Lesson Plan of Zoology Postgraduate
Course affiliated to University of Calcutta
2018-2020
Faculty- Ipsit Chakrabarti

Topic Serial	Distribution of Class	Name of topic with details of sub-topics	Learning outcome
		M.Sc. (ZOOLOGY) SEMESTER COURSE **1st Semester** **ZCT 101 Non-chordate Biology**	
1.	**Class 1-3**	**Topic :** Invertebrate defense against predators and parasites **Objective :** Most of our knowledge about immunology is concerned with vertebrate system, specially human being. But in nature invertebrates have to survive against numerous natural antigen molecules. To have an idea about immune system of invertebrates, students have to have the knowledge about defense mechanisms of invertebrates **Lesson plan :** Description of the immune system of invertebrates including the cells and molecules involved in invertebrate immune system. Mechanisms of various types of immune systems, structure-function relationship, Comparison and evolutionary significance of	**Topic:** Invertebrate defense against predators and parasites **Learning Outcome :** Beside the concept of vertebrate immune system , students will have the preliminary idea about the defense mechanism of invertebrates and their survival strategy in nature.

		invertebrate and vertebrate defense systems are to be described. **ZCT 105 Parasitology**	
2.	**Class 4-8**	**Topic:** Human clinical and veterinary parasitology- detection, diagnosis, prophylaxis, treatment, and pharmacology (emergent parasites) Genome organization in Plasmodium . Molecular basis of antigenic variation in Plasmodium **Objective**: Considering the health problem scenario , parasites are the major causative agents throughout the world. In course of time, some parasites may appear in nature which are genetically completely new, or after a dormant period, a parasite may reappear in any environment . Thus these emergent parasites could be dangerous for any epidemic or pandemic infection. **Lesson plan :** concept of emergent parasites. Nature, epidemiology and parasite related interactions Molecular biology of Plasmodium including the analysis of Plasmodium genomes. Detail discussion on Invertebrate immune system Concept of APC , MHC and their relationship with the cell mediated immunity. Discussion on immunotherapeutics.	**Topics:** Human clinical and veterinary parasitology- detection, diagnosis, prophylaxis, treatment, and pharmacology (emergent parasites). **Learning Outcome:** Parasitology and immunology are the two aspects of infectious diseases. Parasites are the causative agents and immune system is the global defense mechanism of the host against those parasites. Thus to know the life-cycles of both parasites and hosts, mode of interactions, epidemiology and treatments are essential for the students.

1.	**Class 1-5**	**M.Sc. (ZOOLOGY) SEMESTER COURSE , 2nd Semester** **ZCT 210 Immunology** **Topic :** 1. Phylogeny of Immunity:Immunobiology of Invertebrates. Principal strategies, immune-responsive cells and tissues. Phenoloxidase cascades, natural and inducible immune response. 2. Antigens Capture and Presentation Concept of APC .Structure and Function of MHC molecule. MHC processing and presentation 3.Cell Mediated Immunity APC- T cell interaction. IL-2 Receptor Role. Clonal Expansion. Th1, Th2 and Th17 response. Cytotoxic T cell function. T cell signaling. **Objective :1.** Most of our knowledge about immunology is concerned with vertebrate system, specially human being. But in nature invertebrates have to survive against numerous natural antigen molecules. To have an idea about immune system of invertebrates, students have to have the knowledge about defense mechanisms of invertebrates **Lesson plan :** Description of the immune system of invertebrates including the	**Topic :** 1. Phylogeny of Immunity:Immunobiology of Invertebrates. **Learning Outcome:** immunology is the defence mechanism against infectious diseases. Parasites are the causative agents and immune system is the global defense mechanism of the host against those parasites. Thus to know the life-cycles of both parasites and hosts, mode of interactions, epidemiology and treatments are essential for the students.

		cells and molecules involved in invertebrate immune system. Mechanisms of various types of immune systems, structure-function relationship with special reference to Phenoloxidase cascades, natural and inducible immune response. Comparison and evolutionary significance of invertebrate and vertebrate defense systems are to be taught to the students. **ZCT-211 Biochemistry and Genetic Engineering**	
2.	**Class 6-9**	**Topic :** Enzymes: classification, kinetics, examples of inhibitions & inhibitors; modulations **Objective:** Every living cell needs energy primarily for its growth ,development and reproduction. This required amount of energy is produced by several biological reactions catalysed by various enzymes. So enzyme is an important molecule to be studied. **Lesson plan** : definition of enzyme , structure and difference with structural protein with special reference to enzyme's catalytic activity. Nomenclature and classification to organise several enzymes into specific groups. Description of cofactors, coenzyme, isozymes and other related	**Topic:** Enzymes: classification, kinetics, examples of inhibitions & inhibitors; modulations **Learning Outcome:** The knowledge of enzymes is one of the most important concepts for the students. They will know how cells perform all biochemical functions with high precision. Being a biological catalyst enzymes are considered as unique molecules. From DNA synthesis to glycolysis, all are governed and directed by enzymes.

		terms. Factors influencing enzyme activity like temperature, PH and substrate concentrations. Mechanism of enzyme action: hypothesis related to enzyme activity. Detail discussion about enzyme kinetics with graphical representations. Inhibitions of enzymes. **M.Sc. (ZOOLOGY) SEMESTER COURSE , 3rd Semester** **ZET 319 Environmental Biology and Toxicology**	
1.	**Class 1-6**	**Topic:** Analytical toxicology: Immunohistochemistry, FACS, fluorescence microscopy. Dose- response relationships. **Objective:** In the present time Environment and its increasing problems became the hot topic of discussion. Environmental toxicity pollutes different spheres of the earth. Thus understanding of all these problems initiate the discussion about environmental toxicology. **Lesson Plan :** In toxicology the most important factor is the dose of the toxic molecules. Thus to assess the toxicity dose-response relationship has to be addressed. Discussion of various analytical methods help to measure the impact of toxic compound with immense precision.	**Topics :** Interpretation of Dose- response relationships and toxicokinetics. Analytical toxicology: Immunohistochemistry, FACS, fluorescence microscopy. **Learning Outcome:** Toxicology is a major concern of environmental Biology. Input of toxic materials to the environment makes the environment polluted. Concentration of toxicant plays a major role in toxicology, thus assessment of toxicant concentration is an important aspect for this chapter. Some analytical protocols and interpretation of the results are the two wings for the students of environmental study.

2.	**Class 7-9**	**ZET 316 Biodiversity and Ecosystem Functioning** **Topic:** Theories in landscape ecology- Hierarchy theory and the structure of the landscape,Percolation theory, Metapopulation theory, The systems source sink **Objective :** In Biodiversity, landscape ecology is a new concept. This concept is supported by some theories to strengthen the understanding of the functional aspects of biodiversity. **Lesson Plan:** Basic concept of landscape ecology and detail discussion on various theories	**Topic:** Theories in landscape ecology- Hierarchy theory and the structure of the landscape,Percolation theory, Metapopulation theory, The systems source sink **Learning Outcome:** Description of landscape ecology is very much essential for the students of Biodiversity. This new concept along with some theories help the students for better understanding of this concept .

Lesson Plan of Zoology Postgraduate
course affiliated to University of Calcutta
2020-2022
Faculty - IPSIT CHAKRABARTI

Topic Serial	Distribution of Class	Name of topic with details of sub-topics	Learning Outcome
		M.Sc. (ZOOLOGY) SEMESTER COURSE , 1st Semester **ZCT 101 . Invertebrate Functional Forms and Adaptations.**	
1.	**Class 1-3**	**Topic:** Invertebrate defense against predators and parasites **Objective :** Most of our knowledge about immunology is concerned with vertebrate system, specially human being. But in nature invertebrates have to survive against numerous natural antigen molecules. To have an idea about immune system of invertebrates, students have to have the knowledge about defense mechanisms of invertebrates **Lesson plan :** Description of the immune system of invertebrates including the cells and molecules involved in invertebrate immune system. Mechanisms of various types of immune systems, structure-function relationship. Comparison and evolutionary significance of invertebrate and vertebrate defense systems.	**Topic:** Invertebrate defense against predators and parasites **Learning Outcome :** Beside the concept of vertebrate immune system , students will have the preliminary idea about the defense mechanism of invertebrates and their survival strategy in nature. Thus It would be helpful for the students to understand the evolutionary trends of immune system.

		M.Sc. (ZOOLOGY) SEMESTER COURSE , 2nd Semester **ZCT 208 Biochemistry and Genetic Engineering**	**Topic:** Enzymes: classification, kinetics, examples of inhibitions & inhibitors; modulations
1.	**Class 1-4**	**Topic :** Enzymes: classification, kinetics, examples of inhibitions & inhibitors; modulations **Objective:** Every living cell needs energy primarily for its growth ,development and reproduction. This required amount of energy is produced by several biological reactions catalysed by various enzymes. So enzyme is an important molecule to be studied. **Lesson plan** : definition of enzyme , structure and difference with structural protein with special reference to enzyme's catalytic activity. Nomenclature and classification to organise several enzymes into specific groups. Description of cofactors, coenzyme, isozymes and other related terms. Factors influencing enzyme activity like temperature, PH and substrate concentrations. Mechanism of enzyme action: hypothesis related to enzyme activity. Detail discussion about enzyme kinetics with graphical representations. Inhibitions of enzymes.	**Learning Outcome:** The knowledge of enzymes is one of the most important concepts for the students. They will know how cells perform all biochemical functions with high precision. Being a biological catalyst enzymes are considered as unique molecules. From DNA synthesis to glycolysis, all are governed and directed by enzymes.
2.	**Class 5-10**	**ZCT 209 Parasitology and Immunology** **Topic:** Human clinical and veterinary parasitology-detection, diagnosis, prophylaxis, treatment, and	**Topics:** Human clinical and veterinary parasitology-detection, diagnosis, prophylaxis, treatment, and pharmacology (emergent parasites)…….

		pharmacology (emergent parasites). Community medicine Genome organization in Plasmodium. Molecular basis of antigenic variation in Plasmodium Molecular basis of antigenic variation in Plasmodium. Phylogeny of Immunity: Immunobiology of Invertebrates. Principal strategies, immune responsive cells and tissues. Phenoloxidase cascades, natural and inducible immune response. Antigens Capture and Presentation: Concept of APC. Structure and Function of MHC molecule. MHC processing and presentation Cell Mediated Immunity: APC- T cell interaction. IL-2 Receptor Role. Clonal Expansion. Th1, Th2 and Th17 response. Cytotoxic T cell function. T cell signaling. Disease immunobiology – role players and systems network, Immunotherapeutics **Objective**: Considering the health problem scenario , parasites are the major causative agents throughout the world. Major parasites are the representatives of protistan group. Thus two major protistan parasites are included in the syllabus to understand the nature and virulence of parasites. **Lesson plan :** concept of emergent parasites. Nature, epidemiology and parasite related interactions Community medicine and its impact on the mode of	**Learning Outcome:** Parasitology and immunology are the two aspects of infectious diseases. Parasites are the causative agents and immune system is the global defense mechanism of the host against those parasites. Thus to know the life-cycles of both parasites and hosts, mode of interactions, epidemiology and treatments are essential for the students.

		treatment of infected community. Molecular biology of Plasmodium including the analysis of Plasmodium genomes Detail discussion on Invertebrate immune system Concept of APC , MHC and their relationship with the cell mediated immunity. Discussion on immunotherapeutics. **M.Sc. (ZOOLOGY) SEMESTER COURSE , 3rd Semester** **ZET 315 Environmental Biology and Toxicology**	
1.	**Class 1-6**	**Topics :** Interpretation of Dose-response relationships and toxicokinetics. Analytical toxicology: Immunohistochemistry, FACS, fluorescence microscopy. **Objective:** In the present time Environment and its increasing problems became the hot topic of discussion. Environmental toxicity pollutes different spheres of the earth. Thus understanding of all these problems initiate the discussion about environmental toxicology. **Lesson Plan :** In toxicology the most important factor is the dose of the toxic molecules. Thus to assess the toxicity dose-response relationship has to be addressed. Discussion of various analytical methods help to measure the impact of toxic compound with immense precision.	**Topics :** Interpretation of Dose-response relationships and toxicokinetics. Analytical toxicology: Immunohistochemistry, FACS, fluorescence microscopy. **Learning Outcome:** Toxicology is a major concern of environmental Biology. Input of toxic materials to the environment makes the environment polluted. Concentration of toxicant plays a major role in toxicology, thus assessment of toxicant concentration is an important aspect for this chapter. Some analytical protocols and interpretation of the results are the two wings for the students of environmental study.

2.	**Class 7-9**	**ZET 316 Biodiversity and Ecosystem Functioning** **Topic:** Theories in landscape ecology- Hierarchy theory and the structure of the landscape,Percolation theory, Metapopulation theory, The systems source sink **Objective :** In Biodiversity, landscape ecology is a new concept. This concept is supported by some theories to strengthen the understanding of the functional aspects of biodiversity. **Lesson Plan:** Basic concept of landscape ecology and detail discussion on various theories of landscape ecology.	**Topic:** Theories in landscape ecology- Hierarchy theory and the structure of the landscape,Percolation theory, Metapopulation theory, The systems source sink **Learning Outcome:** Description of landscape ecology is very much essential for the students of Biodiversity. This new concept along with some theories help the students for better understanding of this concept .

