12. Report on a visit to national park/biodiversity park/wild life sanctuary

Semester-Four

HC-403

Dissertation

Credits:5

Semester-Four

CE-401

Cytogenetics, Stress Physiology and Metabolic disorders

Credits: 5

Course Objectives: The objective of course is to provide advanced knowledge on cytogenetics, stress physiology and metabolic disorders.

Student Learning Outcomes: Students are expected to learn differences aspects of genomic analysis, meiotic abnormalities, different sex linked diseases and in situ techniques. Also, the course will help students in understanding the physiology of stress and various metabolic disorders.

<p>Unit I Cytogenetics-I</p>	<ol style="list-style-type: none"> 1. Genomic analysis and C-value paradox 2. Human cytogenetics- Human karyotype, banding and nomenclature 3. Numerical and structural abnormalities of chromosomes 4. Meiotic abnormalities- Non-disjunction of chromosomes, mis-division of centromere
<p>Unit II Cytogenetics-II</p>	<ol style="list-style-type: none"> 1. Amniocentesis 2. Monogenic disorders: Autosomal dominant Huntington's diseases, Autosomal recessive (Cystic fibrosis), 3. Sex linked (Color blindness and Hemophilia)
<p>Unit III Metabolic DisordersI</p>	<ol style="list-style-type: none"> 1. In situ- hybridization and its applications: FISH and GISH 2. Transposons and associated disorders 3. Biochemistry of inherited and metabolic disorders: Phenylketoneuria, Alkaptonuria, Albinism
<p>Unit IV Metabolic DisordersII</p>	<p>Neurochemical associated diseases: Alzheimer's disease, Parkinson's disease</p> <ol style="list-style-type: none"> 1. Human nutrition and associated hazards 2. Molecular mechanism of senescence
<p>Unit V Stress Physiology</p>	<ol style="list-style-type: none"> 1. Concept of Biological stress and strain 2. Stress adaptation- Resistance, stress tolerance and acclimatization 3. Stress associated disorders 4. Oxidative stress
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none"> 1. Molecular Cell Biology, Lodish, Berk, Kaiser, Krieger, Bretscher, Ploegh, Amon, Martin 2. Cell Biology, G. Karp 3. Cell and Molecular Biology, De Robertis 4. Lehinger Principles of Biochemistry, D.L. Nelson, M.M. Cox, 07th Edition 5. Biochemistry, J.M. Berg, L. Stryer, J.L. Tymoczko, G.J. Gatto, 08th Edition 6. Harper's Illustrated Biochemistry, V.L. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennely, P.A. Weil, 31st Edition 7. Principles of Cancer Biology, L.J. Kleinsmith 8. Cancer Biology, R.J.B. King, M.W. Robins, 03rd Edition 9. The Insects: An Outline of Entomology, P.J. Gullan, P.S. Cranston 10. General Text book of Entomology, O.W. Richard, R.G. Davies, Part I & II 11. Insect Biology-A textbook of Entomology, H.E. Evans, Wesley Publ. Co.. 12. General Entomology. M.S. Mani, Oxford & IBH Publ. Co. 13. Insects, M.S. Mani, National Book Trust, India 14. A Textbook of Entomology, H.H. Ross, C.A. Ross, J.R.P. Ross, John Wiley & Sons

Semester-Four

CE 401

Applied Biology

Credits: 5

Course Objectives: This course deals with human gene mapping, cell culture, transgenic, nano-technology, nano-particles and their application in drug delivery. The course also covers ecotechnology and Molecular techniques.

Student Learning Outcomes: Students after reading this course are expected to have knowledge orient towards industrial microbiology for self entrepreneurship development and application of nano-science in biological research. Further, it will enhance the students ability in various ecotechnological enterprenuership skills and advance molecular tools techniques.

Unit I Applied Genetics	<ol style="list-style-type: none">1. Human gene mapping- Physical mapping & map-based cloning, molecular markers in genome analysis (RFLP, AFLP, RAPD)2. Ribozyme technology and its application3. Cell and tissue culture methods for animals4. Transgenic animals, molecular approaches to diagnosis and strain identification.
Unit II Applied Microbiology	<ol style="list-style-type: none">1. Microbial fermentation and production of small and macro molecules,2. Elementary Ideas of antibiotics (Classification and resistance)3. Genomics and its application to health and agriculture, including gene therapy.4. Biosensors, Bioterrorism (causative agents and consequences).
Unit III Nanotechnology	<ol style="list-style-type: none">1. Nanotechnology- Break through an introduction2. Application of Nanotechnology,3. Bucky balls, Bucky tubes and their applications,5. Nanotechnology in drug delivery
Unit IV Ecotechnology	<ol style="list-style-type: none">1. Solid waste management2. Biofertilizers3. Vermicomposting4. Biopesticide
Unit IV Molecular Techniques	<ol style="list-style-type: none">1. Isolation of Genomic and plasmid DNA2. Polymerase Chain Reaction and its applications
Unit V Molecular Techniques	<ol style="list-style-type: none">1. DNA, Protein sequencing methods2. Blotting techniques
	<p>Recommended Textbooks and References:</p> <ol style="list-style-type: none">1. Lewin's Genes X, J.E. Krebs, E.S. Golstein, S.T. Kilpatrick, Volume 10, Jones and bartlet Publishers2. Lehinger Principles of Biochemistry, D.L. Nelson, M.M. Cox, 07th Edition3. Biochemistry, J.M. Berg, L. Stryer, J.L. Tymoczko, G.J. Gatto, 08th Edition4. Harper's Illustrated Biochemistry, V.L. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennely, P.A. Weil, 31st Edition5. Microbiology Principles and Explorations, J.G. Black, L.J. Black, 9th Edition, Willey Publishers6. Prescott's Microbiology, J. Willey, K. Sandman, D. Wood, 11th Edition7. Basic Principles of Nanotechnology, W.C. Sanders, CRC Press8. Introduction to Nanotechnology, C.P. Pools, F.J. Owens, Willey Publishers9. A handbook of Nanotechnology, U. Kumar10. Nanophysics and Nanotechnology, E.L. Wolf, Willey Publications

ALLIED CORE: AC- 401

WOMEN AND SOCIETY

Credit: 3

**POST GRADUATE DEPARTMENT OF ZOOLOGY, SBWAC
SKILL BASED CERTIFICATE COURSE (SBCC)**

Research Methodology

Unit 1: Foundations of Research Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs applied.

Unit 2: Research Design Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

Unit 3: Data Collection, Analysis and Report Writing Observation and Collection of Data-Methods of data collection- Sampling, Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis, writing, Preparation of Tables and Bibliography. Data Presentation using digital technology.

Unit 4: Ethical Issues Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

Recommended Textbooks and References:

1. Nicholas Walliman, (2017) Research Methods: The Basics: Routledge
2. C.R.Kothari and Gaurav Garg (2019) Research Methodology, New Age International.
3. Anthony, M, Graziano, A.M. and Raulin, M.L. (2009) Research Methods: A Process of Inquiry, Allyn and Bacon.
4. Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, , Universal Law publishing
5. Coley, S.M. and Scheinberg, C.A. (1990) "Proposal writing". Stage Publications.