Lesson Plan of Zoology Postgraduate
Course affiliated to University of Calcutta
2023-2025
Faculty- Ipsit Chakrabarti

Topic Serial	Distribution of Class	Name of topic with details of sub-topics	Learning outcome
1.	**Class- 1-4**	**M.Sc. (ZOOLOGY)** **SEMESTER COURSE** **1st Semester** **ZCT 103 Cell Biology** **Topic : Tools and techniques in cell biology** **Cell culture – 2D and 3D** **Objective:** At present time, cell culture is one of the most important and essential tools for experimental biology. Cells in culture provide matrix for assessing toxic molecules,pharmacological compound and so on. The techniques and processes of cell culture help the students to run experiment in future. **Lesson plan :** Discussion on techniques of cell culture including various types of cell culture and required molecules for artificial environment. Continuation of the propagation of cells through sub culturing system. Recently it has been found that monocultute (2D) of cells can not provide the exact anatomical environment of the original organs , thus	**Tools and techniques in cell biology** **Cell culture – 2D and 3D** **Learning outcome** : To learn the techniques of cell culture is obvious for the students of cell biology. Different types of cell cultures with various protocols along with advantages and disadvantages are to be taught.

		an extra artificial scaffold is now being used to imitate exact in situ environment of the organs(3D).	

Lesson Plan of Zoology Undergraduate
Course affiliated to the University of Calcutta
2018
Faculty - IPSIT CHAKRABARTI

Topic Serial	Distribution of Class	Name of topic with details of sub-topics	Learning outcome
1.	**Class 1**	**PART I: SEMESTER 1 CORE COURSE 1. Non-Chordates I ZOOA-CC1-1-TH (Under CBCS)** Unit 2: Protista and Metazoa Topic **: General characteristics and Classification of protozoa up to phylum (according to Levine et. al., 1980)** **Objective:** Classification of animal kingdom is the basic feature to organise all non-living and living organisms. Of various phyla , classification of protozoa implies important information about the primordial living world. **Lessen Plan** : General discussion on the importance of classification followed by the description of general and special characters of protozoa.	Topic **: General characteristics and Classification of protozoa up to phylum (according to Levine et. al., 1980)** **Learning outcome:** Classification of protozoa gives an idea about world of primitive world. Thus, teaching of protozoan classification is obvious for the students of zoology.
2.	**Class 2**	Topic:**Locomotion in Euglena, Paramoecium and Amoeba** **Objective**: Locomotion is one of the most important physiological activities among living animals. At the early period of evolution, active locomotion has been proved to be associated with primitive Protistans. To understand the structure – function relationship four Protistans with different locomotary organs are selected to have an idea about different physiology of locomotion .	Topic:**Locomotion in Euglena, Paramoecium and Amoeba** **Learning outcome:** Locomotion is considered as the basic physiological activity in favour of animal world. Three representative animals with different types of locomotary organs give a concept of divergence in locomotion in course of evolution.
	Class 3	**Lessen Plan** : Introduction about locomotion and its importance in a	

		primitive phylum like Protista.	
	Class 4,5	**Lessen Plan** : Detail discussion about structure and function of locomotary organ in *Euglena*.	
	Class 6	**Lessen Plan** : Detail discussion about structure and function of locomotary organ in *Paramoecium*	
	Class 7,8	**Lessen Plan** : Detail discussion about structure and function of locomotary organ in *Amorba.*	
3.	**Class 9**	Topic: **Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*.** **Objective**: Considering the health problem scenario , parasites are the major causative agents throughout the world. Major parasites are the representatives of protistan group. Thus two major protistan parasites are included in the syllabus to understand the nature and virulence of parasites. **Lesson Plan** Introduction of parasites and parasitology, discussion about different terms related to parasitology	Topic: **Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*.** **Learning outcome :** So far the infectious diseases are concerned specially in tropical countries, understanding of protozoan parasites is essential , thus the life-cycle, prophylaxis, treatment of *Plasmodium vivax* and *Entamoeba histolytica* are important topics for the students.
	Class 10	**Lesson Plan** Structure of *Plasmodium vivax* followed by the detailing of the Life cycle including the description of its host species, pathogenesity, prophylaxix and treatment.	
	Class 11	**LessonPlan**:Structure of *Entamoeba histolytica* followed by the detailing of the Life cycle including the description of its host species, pathogenesity, prophylaxix and treatment.	

1.	**Class 1.**	**PART I: SEMESTER 2 CORE COURSE 3: Non- II – Coelomates ZOOA-CC2-3-TH** **Topic: Unit 7:** Hemichordata : General characteristics of Hemichordata. Relationship with non-chordates and chordates. Objective: In course of evolution, Hemichordata plays an important role because it is considered as an intermediate phylum between non-chordates and chordates. **Lesson plan :**General description of hemichordate characters and discussion about the importance of this phylum as it shares both non-chordate and chordate characters.	Hemichordata : General characteristics of Hemichordata. Relationship with non-chordates and chordates. **Learning outcome :** Understanding of evolution specially the transition of invertebrates to vertebrates is supported by studying hemichordates. Detail shared morphological characters imply the importance of hemichordates.
1.		**PART II: SEMESTER 3. CORE COURSE 5 : Chordata ZOOA-CC3-5-TH.** CORE COURSE 7: Fundamentals of Biochemistry ZOOA-CC3-7-TH **Unit 5: Enzymes:** **Topic:** Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition. **Objective:** Every living cell needs energy primarily for its growth ,development and reproduction. This required amount of energy is produced by several biological reactions catalysed by various enzymes. So enzyme is an important molecule to be studied.	**Enzymes:** **Laerning outcome:** The knowledge of enzymes is one of the most important concepts for the students. They will know how cells perform all biochemical functions with high precision. Being a biological catalyst enzymes are considered as unique molecules. From DNA synthesis to glycolysis, all are governed and directed by enzymes.

1.	**Class 1.** **Class 2,3** **Class 4,5** **Class 6,7** **Class 8 -12** **Class 13.**	**Lesson planning** : definition of enzyme , structure and difference with structural protein with special reference to enzyme's catalytic activity. Nomenclature and classification to organise several enzymes into specific groups. Description of cofactors, coenzyme, isozymes and other related terms. Factors influencing enzyme activity like temperature, PH and substrate concentrations. Mechanism of enzyme action: hypothesis related to enzyme activity. Detail discussion about enzyme kinetics with graphical representations. Inhibitions of enzymes. **PART II: SEMESTER 4 CORE COURSE 10: Immunology ZOOA-CC4-10-TH** **Topic : Immunology** **Objective :** Healthy Survival strategy of animals are well supported by the immune system. In nature living organisms have to face the invasion of antigens in different forms. To combat the deleterious activities of the antigens , immune system uses various processes like the system of Major Histocompatibility Complex,	**Topic : Immunology** **Learning outcome :** Defence mechanisms or immune system are the most important survival strategy of animals . Thus, knowledge about various strategies of immunology include different types of cells

2.	**Class 1-6** **Class 7-11** **Class 12-15**	complement system and Hypersensitivity. Unit 5: Major Histocompatibility Complex . **Topic : Structure and functions of MHC molecules. Structure of T cell Receptor and its signalling, T cell development & selection, complement system, Hypersensitivity** **Lesson Plan :** Structure and role of MHC in antigen processing and presentation **Lesson Plan :** Steps of T cell development & selection **Lesson Plan :** Detail structure of T cell Receptor and its signalling.Description of complement system and Hypersensitivity.	and associated molecules which are essential for fighting against wide range of antigen molecules.
1.	**Class 1,2**	**PART III: SEMESTER 5, Discipline Specific Elective , DSE1. Parasitology ZOOA-DSE(A)-5-1-TH.** **Unit 1: Introduction to Parasitology** **Topic:** Brief introduction of Parasitism **Lesson Plan** :Parasite, Parasitoid and Vectors (mechanical and biological vector); Host parasite relationship **Unit 2: Parasitic Protists** **Lesson Plan** : Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and	**Topic : Introduction to Parasitology** **Learning outcome** :Parasitology and immunology are the two aspects of infectious diseases. Parasites are the causative agents and immune system is the global defense mechanism of the host against those parasites. Thus to know the life-cycles of both parasites and hosts, mode of interactions, epidemiology and treatments are essential for the students.

1.	**Class 3-14** **Class 15-26**	Treatment of *Giardia intestinalis, Trypanosoma gambiense, Leishmania-donovani* **Unit 3: Parasitic Platyhelminthes** **Lesson Plan** :Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Schistosoma haematobium, Taenia-solium **PART III: SEMESTER 6 CORE COURSE 13: Developmental Biology ZOOA-CC6-13-TH.** **Topic: Developmental biology** **Objective :** Developmental biology depicts various phases of development. Extraembryonic membranes and placenta are the two essential temporary organs during the period of development. Initial growth and development are absolutely governed by these two important organs in animals of different phyla.	**Topic: Developmental biology** **Learning outcome :** Students can learn vertebrate development – various types, structural details of extra embryonic membranes and placenta. Developments of eye and brain in chick are described to have knowledge about various steps of organ development.

	Class 1-10 **Class 11-18**	**Unit 2: Late Embryonic Development** **Lesson Plan :** Extra-embryonic membranes in Chick; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta) Unit 3: Post Embryonic Development **Lesson Plan** :Development of brain and Eye in Chick. Molecular Induction in Brain and Eye development.	

Name of Teacher: BANANI BINDHANI

Department : Zoology

B.sc (Honours and General)

- **Lesson Plan (CBCS System- 2018-2023)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question Framing
1	SEM 1(H)	ZOOA-CC1-1TH, Unit-2	**Protista and Metazoa** **Topic**: Conjugation in *Paramoecium*	1	2. To know about unique reproduction process and it's significance. 1.Elaborate the conjugation process of *Paramoecium* .
2		ZOOA-CC1-1TH, Unit-4	**Cnidaria**: **Topic**: Corals and coral reef diversity, Role ofsymbiotic algae in reef formation. Conservation of coral and coral reefs.	2	To know about different types of coral reefs and their significance 1. Write down significance of coral reef 2. What is Barrier Coral Reef?
3		ZOOA-CC1-2TH, Unit-2	**DNA Replication** **Topic**:**DNA Replication** **Sub topic:**Mechanism of DNA Replication in Prokaryotes, Prove that replication is Semi-conservative, bidirectional and discontinuous, RNA priming, Replication of telomeres.	4	To know about detailed Mechanism of DNA Replication in Prokaryotes 1. Elaborate the steps of Prokaryotic Replication. 2. Write the experiments on Semi-conservative mode of Replication.
4		ZOOA-CC1-2TH, Unit-3	**Transcription** **Topic**:**Transcription** **Sub topic:**Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.	4	To know about detailed Mechanism of DNA Transcription in both Prokaryotes and Eukaryotes 1.Write the Transcription initiation process. 2. Describe the difference in transcription termination between prokaryote and eukaryote.
5	SEM 2(H)	ZOOA-CC2-3 TH, Unit-6	**Echinodermata:** **Topic**: General characteristics and Classification of Echinodermata ***Sub topic***: General characteristics and Classification up to classes (Ruppert and Barnes, 1994); Watervascular system in Asterias. Echinoderm larva	3	1. Scientific arrangement of different species under this phylum; to know details of different species and classes; 2. To know about Water vascular system

			and affinities with chordates significance		3. Knowledge about significance of Echinoderm Larva.
					1. Write the salient features of Asterious. 2. Briefly describe thestructure of Water Vascular System.
6		ZOOA-CC2-4 TH, Unit-5	**Nucleus**: **Topic:Nucleus** ***Sub topic:***Nuclear envelope, Nuclear pore complex, Nucleolus; Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)	3	1.To know about Nucleus elaborately with function of Chromosome. 2. To know about Nucleosome 3. Acquire knowledge on Chromosome Packaging and Nuclear transportation
					1. What is Nucleosome? 2. Write short notes on Histones. 3. Write the structure of Nuclear pore complex.
7	SEM 3(H)	ZOOA-CC3-5 TH, Unit-7& 8	**7. Aves:** **Topic**: migration in Birds; Principles and aerodynamics of flight **8. Mammals:** **Topic**: Exoskeleton derivatives of mammals	3	1.To know about the Bird flight mechanism 2. To understand Types and significance of Exoskeleton derivatives of mammals
					1.Briefly describe aerodynamics of Bird flight. 2. Write the structure of Hair and Antler.
8		ZOOA-CC3-6 TH, Unit-3	**Nervous System:** **Topic**: Nervous System ***Sub Topic***: Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and non-myelinated nerve fibres; Types of synapse, Synaptic transmission and Neuromuscular junction	5	To know about detailed structure and mechanism of Neuron with Synaptic transmission.
					1. Elaborate Action Potential. 2. Describe the structure of Neuromuscular junction. 3. Draw mechanism of Synaptic transmission.
9		ZOOA-CC3-6 TH, Unit-5	**Reproductive System:** **Topic**: Physiology of mammalian reproduction ***Sub Topic***: Menstrual and estrous cycle, Stages and types, Hormonal role	5	To know about human and others mammals reproduction; duration of reproductive cycle; knowledge about

			in cycle, ovulation process		fertilization and pregnancy; hormonal roles.
					1. Write down different stages of menstrual / estrous cycle 2. State the roles of hormones in Reproductive cycles. 3. What is ovulation?
10		ZOOA-CC3-6 TH, Unit-6	**Endocrine System:** **Topic**: Histology and function of thyroid, and pancreas **Topic**: Placental Hormones	3	1. To observed the details structure of gland and their secretory hormones functions 2. To know about different types Placental hormone action and functions, how they act on cells.
					1. Briefly describe Name and Function of Placental Hormones. 2. State the identifying characters and function of Pancrease.
11		ZOOA-CC3-7 TH, Unit-4	**Nucleic Acids:** **Topic**: Nucleosides and Nucleotides	2	To know about structure and function of Nucleosides and Nucleotides
					1. Briefly describe types of Nucleotides. 2. Distinguish between Nucleosides and Nucleotides.
12	SEM 4(H)	ZOOA-CC4-8 TH, Unit-7	**Skeletal system:** **Topic:**Skeletal system ***Sub Topic***: Overview of axial and appendicular skeleton – limbs, girdles of pigeon; jaw suspension in mammals	4	To know about significance Limb and Girdle Bones.
					1. write the name of Fore Limb bones and Hind Limb bones. 2. Give an account on different types of jaw Suspension.
13		ZOOA-CC4-9 TH, Unit-5	**Thermoregulation& Osmoregulation:** **Topic:**Thermoregulation & Osmoregulation ***Sub Topic***: Thermal regulation in camel and polar bear, Osmoregulation in aquatic vertebrates	3	1. To know about adaptive features on Thermal regulation in camel and polar bear. 2. Get a knowledge on significance of Osmoregulation in aquatic vertebrates.

					1.Briefly describe about adaptive features on Thermal regulation in camel. 2. Write the mechanism of Osmoregulation.
14	SEM 5(H)	ZOOA-CC5-12 TH, Unit-4	**Sex Determination:** **Topic:**Sex Determination ***Sub Topic:***Mechanisms of sex determination in *Drosophila* and in man; Dosage compensation in Drosophila & Human	4	To know about function of different Genes in sex determination in *Drosophila* and in man; knowledge about Dosage compensation. 1. What is the role of sxl gene in sex determination in *Drosophila?* 2. Describe Genic Balance Theory. 3. What is Bar Body?
15		ZOOA-DSE(B) 5-1-TH (Endocrinology), Unit-2	**Hypothalamo-Hypophyseal Axis:** **Topic:**Hypothalamo-Hypophyseal Axis ***Sub Topic*:**Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms, Hypothalamo-Hypophyseal-Gonadal Axis.Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophyseal portal system	6	To know about hormones and their function; how hormones act on cells; knowledge about effect on gonads. 1. Mention the names and function of neurohormones. 2. What is neuroendocrine integration?
16		ZOOA-DSE(B) 5-1-TH (Endocrinology), Unit-3	**Peripheral Endocrine Glands:** **Topic:**Peripheral Endocrine Glands ***Sub topic:***Structure, Hormones and Functions of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis. Disorders of endocrine glands (Diabetes mellitus type I & Type II; Graves' Disease).	6	1. To know about mechanism of hormone of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis. 2. To know about Diabetes mellitus type I & Type II; Graves' Disease. 1. Briefly describe function of Adrenal , Pancreas and Ovary. 2. State the difference between Diabetes mellitus type I & Type II. 3. What is Graves' Disease?

17	SEM 6(H)	ZOOA-CC6-14 TH, Unit-4	**Natural Selection: Modes with Examples:** **Topic:**Natural Selection: Modes with Examples .	2	1. To know about different modes of Natural selection. 1. Briefly describe different types of Natural Selection process with example.
18		ZOOA-CC6-14 TH, Unit-6	**Origin and Evolution of Man:Topic:**Origin and Evolution of Man ***Sub Topic:***Origin and Evolution of Man, Unique Hominid characteristics contrasted with primate characteristic	2	To understand about evolution of Human.. 1. Briefly describe about Hominid characters.
19		ZOOA-CC6-14 TH, Unit-7	**Population genetics:** **Topic:Population genetics: Hardy-Weinberg Law** ***Sub Topic:***Hardy-Weinberg Law; factors disrupting H-W equilibrium (Genetic Drift, Migration and Mutation and Selection in changing allele frequencies (only derivations required). Simple problems related to estimation of allelic and gene frequencies.	5	1. To know about Hardy-Weinberg Law and natural effects on law. 2. Problems on Hardy-Weinberg Law. 1. Describe Hardy-Weinberg Law. 2. State the equation of selection effect on Hardy- Weinberg Law.
20	SEM 1(G)	ZOOG - CC1-1 TH, Unit-7	**Arthropoda:** **Topic:** Classification ***Sub Topic***: General characters and classification up to classes (Ruppert and Barnes, 1994, 6th Ed.); Eye in Cockroach, Metamorphosis in Lepidoptera	3	To Know about Arthropoda group and their species examples; Knowledge about Metamorphosis in Lepidoptera and mechanism & structure of Eye in Cockroach. 1. Describe the structure of Eye in Cockroach.
21		ZOOG - CC1-1 TH, Unit-16	**Mammals:** **Topic**: Classification ***Sub topic:***Classification up to orders (Young, 1981); Hair, Horn & Antler, Nail & claw	2	To know about class Mammals nad examples ; observe Exoskeletal derivatives. Briefly describe about Exoskeletal derivatives of mammals .
22	SEM 2(G)	ZOOG - CC2-2 TH, Unit-1	**Integumentary System:** **Topic:** Structure and function of integument ***Sub Topic***: Structure and types of integument of mammal and bird	2	To know about significance of integuments in different groups of animal.

			Structural peculiarities, functions		1. Discuss about general structure of feather. 2. Write the functions of skin 3. Mention the names of different layers of skin.
23		ZOOG - CC2-2 TH, Unit-6	**Early Embryonic Development** **<u>Topic</u>:Fertilization: Sea-Urchin**	2	1. To know about mechanism Fertilization: Sea-Urchin. 1. Describe about Fertilization process of Sea-Urchin
24		ZOOG - CC2-2 TH, Unit-7	**Late Embryonic Development** **<u>Topic</u>:Placenta types and function**	1	To know about Placenta types and function 1. State the name and diagram of different types of placenta.
25	SEM 3(G)	ZOOG - CC3-3 TH, Unit-6	**Reproduction and Endocrine Glands:** **<u>Topic</u>**: 1. Physiology of female, reproduction: Histology of ovary, hormonal control of menstrual cycle. 2. Structure and function of pituitary, thyroid	4	To know about hormonal control of menstrual cycle. 1. Discuss about hormonal control of menstrual cycle 2. Describe Structure and function of thyroid gland.
26	SEM 4(G)	ZOOG - CC4-4 TH, Unit-2	**Linkage, Crossing Over:** **<u>Topic:</u>**Linkage and crossing over, Complete & Incomplete Linkage, Recombination frequency as a measure of linkage intensity. Holiday Model	2	To know about detailed Linkage and crossing over. 1. Briefly describe about Complete & Incomplete Linkage. 2. write short notes on crossing over.
27		ZOOG - CC4-4 TH, Unit-7	**Process of Evolutionary changes** **<u>Topic</u>: Isolating mechanism, Natural Selection.**	2	To know about types of Isolating mechanism. 1. What is Natural Selection.
28	SEM 5(G)	ZOOG - DSE-A-5-1 TH, Unit- 4	**Parasitic Helminthes** **<u>Topic</u>**: Life History and pathogenicity of Alcylostoma duodenale, Wuchereria bancrofti.	2	Proper knowledge about Life History and pathogenicity of Alcylostoma duodenale, Wuchereria bancrofti . 1. Write short notes on Life History and pathogenicity of Alcylostoma duodenale.
29	SEM 6(G)	ZOOG - DSE-B-6-2	**Community:** **<u>Topic:</u>**Community characteristics:	3	To know about species diversity, abundance,

		TH, Unit-3	species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect.		dominance, richness, Vertical stratification, Ecotone and edge effect 1. What is Ecotoney? 2. What is edge effect?
30		ZOOG - SEC-B-6-4 TH, Unit-3	**Non-infectious Diseases** **Topic:** Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit	3	To know about Diabetes (Type I and Type II), Hypertension (Primary and secondary); mechanism of testing kit. 1. State the symptoms of Hypertension. 2. Write the difference between Type I and Type II Diabetes.

Name of Teacher: BANANI BINDHANI

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- **Lesson Plan (2018-2020 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question framing
1	**SEM 1**	ZCT-104 , Unit- 1	**Genetics** **Topic**: **Chromatin Dynamics** **Sub topic:**1.1 Chromatin remodeling; Replicative nucleosomal assembly; nucleosome positioning at functional promoter. 1.2 Molecular nature of functional status of chromatin; chromatin silencing & positing effect variegation. 1.3 Histone code, reader-writer complex	7	To understand about detailed chromatin structure, function, nucleosome detailed structure, Histone complex 1. Describe about nucleosome positioning 2. Write short notes on reader-writer complex. 3. Elaborate position effect and silencing.
2		ZCT-104 , Unit- 2	**Genetics** **Topic:**DNA replication and regulation **Sub Topic:**2.1 Enzymology of eukaryotic replication and gene amplification.	2	To know about role and application of different enzymes, proteins as well as genes in eukaryotic replication process. 1. Briefly discuss about role of different proteins and enzymes in eukaryotic replication process. 2. State the difference between eukaryotic and prokaryotic replication process.
3		ZCT-104 , Unit- 3& 4	**Genetics** **Topic:**Regulation of gene expression Translation & Post Translational events **Sub Topic:**3.1 Transcription in eukarytotes: Initiation, elongation & termination 4.1 Translation in eukaryotes:	5	To understand about detailed eukaryotic transcription and translation process and their significances. 1.Elaborate eukaryotic transcription initiation process. 2. Discuss the steps of elongation process.

			Initiation, Elongation and termination.		3. Importance of Ribosome in Translation process. 4. Steps of Translation termination.
4	**SEM 2**	ZCT-209, Unit-2	**Developmental Biology** **Topic:**Metamorphosis and organogenesis in model organisms **Sub Topic:**Zebrafish: Cell movement and signal during early development, Patterning, polarityand regionalization of nervous system. Limb development in vertebrate.	6	To know about basic developmental pattern of Zebra fish, different organ formation, Limb development 1. Elaborate different steps of fate map formation. 2. Mention the definite stage of Limb development region.
5		ZCT 211, Unit-6	**Biochemistry and Genetic Engineering** **Topic:**Recombinant DNA technology **Sub Topic:**Generation of transgenic animals. Gene knock-out and gene silencing.	1	To understand practical application transgenic animals. 1. Briefly describe importance of transgenic animals 2. How gene silencing occur.
6		ZCT-212, Unit-3	**Endocrinology** **Topic:**Thymic hormones and cell immunity **Sub Topic:**Thymic hormone synthesis and function, B-cell and T-cell production	1	To Know how T3 and T4 synthesis and function 1. Briefly describe T3 and T4 production. 2. Role of T3 and T4 hormones in immune system.
7		ZCT-212, Unit-4	**Endocrinology** **Topic:**Pineal gland structure, biosynthesis of melatonin, diurnal variations of pineal gland functions. Sub Topic: Melatonin structure, production, function	3	To know about molecular basis melatonin function, Zet-lag. 1.State the role of Melatonin in body clock mechanism. 2. Pathway of Melatonin synthesis.
8	**SEM 3**	ZCT-316, Unit-2	**Animal Behavior and Wildlife Biology** **Cooperation and conflict**	3	To understand about behaviour over mate choice and reproduction.

			Topic: Cooperation and conflict Sub Topic: 2.1 Range of cooperative behavior and theories of cooperation, Kin selection 2.2 Elaborate ornaments: Fisher's hypothesis and Handicap hypothesis 2.3 Conflict over mate choice		1. Discuss about Handicap hypothesis. 2. What is cooperative behaviour? Give example.
9		ZCT-316, Unit- 3	**Topic:Foraging** Sub Topic: 3.1 Optimal foraging theory 3.2 Foraging and predation risk: defense strategies against predators 3.3 Territoriality and Group foraging	2	To know about evolutionary foraging behaviour. Discuss about constrains during foraging. Elaborate optimal foraging theory.
10		ZCT-316, Unit- 4	**Topic:Aggression** **Sub Topic:**4.1 Aggressive behaviour 4.2 Game theory models and strategies – Prisoners' dilemma and reciprocal altruism and evolution of sociality	2	To understand animal aggression behaviour. 1.State Hawk- Dove aggression model. 2. Give example of altruistic behaviour .
11		ZET-330, Unit- 2 & 3	**Endocrinology** **Topic:**2. **Sex determination and sex differentiation**: from genes to gender (Fish and Human). 3. **Female reproductive system**: Hormonal regulation of ovulation, gestation, parturition and lactation.	4	To know about -how axis control female reproduction. Hormonal role in sex determination and sex differentiation. 1. State the role of hormones in oogenesis. 2. Write hormonal acitivity during gestation and parturition .
12		ZET-330, Unit- 5 & 7	**Topic: 5. Prostaglandins:** Source, chemical nature, structure, functions, physiological significance and clinical implications**.** 7. **Endocrinology ofphotosexual activity:** Extra-	4	To know about detailed function of prostaglandin hormone To understand the Melatonin secretion pathway as well as effect on reproduction of fish and

			retinal photoreceptors, photorefractoriness, role of**melatonin** in reproduction (Model system – Fish).		humans Discuss briefly about significance of Prostaglandin in reproduction. Elaborate the effect of Melatonin in reproduction.
13	**SEM 4**	ZCT-433, Unit-3	**Evolution** **Topic:**3. **Gene Frequencies in Population** **Sub Topic:**3.1 The Hardy-Weinberg principle and analysis of gene frequencies in natural population. 3.2 Major factors influencing gene frequencies (migration, inbreeding), effects of selection and mutation on gene frequencies.	3	To understand aboutHardy-Weinberg principle on evolution and effects of natural factors on gene frequency changes from generation to generation. 1. Describe about Hardy-Weinberg principle with equation 2. State the effect of selection on Hardy-Weinberg principle.
14		ZCT-433, Unit-4	**Topic:Patterns and trends in evolution** **Sub Topic:**4.2 Tools of studying human evolution 4.3 Cultural evolution	2	To know about human evolution Mention the tools that help in analysis of human evolution
15		ZCT-433, Unit-5	**Topic:Species and Speciation** **Sub Topic:**5.1 Genetic basis of species difference and reproductive barriers	1	To know about different reproductive barriers Discuss of the effect of reproductive barriers on evolution.

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- **Lesson Plan (2018-2020 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question framing
1	**SEM 1**	ZCT-102 , Unit- 2	**Ecological Theories** **Topic**: **Community Ecology** **Sub topic:**2.5 Ecological modeling - Predator-prey models,Epidemiological models, Harvest models, Foraging models	2	To understand aboutPrey-predator relationship in ecological evolution 1. Describe about Foraging model 2.Elaborate Epidemiological model with equation
2		ZCT-104 , Unit- 2	**Genetics** **Topic:DNA replication and regulation** **Sub Topic:**2.1Enzymes involved in prokaryotic and eukaryotic replication and gene amplification 2.2 Role of Non-coding RNA in prokaryotic and eukaryotic DNA replication	3	To know about role and application of different enzymes, proteins as well as genes in eukaryotic replication process. 1. Briefly discuss about role of different proteins and enzymes in eukaryotic replication process. 2. State the difference between eukaryotic and prokaryotic replication process.
3		ZCT-104 , Unit- 3& 4	**Genetics** **Topic:**Regulation of gene expression Translation & Post Translational events **Sub Topic:**3.1 Transcription processes: Initiation, elongation & termination 3.2 Epigenetic regulation and post transcriptional changes 4.1 Translation in eukaryotes: Initiation, Elongation and	5	To understand about detailed eukaryotic transcription and translation process and their significances. 1.Elaborate eukaryotic transcription initiation process. 2. Discuss the steps of elongation process. 3. Importance of Ribosome in Translation process.

			termination.		4. Steps of Translation termination.
4	**SEM 2**	ZCT-207, Unit-2	**Developmental Biology** **Topic:**Developmental Biology **Sub Topic:**Zebrafish: Cell movement and signal during early development, Patterning, polarityand regionalization of nervous system. Limb development in vertebrate.	2	To know about basic developmental pattern of Zebra fish, different organ formation, Limb development 1. Elaborate different steps of fate map formation. 2. Mention the definite stage of Limb development region.
5		ZCT 207, Unit- 4 & 5 & 6	**Neurobiology:** **Topic:**4. Life of a neuron - Neurogenesis – role of stem cells, Neuronal ageing and death 5. Neurophysiology - Neuronal plasticity, Neurotransmitters and receptors, Electrical properties of nerve cells: membrane and action potential. Synaptic transmission and neural integration, Neuromuscular junctions. Neuro-endo-immune circuitry 6. Aspects of neuronal disorders- Neurotransmitter-related, Structural, Metabolic	5	To understand Neuron development, properties, Central Nervous System, disorders 1. Briefly describe Neuron plasticity. 2. How action potential rise. 3. Define three neurotransmitters structure and function.
6		ZCT-208, Unit-8	**Genetic Engineering** **Topic:**Genomics, Proteomics & Bioinformatics **Sub Topic:**8.2 DNA micro-array and its use.	1	To Know DNA micro-array and its use 1. Briefly describe significance of DNA micro array.
8	**SEM 3**	ZCT-312, Unit-3	**Endocrinology & Comparative Animal Physiology** **Topic:**Thymic hormones and cell immunity**.**	1	To understand about function of Thymic hormones. 1.Discuss about function of Thymic Hormones.
9		ZCT-312, Unit- 4	**Topic:Pineal gland structure, biosynthesis of melatonin, diurnal variations of pineal**	2	To know about secretion and function of melatonin.

			gland functions.		Discuss about effects of light on Pineal Gland.
10		ZCT-312, Unit- 10	**Topic:Physiology of Circulation and Respiration** **Sub Topic:**Comparative structure of cells in circulation of invertebrates and vertebrates, Composition of blood, plasma and blood Corpuscles, invertebrates, Functions	2	To understand function of blood cells and circulation. 1.State Hawk- Dove aggression model. 2. Give example of altruistic behaviour..
11		ZET-330, Unit- 2 & 3	**Endocrinology** **Topic:**2. **Sex determination and sex differentiation**: from genes to gender (Fish and Human). 3. **Female reproductive system**: Hormonal regulation of ovulation, gestation, parturition and lactation.	4	To know about -how axis control female reproduction. Hormonal role in sex determination and sex differentiation. 1. State the role of hormones in oogenesis. 2. Write hormonal acitivity during gestation and parturition .
12		ZET-330, Unit- 5 & 7	**Topic: 5. Prostaglandins:** Source, chemical nature, structure, functions, physiological significance and clinical implications**.** 7. **Endocrinology ofphotosexual activity:** Extra-retinal photoreceptors, photorefractoriness, role of**melatonin** in reproduction (Model system – Fish).	4	To know about detailed function of prostaglandin hormone To understand the Melatonin secretion pathway as well as effect on reproduction of fish and humans Discuss briefly about significance of Prostaglandin in reproduction. Elaborate the effect of Melatonin in reproduction.
13	**SEM 4**	ZCT-433, Unit-3	**Evolution** **Topic:**3**. Gene Frequencies in Population** **Sub Topic:**3.1 The Hardy-Weinberg principle and analysis of gene frequencies in natural	3	To understand about Hardy-Weinberg principle on evolution and effects of natural factors on gene frequency changes from generation to generation.

			population. 3.2 Major factors influencing gene frequencies (migration, inbreeding), effects of selection and mutation on gene frequencies.		1. Describe about Hardy-Weinberg principle with equation 2. State the effect of selection on Hardy-Weinberg principle.
14		ZCT-433, Unit-4	**Topic:Patterns and trends in evolution** **Sub Topic:**4.2 Tools of studying human evolution 4.3 Cultural evolution	2	To know about human evolution Mention the tools that help in analysis of human evolution
15		ZCT-433, Unit-5	**Topic: Species and Speciation** **Sub Topic:**5.1 Genetic basis of species difference and reproductive barriers	1	To know about different reproductive barriers Discuss of the effect of reproductive barriers on evolution.

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B.sc (Honours and General)

- **Lesson Plan (CBCS System- 2018-2023)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question Framing
1	SEM 1(H)	ZOOA-CC1-1TH, Unit-4	**Cnidaria:** **Topic**: General characteristics of Cnidaria and classification, ***Sub topic***: Discuss about details classification upto classes with example **Topic**: Metagenesis of Obelia, ***Sub topic***: Describe the Structure of obelia, Different forms of obelia, life cycle with diagram Metagenesis meaning, **Topic**:Polymorphism of Cnidaria, ***Sub topic***: Definition, uniqueness of polymorphism, Structure of medusa & polyp, Polymorphic forms, Life cycle with diagram .	6	1. Scientific arrangement of different species under this phylum; to know details of different species and classes; 2. To know about metagenesis and unique life cycle of obelia, haploid and diploid alteration; 3. To know about medusa and polyp stages ; different form in same species; diversity of class. 1. Classify cnidaria upto subclass with examples. 2. Briefly describe metagenesis of Obelia with suitable diagram? 3. What is metagenesis? 4. What is polymorphism? 5. What is Medusa ? write the structure of medusa 6. Give an account on polymorphism of hydrozoa/siphonophora/ Cnidaria.
2		ZOOA-CC1-2TH, Unit-8	**Molecular techniques**: **Topic**: PCR ***Sub topic***: Principle and mechanism of PCR, significance **Topic**: Western , Southern blot and northern blot ***Sub topic:*** Discuss about Principle and mechanism, flow chart, polymerase functions, significance, Application.	6	To know about Practical application; how to used in forensic science; significance in research field and technical knowledge; To identify specific DNA and RNA sequence. 1. Write down principle and mechanism of PCR/Sourthern blot/Northern Blot 2. Write down forensic apllication of Northern and

					sourthern blot. 3. What is Taq polymerase?
3	SEM 2(H)	ZOOA-CC2-3 TH, Unit-3	**Arthropoda:** **Topic**: General characteristics and Classification of arthropoda, ***Sub topic***: Details classification upto classes with example **Topic**: respiration of prawn and cockroach ***Sub topic***: aquatic and terrestrial respiration Structure of respiratory organ with diagram, mechanism of respiration, peculiarities of respiration **Topic** : Metamorphosis of insect ***Sub topic***: Metamorphosis type, life cycle, endocrine glands of insect, pro thorasic gland of insect, mechanism of metamorphosis, hormonal role **Topic:** Social life of termite ***Sub topic***: Discuss about caste system, different structural details of caste , social life, life cycle and reproduction, significance	6	1. Scientific arrangement of different species under this phylum; to know details of different species and classes; 2. To know about diversity; different respiratory forms 3. Knowledge about metamorphosis; practical and field application 4. Significance of termite; conservation; altruistic behaviour, ecological importance. 1. Write the salient features of Arachnida and insect. 2. Briefly describe the respiratory structure of prawn with diagram? 3. Briefly describe respiration in prawn? 4. Briefly describe the structure and function of trachea in cockroach. 5. Mention the names and position of different gills in prawn. 6. Describe about caste system of termite. 7. What is social insect?
4		ZOOA-CC2-4 TH, Unit-7	**Cell signalling**: **Topic:** Cell signalling transduction pathway ***Sub topic:*** Description of Types of signalling pathway, receptor type, ligand, hormone, protein hormone and steroid hormone mechanism, classification of hormone and their binding site on cell **Topic:** RTK & JAK/STAT ***Sub topic***: Receptor structure, mechanism of action, down regulation **Topic:** Apoptosis ***Sub Topic:*** Definition and types of apoptosis, intrinsic and extrinsic pathway, regulation of apoptosis,	10	1. To know about hormone and their mechanism; how hormone act on cell and ligand-receptor relation; Cross talk mechanism; concept of second messenger system; 2. Details about intracellur mechanism 3. To know about apoptosis, cell death mechanism and significance in human body; How P^{53} act as anti-cancer molecule and control DNA repair mechanism.

			Caspase & P^{53},P^{21} details, Others apoptotic marker.		1. What is cell signalling? 2. Write short notes on paracrine, autocrine and endocrine signalling. 3. Write the structure of G protein linked receptor and steroid receptor 4. Classify hormones based on their chemical structure. 5. What is RTK? 6. Briefly describe steroid hormone mechanism in cell.
5	SEM 3(H)	ZOOA-CC3-5 TH, Unit-5	**Amphibia:** **Topic**: parental care of amphibia ***Sub Topic***: Define parental care, Types of parental care and example, diagrammatic representation of parental care.	2	To know about the life of amphibian ; diversity; natural selection; Significance of parental care. 1. Briefly describe direct and indirect parental care of amphibia with suitable examples.
6		ZOOA-CC3-5 TH, Unit-8	**Mammals:** **Topic**: Exoskeleton ***Sub Topic***: Structure and types exoskeleton with diagram, Example. Different layers of skin, Details about hair with diagram, Others integumentary structure of mammals , Discuss about horn and antler.	3	To know about skin of mammals and layers of skin; significance of skin. 1. Mention the differents layers of skin 2. Describe the structure of skin
7		ZOOA-CC3-6 TH, Unit-5	**Reproductive System:** **Topic**: Physiology of mammalian reproduction ***Sub Topic***: Menstrual and estrous cycle, Stages and types, Hormonal role in cycle, ovulation process	5	To know about human and others mammals reproduction; duration of reproductive cycle; knowledge about fertilization and pregnancy; hormonal roles. 1. Write down different stages of menstrual / estrous cycle 2. State the roles of hormones in Reproductive cycles. 3. What is ovulation?
8		ZOOA-CC3-6 TH, Unit-6	**Endocrine System:** **Topic**: Histology of pituitary and adrenal ***Sub topic***: General concept of endocrine gland, Structure of Endocrine gland, hormone secretion, cell types **Topic**: Classification of hormone and	8	1. To observed the details structure of gland and their secretory hormones functions 2. To know about different types hormone action and functions, how they act on cells.

			mechanism of action ***Sub Topic:*** Signal transduction pathway, hormone action, steroid hormone function, protein hormone function **Topic:** Hormonal Axis ***Sub Topic:*** Different hormonal axis, Hypothalamo-Pituitary axis and downstream pathways , different hormonal action through this pathway		3. To know about upstream and downstream hormonal action and pathways; How hormone work through different hormonal axis in our body. 1. Briefly describe cAMP pathway 2. Describe neuroendocrine integration with suitable example
9		ZOOA-CC3-7 TH, Unit-3	**Protein Metabolism:** **Topic**: Transamination and Deamination ***Sub Topic***: Definition, Enzymes and substrate names, importance, Chemical reaction and final product, Conversion of amino acid to keto acid	4	To know about metabolism of protein in our body ; ammonia formation and secretion; detoxification process; fate protein in our body and significance; conversion process. 1. Briefly describe transamination / Deamination process 2. Distinguish between transamination and deamination process 3. Describe about types of deamination process.
10	SEM 4(H)	ZOOA-CC4-8 TH, Unit-1	**Integumentary System:** **Topic:** Structure and function of integument ***Sub Topic***: Structure and types of integument of mammal, bird, amphibian. Structural peculiarities, functions	4	To know about significance of integuments in different groups of animal. 1. write the significance of integuments 2. Give an account on general feather of birds. 3. What is Remiges, retrices, down feather, filoplumes? 4. Write the structure of skin with diagram.
11		ZOOA-CC4-10 TH, Unit-1	**Overview of Immune system:** **Topic:** Introduction and concept of health and disease ***Sub Topic***: Cells and organ of immune system, Details of formation of immune cell. thymus and bone marrow	3	To know about immune system; how to formed immune cells; knowledge about position and structure of different immune organ. 1.Briefly describe about primary and secondary lymphoid organ.
12		ZOOA-CC4-10 TH, Unit-2	**Innate and adaptive immunity:** **Topic**: Anatomical barrier , Adaptive Immunity	5	To know about antigen-antibody reaction; antibody formation; immune

			Sub Topic: Types of barrier, cells type, phagocytosis, inflammation, cell mediated and humoral response, their relation and counteract, reaction between antigen and antibody, concept of vaccination		complexes; prevention of pathogens and antigen by our immune system; immunization process and vaccination. 1. Briefly describe about cell mediated and humoral immunity? 2. Write short notes on innate immunity 3. Distinguish between innate and adaptive immunity 4. What is vaccine?
13	SEM 5(H)	ZOOA-CC5-11 TH, Unit-2	**Population:** **Topic:** Population concept ***Sub Topic:*** Definition, structure, survivorship curves, life table, dispersal and dispersion, growth curve, exponential and logistic growth equation and pattern, r and k strategies, Population interaction, Density dependent and independent factors, Experimental study and analysis, differences of term.	10	To know about population; types; knowledge about growth of population; interaction. 1. What is - Natality, mortality, fecundity, population density? 2. Describe- 'j' and 's' shaped growth curve. 3. Describe life table with graph 4. Write short notes on r and k selected species. 4. Give and account on population dispersion and dispersal.
14		ZOOA-CC5-12 TH, Unit-3	**Mutation:** **Topic:** Chromosomal aberrations and mutation ***Sub topic***: Chromosome types and structure, Types of Chromosomal aberration, types of mutation, Mutation detection in different organism and experimental prove, molecular basis of mutation, Non Disjunction	5	To know about chromosomal abnormalities and disorder; detection; observation of mutation in different organism with experiment and their application in research field. 1. Describe about structural chromosomal aberration. 2. What is- euploidy, aneuploidy? 3. Briefly describe different types of muation.
15		ZOOA-DSE(B) 5-1-TH (Endocrinolo	**Introduction to endocrinology:** **Topic:** Endocrine system ***Sub Topic*:** Classification of hormone with examples and their function,	6	To know about hormones and their function; how hormones act on cells; knowledge about

		gy), Unit-1	hypothalamus, neurosecretion, neuro hormones and their function, transport		neuroendocrine integration. 1. Mention the names and function of neurohormones. 2. What is neuroendocrine integration?
16		ZOOA-DSE(B) 5-1-TH (Endocrinology), Unit-4	**Regulation of hormone action:** **Topic:** Mechanism of hormone action ***Sub topic:*** cAMP and IP3-DAG pathways Topic: Metabolism ***Sub Topic:*** Calcium and carbohydrate metabolism , role of hormones in metabolism, function **Topic:** Bioassay ***Sub Topic:*** RIA and ELISA principle and mechanism, application **Topic:** Reproductive cycle ***Sub topic***: Menstrual and estrous cycle, Stages and types, Hormonal role in cycle, ovulation process	12	1. To know about mechanism of hormone and different pathway; How hormones act through this second messenger system; knowledge about protein kinase; 2. To know about Carbohydrate and calcium metabolism, normal level in blood; function of carbohydrate and calcium in human body; role of different hormones in carbohydrate and calcium to maintain proper balance. 3. To know about reproductive cycle and hormonal roles. 1. Briefly describe cAMP/IP3 DAG pathway. 2. State the roles of hormones in carbohydrate / calciuam metabolism. 3. What is RTK? 4. What is auto phosphorylation? 5. State the roles of hormone in menstrual / estrous cycle.
17	SEM 6(H)	ZOOA-CC6-13 TH, Unit-1	**Early embryonic development:** **Topic:** Fertilization ***Sub Topic:*** Fertilization In sea urchin and mammals, process- Capacitation, acrosome reaction, cortical granule reaction, calciuam role, prevention of polyspermy **Topic:** Types of egg ***Sub topic:*** Classification of eggs depend on amount of yolk substances **Topic:** Embryonic induction	10	1. To know about internal and external fertilization; details process of fertilization; control; prevention of polyspermy. 2.To know about different types of eggs and examples. 3. Knowledge about organizer ; role of protein; brief idea about organ transplant.

			Sub topic: organizer concept, Speman & Mangold's experiment, Induction process and protein role.		1. Briefly describe the fertilization process in sea urchin/ mammals? 2. State the role of calcium in prevention of polyspermy. 3. Classify eggs based on their yolk substance. 4. State the role of protein in formation of organ.
18		ZOOA-CC6-14 TH, Unit-5	**Species Concept:** **Topic:** Speciation ***Sub Topic:*** General idea about speciation, Types of Speciation, Abrupt speciation and gradual speciation, biological species concept- Drawback of biological species concept, evolutionary species concept, Adaptive radiation, isolating mechanism.	3	To understand about formation species; evolution of new species. 1. Briefly describe about biological species concept? 2. write short notes on Speciation.
19	SEM 1(G)	ZOOG - CC1-1 TH, Unit-3	**Cnidaria:** Topic: Classification ***Sub Topic***: General character, example, Metagenesis of Obelia	3	To Know about Cnidaria group and their species examples; Knowledge about life cycle peculiarities and uniqueness of Obelia. 1. Describe the life cycle of Obelia.
20		ZOOG - CC1-1 TH, Unit-13	**Amphibia:** **Topic**: Classification and parental care ***Sub topic:*** General character and order character of amphibia with suitable examples, Parental care of amphibia with examples	2	To know about class amphibia nad examples ; observe their parental caring. Briefly describe about parental care of amphibia.
21	SEM 2(G)	ZOOG - CC2-2 TH, Unit-1	**Integumentary System:** **Topic:** Structure and function of integument ***Sub Topic***: Structure and types of integument of mammal and bird Structural peculiarities, functions	4	To know about significance of integuments in different groups of animal. 1. Discuss about general structure of feather. 2. Write the functions of skin 3. Mention the names of different layers of skin.
22	SEM 3(G)	ZOOG - CC3-3 TH, Unit-9	**Protein metabolism:** **Topic**: Transamination, deamination, Urea cycle	4	To know about protein metabolism in our body and by product of protein

			Sub Topic: Principle and mechanism, reaction with enzyme names , final product, Significance		metabolism; how to remove ammonia from body; significance of our body. 1. discuss about oxidative deamination process 2. Discuss about transamination process.
23	SEM 4(G)	ZOOG - CC4-4 TH, Unit-8	**Speciation:** **Topic:** Speciation type ***Sub Topic***: Sympatric , Parapatric, allopatric speciation, biological species concept, isolation process, factors	4	To know, how species formed; factors which effects speciation process. 1. Briefly describe about biological species concept? 2. write short notes on Speciation.
24	SEM 5(G)	ZOOG - DSE-A-5-1 TH, Unit-9	**Poultry farming:** **Topic**: Poultry breeding and management ***Sub Topic:*** Breeding, hatching, breeding stock, management, processing and preservation of eggs	4	Proper knowledge about poultry; management; practical application ; economic importance. * **Visit poultry farm- ; to observe-how to keep and maintain poultry birds and management of fowl disease** 1. Mention the names of different breeds of poultry bird 2. Write short notes on disease of fowl.
25	SEM 5(G)	ZOOG - DSE-B-6-1 TH, Unit-2	**Population:** **Topic:** Population concept ***Sub Topic:*** Definition, structure, survivorship curves, life table, dispersal and dispersion, growth curve, r and k strategies, Population interaction, Density dependent and independent factors	10	To know about population; types; knowledge about growth of population; interaction. 1. What is natality/ mortality? 2. What is population density? 3. Discuss about r and k selected species.

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Department : Zoology

M.sc

- **Lesson Plan (2018-2020 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question framing
1	SEM 1	ZCT-103 , Unit- 4	**Cell Signalling** **Topic**: Cell signalling and cell-cell interaction **Sub topic:** Cell surface and intra cellular receptor, discussion about different types of receptor, Steroid and non steroidal hormone mechanism, Endocrine signalling, Different signalling pathways - cAMP, Ras-raf, JAK-STAT,IP3-DAG pathway, Crosstalk mechanism	6	To understand about signalling mechanism and different types ; Receptor types; to know how hormone act on cell ; Details knowledge of cross-linking of different hormonal pathways. 1. Describe about cAMP/Ras-Raf pathways 2. Write short notes on cytoplasmic receptor. 3. Discuss about steroid hormonal mechanism inside of cell.
2		ZCT-103 , Unit- 5	**Cell death Mechanism** **Topic:** Autophagy, Apoptosis, Anoikis **Sub Topic:** Definition and Types of Autopagy, Mechanism of autophagy, Discussion about apoptosis , features of apoptotic cell, Intrinsic and extrinsic pathway of apoptosis, Caspase dependent pathway, Role of P53 and P21, Description of Anoikis	8	To know about programme cell death pathways; understand about all cellular death mechanism; Difference between autophagy and apoptosis. 1. Briefly discuss about caspase mediated pathway of apoptosis? 2. State the role of P53 in apoptosis. 3. Describe about autophagy process.
3		ZCT-103 , Unit- 6	**Staining** **Topic:** Staining and dyes **Sub Topic:** Definition, types of stain, Fixatives, Classification	3	To understand about staining of cells ; significance of stain.

			of stain, Nomenclature, Mordants, Metachromasia		Classify stain depends on their chemical properties
4	SEM 2	ZCT-211, Unit-1	**Amino acid** **Topic:** Amino acid properties **Sub Topic:** Basic properties of amino acids, Primary - secondary- tertiary and quartenary structure of protein.	4	To know about basic structure of protein and peptide bond; To understand different structural properties of protein. Briefly describe about Secondary structure of protein.
5		ZCT 212, Unit-1	**Pheromones** **Topic:** Pheromone **Sub Topic:** Discuss about classification of pheromone, discuss about properties and chemical nature of pheromones, structure and function of pheromones., Application in agriculture field and discuss significance	4	To understand practical application of pheromone in pest control; Pheromone used as biological control methods. 1. Briefly describe about properties and types of pheromone. 2. How pheromone used in agricultural field.
6		ZCT-212, Unit-2	**GI tract Hormone** **Topic:** GI tract hormone **Sub Topic:** Sources of GI tract hormones , Types of GI tract hormone, Mechanism and Function of GI tract hormones,	3	To Know how GI tract hormone helps in digestion in our Body. 1. Briefly describe about structure and function of secretin. 2. Briefly describe about structure and function of CCK.
7		ZCT-212, Unit-5	**Hormones** **Topic:** Hormone and human health Sub Topic: Stress, metabolic and reproductive disorder, molecular basis	6	To know about molecular basis of different hormonal disorder- which related to hypo or hyper secretion of hormone. State the role of hormones in reproductive disorder.

8	SEM 3	ZCT-316, Unit-3	**Foraging** **Topic:** Foraging Sub Topic: Optimal foraging theory, foraging and predation risk, territoriality and group foraging	2	To understand about foraging behaviour. 1. Discuss about territoriality with suitable examples. 2. Discuss about types of foraging behaviour
9		ZET-330, Unit- 1	**Evolution of Gonad** **Topic:** Gonad Sub Topic: Phylogeny and ontogeny of testis and ovary	2	To know about gonad Discuss about ontogeny of testis/ovary
10		ZET-330, Unit- 2	**Sex determination** **Topic:** Sex determination **Sub Topic:** Sex differentiation from gene to gonad in fish and human, molecular basis	2	To understand molecular basis of sex determination. 1.State the role of gene in sex determination of human and fish. 2. State the role autosome in sex determination in human.
11		ZET-330, Unit- 4	**Male reproductive system** **Topic:** Male reproductive system **Sub Topic:** Histological structure, sertoli cell, leydig cell, Hypothalomo-pituitary-gonadal axis, role of hormone in spermatogenesis	2	To know about -how axis control male reproduction. 1. State the role of hormone in spermatogenesis. 2. Write the funtion of sertoli cell. 3. What is blood testis barrier?
12		ZET-330, Unit- 8	**Endocrine disruption** **Topic:** Endocrine disruption **Sub topic:** endocrine disruption of reproduction in fish, molecular basis, experiment	2	To know about molecular basis of different hormonal disorder- which related to hypo or hyper secretion of hormone.

					Discuss briefly about endocrine disruption of reproduction in fish.
13	SEM 4	ZCT-430, Unit-5	**Species** **Topic:** Species and Speciation **Sub Topic:** Genetic basis of species difference, sympatric - allopatric speciation, isolation mechanism, evolution of interaction among species, factors of speciation, biological species concept	2	To understand about evolution of new species from old species. 1. Describe about different modes of speciation 2. Describe about biological species concept

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Department : Zoology

M.sc

- **Lesson Plan (2020-2022 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question framing
1	SEM 1	ZCT-101, Unit- 12	**Communication** **Topic**: Insect communication **Sub Topic:** Description on chemical mode of communication, mode of communications, types of communication, Definition and types of Bioluminiscence , examples of bioluminiscence	4	To understand about communication and insect language; To know about chemical basis of bioluminiscence; significance and types of bioluminiscence.
2		ZCT-103 , Unit- 4	**Cell Signalling** **Topic**: Cell signalling and cell-cell interaction **Sub topic:** Cell surface and intra cellular receptor, discussion about different types of receptor, Steroid and non steroidal hormone mechanism, Endocrine signalling, Different signalling pathways - cAMP, Ras-raf, JAK-STAT,IP3-DAG pathway, Crosstalk mechanism	6	To understand about signalling mechanism and different types ; Receptor types; to know how hormone act on cell ; Details knowledge of cross-linking of different hormonal pathways. 1. Describe about cAMP/Ras-Raf pathways 2. Write short notes on cytoplasmic receptor. 3. Discuss about steroid hormonal mechanism inside of cell.
3		ZCT-103 , Unit- 5	**Cell death Mechanism** **Topic:** Autophagy, Apoptosis, Anoikis **Sub Topic:** Definition and Types of Autopagy, Mechanism of autophagy, Discussion about apoptosis , features of apoptotic cell, Intrinsic and extrinsic pathway of apoptosis, Caspase dependent pathway, Role of P53 and P21, Description of Anoikis	8	To know about programme cell death pathways; understand about all cellular death mechanism; Difference between autophagy and apoptosis. 1. Briefly discuss about caspase mediated pathway of apoptosis? 2. State the role of P53 in apoptosis. 3. Describe about autophagy process.

4		ZCT-103 , Unit- 6	**Staining** **Topic:** Staining and dyes **Sub Topic:** Definition, types of stain, Fixatives, Classification of stain, Nomenclature, Mordants, Metachromasia	3	To understand about staining of cells ; significance of stain. Classify stain depends on their chemical properties
5	SEM 2	ZCT-208, Unit-1	**Amino acid** **Topic:** Amino acid properties **Sub Topic:** Basic properties of amino acids, Primary - secondary- tertiary and quartenary structure of protein.	4	To know about basic structure of protein and peptide bond; To understand different structural properties of protein. Briefly describe about Secondary structure of protein.
6	SEM 3	ZCT 312, Unit-5	**Pheromones** **Topic:** Pheromone **Sub Topic:** Discuss about classification of pheromone, discuss about properties and chemical nature of pheromones, structure and function of pheromones., Application in agriculture field and discuss significance	4	To understand practical application of pheromone in pest control; Pheromone used as biological control methods. 1. Briefly describe about properties and types of pheromone. 2. How pheromone used in agricultural field.
7		ZCT-312, Unit-2	**GI tract Hormone** **Topic:** GI tract hormone **Sub Topic:** Sources of GI tract hormones , Types of GI tract hormone, Mechanism and Function of GI tract hormones,	3	To Know how GI tract hormone helps in digestion in our Body. 1. Briefly describe about structure and function of secretin. 2. Briefly describe about structure and function of CCK.
8		ZCT-312, Unit-1	**Hormones** **Topic:** Hormone and human health Sub Topic: Stress, metabolic	6	To know about molecular basis of different hormonal disorder- which related to hypo or hyper secretion of hormone.

			and reproductive disorder, molecular basis		State the role of hormones in reproductive disorder.
9		ZET-327, Unit- 1	**Evolution of Gonad** **Topic:** Gonad Sub Topic: Phylogeny and ontogeny of testis and ovary	2	To know about gonad Discuss about ontogeny of testis/ovary
10		ZET-327, Unit- 2	**Sex determination** **Topic:** Sex determination **Sub Topic:** Sex differentiation from gene to gonad in fish and human, molecular basis	2	To understand molecular basis of sex determination. 1.State the role of gene in sex determination of human and fish. 2. State the role autosome in sex determination in human.
11		ZET-327, Unit- 4	**Male reproductive system** **Topic:** Male reproductive system **Sub Topic:** Histological structure, sertoli cell, leydig cell, Hypothalomo-pituitary-gonadal axis, role of hormone in spermatogenesis	2	To know about -how axis control male reproduction. 1. State the role of hormone in spermatogenesis. 2. Write the funtion of sertoli cell. 3. What is blood testis barrier?
12		ZET-327, Unit- 7	**Endocrine disruption** **Topic:** Endocrine disruption **Sub topic:** endocrine disruption of reproduction in fish, molecular basis, experiment	2	To know about molecular basis of different hormonal disorder- which related to hypo or hyper secretion of hormone. Discuss briefly about endocrine disruption of reproduction in fish.

13	SEM 4	ZCT-430, Unit-8	**Species** **Topic:** Species and Speciation **Sub Topic:** Genetic basis of species difference, sympatric - allopatric speciation, isolation mechanism, evolution of interaction among species, factors of speciation, biological species concept, Evolution of interaction among species	2	To understand about evolution of new species from old species. 1. Describe about different modes of speciation 2. Describe about biological species concept

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Department : Zoology

M.sc

- **Lesson Plan (2023-2025 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Question framing
1	SEM 1	ZCT-101, Unit- 9	**Communication** **Topic**: Language of Insect communication **Sub Topic:** Description on chemical mode of communication, mode of communications, types of communication, Definition and types of Bioluminiscence , examples of bioluminiscence	4	To understand about communication and insect language; To know about chemical basis of bioluminiscence; significance and types of bioluminiscence.
2		ZCT-103 , Unit- 5	**Cell Signalling** **Topic**: Cell signalling and cell-cell interaction **Sub topic:** Cell surface and intra cellular receptor, discussion about different types of receptor, Steroid and non steroidal hormone mechanism, Endocrine signalling, Different signalling pathways - cAMP, Ras-raf, JAK-STAT,IP3-DAG pathway, Crosstalk mechanism	6	To understand about signalling mechanism and different types ; Receptor types; to know how hormone act on cell ; Details knowledge of cross-linking of different hormonal pathways. 1. Describe about cAMP/Ras-Raf pathways 2. Write short notes on cytoplasmic receptor. 3. Discuss about steroid hormonal mechanism inside of cell.
3		ZCT-103 , Unit- 6	**Cell death Mechanism** **Topic:** Autophagy, Apoptosis, Anoikis **Sub Topic:** Definition and Types of Autopagy, Mechanism of autophagy, Discussion about apoptosis , features of apoptotic cell, Intrinsic and extrinsic pathway of apoptosis, Caspase dependent pathway, Role of P53 and P21, Description of Anoikis	8	To know about programme cell death pathways; understand about all cellular death mechanism; Difference between autophagy and apoptosis. 1. Briefly discuss about caspase mediated pathway of apoptosis? 2. State the role of P53 in apoptosis. 3. Describe about autophagy process.

4		ZCT-103 , Unit- 8	**Staining** **Topic:** Staining and dyes **Sub Topic:** Definition, types of stain, Fixatives, Classification of stain, Nomenclature, Mordants, Metachromasia	3	To understand about staining of cells ; significance of stain. Classify stain depends on their chemical properties
5	SEM 2	ZCT-208, Unit-1	**Amino acid** **Topic:** Amino acid properties **Sub Topic:** Basic properties of amino acids, Primary - secondary- tertiary and quartenary structure of protein.	4	To know about basic structure of protein and peptide bond; To understand different structural properties of protein. Briefly describe about Secondary structure of protein.
6	SEM 3	ZCT 312, Unit-5	**Pheromones** **Topic:** Pheromone **Sub Topic:** Discuss about classification of pheromone, discuss about properties and chemical nature of pheromones, structure and function of pheromones., Application in agriculture field and discuss significance	4	To understand practical application of pheromone in pest control; Pheromone used as biological control methods. 1. Briefly describe about properties and types of pheromone. 2. How pheromone used in agricultural field.
7		ZCT-312, Unit-2	**GI tract Hormone** **Topic:** GI tract hormone **Sub Topic:** Sources of GI tract hormones , Types of GI tract hormone, Mechanism and Function of GI tract hormones,	3	To Know how GI tract hormone helps in digestion in our Body. 1. Briefly describe about structure and function of secretin. 2. Briefly describe about structure and function of CCK.
8		ZCT-312, Unit-1	**Hormones** **Topic:** Hormone and human health Sub Topic: Stress, metabolic	6	To know about molecular basis of different hormonal disorder- which related to hypo or hyper secretion of hormone.

			and reproductive disorder, molecular basis		
					State the role of hormones in reproductive disorder.
9		ZET-327, Unit- 1	**Evolution of Gonad** **Topic:** Gonad Sub Topic: Phylogeny and ontogeny of testis and ovary	2	To know about gonad
					Discuss about ontogeny of testis/ovary
10		ZET-327, Unit- 2	**Sex determination** **Topic:** Sex determination **Sub Topic:** Sex differentiation from gene to gonad in fish and human, molecular basis	2	To understand molecular basis of sex determination.
					1.State the role of gene in sex determination of human and fish. 2. State the role autosome in sex determination in human.
11		ZET-327, Unit- 4	**Male reproductive system** **Topic:** Male reproductive system **Sub Topic:** Histological structure, sertoli cell, leydig cell, Hypothalomo-pituitary-gonadal axis, role of hormone in spermatogenesis	2	To know about -how axis control male reproduction.
					1. State the role of hormone in spermatogenesis. 2. Write the funtion of sertoli cell. 3. What is blood testis barrier?
12		ZET-327, Unit- 7	**Endocrine disruption** **Topic:** Endocrine disruption **Sub topic:** endocrine disruption of reproduction in fish, molecular basis, experiment	2	To know about molecular basis of different hormonal disorder- which related to hypo or hyper secretion of hormone.
					Discuss briefly about endocrine disruption of reproduction in fish.

13	SEM 4	ZCT-430, Unit-8	**Species** **Topic:** Species and Speciation **Sub Topic:** Genetic basis of species difference, sympatric - allopatric speciation, isolation mechanism, evolution of interaction among species, factors of speciation, biological species concept, Evolution of interaction among species	2	To understand about evolution of new species from old species. 1. Describe about different modes of speciation 2. Describe about biological species concept

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
1.	**PART I: SEMESTER I** **Paper code: ZOOG-CC1-TH (Animal Diversity)** **Unit 1: Kingdom Protista** **Topic: General characters and classification up to classes (Levine et. al., 1980); Locomotory Organelles and locomotion in *Amoeba* and *Paramecium*** **Objective :** To have an idea about the classification of Kingdom protista with special reference to their general characters only upto subclass (**Levine et. al., 1980)**, to understand how locomotion occurs in ***Amoeba* and *Paramecium* with special reference to their locomotory oraganelles.** Class 1 : General characters and classification up to classes (Levine et. al., 1980) Class 2: Locomotory Organelles and locomotion in *Amoeba* and *Paramecium*		**Susmita Majumder**
2.	Unit 6: Phylum Annelida **Topic : General characters and classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Metamerism in Annelida** **Objectives:** To have an idea about the classification of Phylum Annelida with special reference to their general characters only upto subclass (Rupert and Barnes, 1994, 6th Ed.), and also to understand the basic concepts of metamerism in Annelides nd also to understand the concept of metamerism in animals, it's evolutionary significance with special reference to Annelides Class: General characters and classification up to classes (Rupert and Barnes, 1994, 6th Ed.) Class: Metamerism in Annelida		
3.	Part I : Semester II **Paper code : ZOOG-CC2-TH (Comparative anatomy & Developmental Biology)** **Unit 3: Respiratory system** **Topic: Brief account of gills and lungs** **Objective:** To understand the structure and function of gills and lungs in different Class : Brief account of gills and lungs **Unit6: Early Embryonic Development**		

	Topic: Early development of frog; structure of mature egg and its membranes, patterns of cleavage, fate map, fate of germ layers. Objectives: To understand how embryonic development of frog occurs in their early stages, to study the structure and function of different types of eggs and their membranes, to understand the different patterns of cleavage, to have an idea about the structure and function of a fate map and it's significance, and to understand the fate of different germ layers. Class 1: Early development of frog Class 2: Structure of mature egg and its membranes and patterns of cleavage Class 3: Fate map and fate of germ layers. **Part II: Semester 3** **Paper code: ZOOG-CC3-TH (Physiology and Biochemistry)** **Unit 5: Excretion**		
4.	**Topic: Structure of nephron, Mechanism of Urine formation; Counter-current Mechanism** **Objective:** To understand the basic structure of a nephron, how urine is formed with special reference to Counter-current mechanism and it's significance Class 1: **Structure of nephron** Class 2: **Mechanism of Urine formation and Counter-current Mechanism**		
5.	**Unit 10: Enzyme** **Topic:** Enzyme Classification, factors affecting enzyme action, Inhibition. **Objective: To have an idea about the different types enzymes with special reference to enzyme classification, to know about the important factors that affect enzymes action and how different inhibitors participate in enzyme inhibition** Class 1: Enzyme Classification Class 2: Factors affecting enzyme action and inhibition. **Part II : SEMESTER 4** **Paper code : ZOOG-CC4-TH (Genetics and Evolutionary biology)** **Unit 1 : Mendelian Genetics and its Extension**		

6.	**Topic:** Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and codominance, Multiple alleles, lethal alleles, sex linked inheritance in *Drosophila* (White eye locus) & Human (Thalassemia). Class : To have an idea of different general identifying characteristics of mammals & their classification up to living sub classes (Young, 1981) with representative species of each subclasses **Objectives:** To understand the principal of inheritance, to have an idea about the chromosome theory of inheritance, to have an idea about incomplete dominance and codominance and their significance, to know about the detailed concept of Multiple alleles, lethal alleles, sex linked inheritance in *Drosophila* (White eye locus) & Human (Thalassemia) Class 1: Principles of Inheritance and Chromosome theory of inheritance Class 2: Incomplete dominance and codominance, Multiple alleles, lethal alleles Class 3: Sex linked inheritance in *Drosophila* (White eye locus) & Human (Thalassemia).		
7.	**Unit 5: Origin of Life** **Topic : Chemical Origin of life** **Objectives:** To know how the first life form on earth came to it's existence, with special reference to different theories and hypothesis on the chemical origin of life. Class: Chemical Origin of life		
8.	**Part III : SEMESTER 5** **Paper code : ZOOG-DSE-A-5-1-TH (Applied Zoology)** **Unit 8 : Animal Husbandry** **Topic: Induction of early puberty and synchronization of estrus in cattle** **Objectives:** To have an idea about estrus synchronization in cattles and how puberty can be induced early in those cattle animals Class: Induction of early puberty and synchronization of estrus in cattle		
	Part III : SEMESTER 6 **Paper code : ZOOG-DSE-B-6-2-TH (Applied Zoology)** **Unit 1 : Introduction to Ecology**		

9.	**Topic: Ecosystem, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere** **Objectives:** To understand the concept of ecosystem, autoecology, synecology, what are the different levels of organizations in an ecosystem, to have an idea about the different laws of limiting factors, to study the different physical factors, and to have an idea about the biosphere Class 1: Ecosystem, Autecology and synecology Class 2: , Laws of limiting factors, Study of Physical factors, The Biosphere		
10.	**PART II: SEMESTER 4** **Paper code : ZOOG-SECB-4-2-TH (Aquarium Fish Keeping)** **Unit 1: Introduction to Aquarium Fish Keeping** **Topic: The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes** **Objectives:** To understand the concept of aquarium fish keeping, what are the potential major scopes of aquarium fish industry as a cottage industry , what kind of endemic and exotic species of aquarium fishes are used in this regard, and what are their applications. Also to understand the different scopes to develop entrepreneurship on the indigenous fish and plant species having ornamental value, and also what are the different scopes for the development of industry on live food and artificial feed and aquarium accessories required for ornamental fish keeping Class 1: The potential scope of Aquarium Fish Industry as a Cottage Industry, Class 2: Exotic and Endemic species of Aquarium Fishes		

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER 1 **Paper code: ZCT 103 (Cell Biology)** **Unit 1: Membrane assembly**		**Susmita Majumder**
1.	**Topic: Introduction to Membrane assembly** **Objective:** To understand the interrelationships of plasma membrane of a cell during it's membrane assembly Class1: Introduction to membrane assembly & and it's know how		
2.	**Topic: Different routes for membrane expansion during membrane assembly** **Objective**: To understand how membrane lipid flow occurs via transport vesicles and non-vesicular transfer proteins at membrane contact sites. Class1: Vesicular and non-vesicular transport during membrane expansion. Class 2: Membrane expansion in the course of phagocytosis Class 3: The mechanism of PIP4P to synchronise lipid transport with vesicular trafficking		
3.	**Topic: Membrane tethering and lipid transport by SMP domain-containing proteins** **Objective**: To understand the concept of membrane tethering and lipid transport with special reference to SMP domain-containing proteins Class 1: A brief introduction to SMP domain membrane tethering containing proteins Class 2: Function of all known SMP domain-containing proteins.		
4.	**Topic: Application of imaging approaches to study organelle interactions and dynamics.** **Objective**: To understand the communication between compartments and membrane contact sites (MCSs) Class1: Introduction to MCSs and their types. Class 2: Imaging approaches of MCSs using GFPs Class3: Spectral imaging of interactions among organelles		
5.	**Topic: The history of contact sites** **Objectives:** To understand the intracellular communication at contact sites Class 1: Some landmark discoveries in the history of contact sites of the last 60 years		
6.	**Topic: Sterol transport** **Objective:** To understand the homeostatic processes that maintain the cholesterol level of each organelle within a narrow range. Class 1: Molecular mechanism of sterol transport within a cell.		

7.	**Topic: Regulation of MVB biogenesis by ER–endosome membrane contact sites** **Objective:** To understand the concept of multivesicular body (MVB) biogenesis and downstream regulation of EGF receptor (EGFR) tyrosine kinase signalling. Class 1: A brief introduction to multivesicular body (MVB) biogenesis and membrane expansion during maturation of the endocytic pathway.		
8.	**Topic: Autophagosome biogenesis and the source of the phagophore membrane** **Objective:** To understand the structure and function of phagophore membrane and autophagosome biogenesis Class 1: Overview of the lipid origin for the formation of the phagophore membrane and the process of autophagosome biogenesis.		
9.	**Topic: Inter-organellar dynamics drive peroxisomal biogenesis and function** **Objective:** To understand the dynamics of different inter-organelles and how that drive peroxisome biogenesis and their function. Class 1: The cellular mechanism of inter-organellar dynamics and how it drives peroxisomal biogenesis through inter-organellar contact sites and transport pathway.		
10. 11.	**Paper code : ZCT-104 (Genetics)** **Unit 1: Chromatin Dynamics** **Topic 1: Chromatin remodelling** Objective: To have brief idea about the different steps of chromatin remodelling, chromatin remodelling complexes (CRCs); their types and mechanism of action, significance of chromatin remodelling Class 1: Brief concept of the molecular structure of a chromatin, it's accessible & inaccessible sites, introduction to chromatin remodelling Class 2: Introduction to CRCs, their types and mechanism of action, importance of chromatin remodelling. **Topic 2: Replicative nucleosomal assembly** Objective: To understand the concept of nucleosomal assembly during replication. Class 1: Introduction of Replicative nucleosomal assembly		

	Class 2: The principle chromatin assembly reactions during DNA replication Class 3: A brief concept of chromatin assembly factor-1(CAF-1) in the assembly of nucleosomes during DNA replication		
12.	**Topic 3: Molecular nature and functional status of chromatin** **Objective :** To understand the concept of chromatin structure, their molecular nature & functional status. Class 1: Molecular nature of chromatin structure and their functional status		
13.	**Topic 3: Chromatin silencing** **Objective:** To understand the concept of the major new insights into the mechanism by which a chromatin gets silenced and eukaryotic organisms initiate heterochromatin formation Class 1: Introduction to chromatin silencing, their different routes Class 2: Chromatin silencing is amalgam of different other molecular processes.		
14.	**Topic 4: Position effect variegation** **Objective:** To understand the concept of heterochromatic spreading and the molecular process of position effect variegation (PEVs), effects of PEVs and it's significance Class 1: Introduction to position effect variegation (PEVs) and it's molecular mechanism Class 2: Concept of heterochromatic spreading and the significance of PEVs.		
15.	**Unit 3:** **Topic 1: Epigenetic regulation** **Objective :** To understand the molecular concept of -epigenetics, epigenetic modification and their different types; importance of methylation, acetylation, phosphorylation, ubiquitination, and sumoylation etc. Class 1: Introduction to molecular concept of epigenetic regulation. Class 2: Different types of epigenetic modification and their importance		
16.	**Topic 2: Dosage compensation in Mammals and *Drosophila***		

	Objective: To have a detailed idea about dosage compensation, concept of dosage compensation in mammals, the mechanism initiation of X inactivation, propagation and maintenance of the inactive state, X-chromosome reactivation and reprogramming; the molecular mechanism of dosage compensation in *Drosophila*, the mechanism of male specific lethal (MSL) complex and it's site-specific histone acetylation. Class 1: Introduction to Dosage compensation and it's molecular mechanism in Mammals with special reference to humans and cats. Class 2: The molecular mechanism of dosage compensation in *Drosophila* with special reference to male specific lethal (MSL) complex		
17.	**Topic 3: Genetic imprinting: Mechanism and Model** **Objective:** To understand the concept of Genetic imprinting, it's molecular mechanism and different models related to genetic imprinting, their types, important diseases related to failure of genetic imprinting. Class 1: Mechanism of genetic imprinting & their types Class 2: Different models of genetic imprinting & diseases related to it.		
18.	**Unit 4: Recombination & repair** **Topic 1: Recombination types and processes in eukaryotes** **Objectives:** To have a detailed idea about the molecular mechanism of Recombination, different types of recombination process in eukaryotes and their significances. Class 1: Different types of recombination Class 2: Different types of recombination in eukaryotes and their significance		
19.	**Topic 2: Enzymes involved in human meiotic recombination** **Objectives :** To understand the roles different enzymes involved in human meiotic recombination Class: Roles of different enzymes involved in human meiotic recombination		
20.	**Topic 3: DNA repair mechanisms**		

	Objectives: To have a detailed idea about the molecular mechanism of DNA repair and different types of inherited human diseases with defects in DNA repair Class: Different types of DNA repair mechanisms and different human diseases related to defects in DNA repair **Unit 6: Transposable Genetic Element** **Objectives:** To understand the concept of transposable elements, their working mechanism, Ac-Ds element in Maize, IS element in bacteria, P-element in *Drosophila*, composite transposon, retrotransposon, hybrid dysgenesis and role of piRNA in transposon silencing, to have an idea about the different important roles of transposable elements in evolution and genome modification.		
21.	**Topic 1:** Ac-Ds element in Maize, IS element in bacteria, P-element in *Drosophila*, composite transposon, retrotransposon, hybrid dysgenesis and role of piRNA in transposon silencing Class 1: Introduction to transposable genetic elements and their different types: Ac-Ds element in Maize, IS element in bacteria, P-element in *Drosophila*, composite transposon, retrotransposon Class 2: Molecular mechanism of Hybrid dysgenesis and role of piRNA in transposon silencing Class 3: Different important roles of transposable elements in evolution and genome modification **Unit 7: Genetics of Cell cycle**		
22.	**Topic 1: Introduction to different events of cell cycle** **Objective:** To understand the brief concept of cell cycle and the different events/ phases involved with it. Class 1: Introduction to cell cycle, brief description of different events that occur within a cell, such as in – G1, S, G2 & M phases.		
23.	**Topic 2: Cell cycle regulation and factors** **Objective:** To understand how cell cycle is regulated by various stimulatory and inhibitory factors		

24.	Class 1: Concept of cell cycle regulation. Different types of stimulatory and inhibitory factors and their role in cell cycle regulation. **Topic 3: Cell cycle checkpoints** **Objective:** To understand the role of different cell cycle checkpoints during cell cycle regulation Class 1: Concept of cell cycle check points and their role during cell cycle regulation **Unit 8: Somatic cell genetics** **Objectives**: To have an idea about the mechanism of somatic cell fusion, heterokaryon selection & hybridoma technology and also the molecular mechanism of Chromosome mapping and its types and application in different fields of Genetics.		
25.	**Topic1: Introduction to Cell fusion, Heterokaryon selection & hybridoma technology, Chromosome mapping** Class1: Introduction to somatic cell hybridoma technology with special reference to cell fusion and heterokaryon selection.		
26.	**Topic 2: Chromosome mapping, its types and application in different fields of Genetics.** Class 1: Introduction to chromosome mapping, different types of chromosome mapping and its application in different fields of Genetics.		

Class : M.Sc. Zoology Session : 2023-25 (2 Years system)

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER 1 **Paper code: ZCT 103 (Cell Biology)** **Unit 1: Membrane assembly**		**Susmita Majumder**
1.	**Topic: Introduction to Membrane assembly** **Objective:** To understand the interrelationships of plasma membrane of a cell during it's membrane assembly Class1: Introduction to membrane assembly & and it's know how		
2.	**Topic: Different routes for membrane expansion during membrane assembly** **Objective**: To understand how membrane lipid flow occurs via transport vesicles and non-vesicular transfer proteins at membrane contact sites. Class1: Vesicular and non-vesicular transport during membrane expansion. Class 2: Membrane expansion in the course of phagocytosis Class 3: The mechanism of PIP4P to synchronise lipid transport with vesicular trafficking		
3.	**Topic: Membrane tethering and lipid transport by SMP domain-containing proteins** **Objective**: To understand the concept of membrane tethering and lipid transport with special reference to SMP domain-containing proteins Class 1: A brief introduction to SMP domain membrane tethering containing proteins Class 2: Function of all known SMP domain-containing proteins.		

4.	**Topic: Application of imaging approaches to study organelle interactions and dynamics.** **Objective**: To understand the communication between compartments and membrane contact sites (MCSs) Class1: Introduction to MCSs and their types. Class 2: Imaging approaches of MCSs using GFPs Class3: Spectral imaging of interactions among organelles		
5.	**Topic: The history of contact sites** **Objectives:** To understand the intracellular communication at contact sites Class 1: Some landmark discoveries in the history of contact sites of the last 60 years		
6.	**Topic: Sterol transport** **Objective:** To understand the homeostatic processes that maintain the cholesterol level of each organelle within a narrow range. Class 1: Molecular mechanism of sterol transport within a cell.		
7.	**Topic: Regulation of MVB biogenesis by ER–endosome membrane contact sites** **Objective:** To understand the concept of multivesicular body (MVB) biogenesis and downstream regulation of EGF receptor (EGFR) tyrosine kinase signalling. Class 1: A brief introduction to multivesicular body (MVB) biogenesis and membrane expansion during maturation of the endocytic pathway.		
8.	**Topic: Autophagosome biogenesis and the source of the phagophore membrane** **Objective:** To understand the structure and function of phagophore membrane and autophagosome biogenesis		

	Class 1: Overview of the lipid origin for the formation of the phagophore membrane and the process of autophagosome biogenesis.		
9.	**Topic: Inter-organellar dynamics drive peroxisomal biogenesis and function** **Objective:** To understand the dynamics of different inter-organelles and how that drive peroxisome biogenesis and their function. Class 1: The cellular mechanism of inter-organellar dynamics and how it drives peroxisomal biogenesis through inter-organellar contact sites and transport pathway.		
10.	**Unit 7: Cell cycle** **Topic: Introduction to different events of cell cycle** **Objective:** To understand the brief concept of cell cycle and the different events/ phases involved with it. Class 1: Introduction to cell cycle, brief description of different events that occur within a cell, such as in – G1, S, G2 & M phases.		
11.	**Topic: Cell cycle regulation and factors** **Objective:** To understand how cell cycle is regulated by various stimulatory and inhibitory factors Class 1: Concept of cell cycle regulation. Different types of stimulatory and inhibitory factors and their role in cell cycle regulation.		
12.	**Topic: Cell cycle checkpoints** **Objective:** To understand the role of different cell cycle checkpoints during cell cycle regulation Class 1: Concept of cell cycle check points and their role during cell cycle regulation		
	Paper code : ZCT-104 (Genetics) **Unit 1: Chromatin Dynamics**		

13.	**Topic 1: Chromatin remodelling** Objective: To have brief idea about the different steps of chromatin remodelling, chromatin remodelling complexes (CRCs); their types and mechanism of action, significance of chromatin remodelling Class 1: Brief concept of the molecular structure of a chromatin, it's accessible & inaccessible sites, introduction to chromatin remodelling Class 2: Introduction to CRCs, their types and mechanism of action, importance of chromatin remodelling.		
14.	**Topic 2: Replicative nucleosomal assembly** Objective: To understand the concept of nucleosomal assembly during replication. Class 1: Introduction of Replicative nucleosomal assembly Class 2: The principle chromatin assembly reactions during DNA replication Class 3: A brief concept of chromatin assembly factor-1(CAF-1) in the assembly of nucleosomes during DNA replication		
15.	**Topic 3: Molecular nature and functional status of chromatin** **Objective :** To understand the concept of chromatin structure, their molecular nature & functional status. Class 1: Molecular nature of chromatin structure and their functional status		
16.	**Topic 3: Chromatin silencing** **Objective:** To understand the concept of the major new insights into the mechanism by which a chromatin gets silenced and eukaryotic organisms initiate heterochromatin formation Class 1: Introduction to chromatin silencing, their different routes Class 2: Chromatin silencing is amalgam of different other molecular processes.		
17.	**Topic 4: Position effect variegation** **Objective:** To understand the concept of heterochromatic spreading and the molecular process of position effect variegation (PEVs), effects of PEVs and it's significance Class 1: Introduction to position effect variegation (PEVs) and it's molecular mechanism		

	Class 2: Concept of heterochromatic spreading and the significance of PEVs. **Unit 3:**		
18.	**Topic 1: Epigenetic regulation** **Objective :** To understand the molecular concept of -epigenetics, epigenetic modification and their different types; importance of methylation, acetylation, phosphorylation, ubiquitination, and sumoylation etc. Class 1: Introduction to molecular concept of epigenetic regulation. Class 2: Different types of epigenetic modification and their importance		
19.	**Topic 2: Dosage compensation in Mammals and *Drosophila*** **Objective:** To have a detailed idea about dosage compensation, concept of dosage compensation in mammals, the mechanism initiation of X inactivation, propagation and maintenance of the inactive state, X-chromosome reactivation and reprogramming; the molecular mechanism of dosage compensation in *Drosophila*, the mechanism of male specific lethal (MSL) complex and it's site-specific histone acetylation. Class 1: Introduction to Dosage compensation and it's molecular mechanism in Mammals with special reference to humans and cats. Class 2: The molecular mechanism of dosage compensation in *Drosophila* with special reference to male specific lethal (MSL) complex		
20.	**Topic 3: Genetic imprinting: Mechanism and Model** **Objective:** To understand the concept of Genetic imprinting, it's molecular mechanism and different models related to genetic imprinting, their types, important diseases related to failure of genetic imprinting. Class 1: Mechanism of genetic imprinting & their types Class 2: Different models of genetic imprinting & diseases related to it. **Unit 4: Protein splicing, chaperones and protein folding.**		

	Objectives: To understand the molecular mechanism of protein splicing and protein folding with special reference to chaperons		
21.	**Topic : Protein splicing** Class : Molecular mechanism of protein splicing		
22.	**Topic 1: Chaperons and protein folding** Class : Concept of chaperons and mechanism of protein folding		
	Unit 5: Recombination & repair		
23.	**Topic 1: Recombination types and processes in eukaryotes** **Objectives:** To have a detailed idea about the molecular mechanism of Recombination, different types of recombination process in eukaryotes and their significances. Class 1: Different types of recombination Class 2: Different types of recombination in eukaryotes and their significance		
24.	**Topic 2: Enzymes involved in human meiotic recombination** **Objectives :** To understand the roles different enzymes involved in human meiotic recombination Class: Roles of different enzymes involved in human meiotic recombination		
25.	**Topic 3: DNA repair mechanisms** **Objectives:** To have a detailed idea about the molecular mechanism of DNA repair and different types of inherited human diseases with defects in DNA repair Class: Different types of DNA repair mechanisms and different human diseases related to defects in DNA repair		
	Unit 6: Transposable Genetic Element **Objectives:** To understand the concept of transposable elements, their working mechanism, Ac-Ds element in Maize, IS element in bacteria, P-element in *Drosophila*, composite transposon, retrotransposon, hybrid dysgenesis and role of piRNA in transposon		

	silencing, to have an idea about the different important roles of transposable elements in evolution and genome modification.		
26.	**Topic : Ac-Ds element in Maize, IS element in bacteria, P-element in *Drosophila*, composite transposon, retrotransposon, hybrid dysgenesis and role of piRNA in transposon silencing** Class 1: Introduction to transposable genetic elements and their different types: Ac-Ds element in Maize, IS element in bacteria, P-element in *Drosophila*, composite transposon, retrotransposon Class 2: Molecular mechanism of Hybrid dysgenesis and role of piRNA in transposon silencing Class 3: Different important roles of transposable elements in evolution and genome modification		
27.	**Unit 7: Genetics of Cell cycle** **Topic 1: Introduction to different events of cell cycle** **Objective:** To understand the brief concept of cell cycle and the different events/ phases involved with it. Class : Introduction to cell cycle, brief description of different events that occur within a cell, such as in – G1, S, G2 & M phases.		
28.	**Topic 2: Cell cycle regulation and factors** **Objective:** To understand how cell cycle is regulated by various stimulatory and inhibitory factors Class : Concept of cell cycle regulation. Different types of stimulatory and inhibitory factors and their role in cell cycle regulation.		
29.	**Topic 3: Cell cycle checkpoints** **Objective:** To understand the role of different cell cycle checkpoints during cell cycle regulation Class : Concept of cell cycle check points and their role during cell cycle regulation		
	Unit 8: Somatic cell genetics		

	Objectives: To have an idea about the mechanism of somatic cell fusion, heterokaryon selection & hybridoma technology and also the molecular mechanism of Chromosome mapping and its types and application in different fields of Genetics.		
30.	**Topic1: Introduction to Cell fusion, Heterokaryon selection & hybridoma technology, Chromosome mapping** Class: Introduction to somatic cell hybridoma technology with special reference to cell fusion and heterokaryon selection.		
31.	**Topic 2: Chromosome mapping, its types and application in different fields of Genetics.** Class : Introduction to chromosome mapping, different types of chromosome mapping and its application in different fields of Genetics.		

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER II **Paper code: ZCT 209 (Developmental Biology)** **Unit 1: Principles of Developmental Biology**		**Susmita Majumder**
1.	**Topic: Potency, commitment, specification, induction, competence.** **Objective :** To understand the concept of Potency, commitment, specification, induction, competence and their molecular mechanism during development		
2.	**Topic 2: Determination and Differentiation; morphogenetic gradient, cell fate and cell lineages.** **Objective:** To have an idea about Determination and Differentiation; morphogenetic gradient, cell fate and cell lineages and their molecular mechanism during development		
3.	**Topic 3 : Cell to cell communication during early development.** **Objective:** To understand the molecular mechanism of cell to cell communication during early development		
4.			
5.			
6.			

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER II **Paper code: ZCT 209 (Developmental Biology)** **Unit 1: Principles of Developmental Biology**		**Susmita Majumder**
1.	**Topic: Potency, commitment, specification, induction, competence.** **Objective :** To understand the concept of Potency, commitment, specification, induction, competence and their molecular mechanism during development		
2.	**Topic 2: Determination and Differentiation; morphogenetic gradient, cell fate and cell lineages.** **Objective:** To have an idea about Determination and Differentiation; morphogenetic gradient, cell fate and cell lineages and their molecular mechanism during development		
3.	**Topic 3 : Cell to cell communication during early development.** **Objective:** To understand the molecular mechanism of cell to cell communication during early development		
4.			
5.			
6.			

PG SEM 3 Session : 2018-20 Lesson Plan

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER III **Paper code: ZCT 315 (Taxonomy and Biostatistics)** **Unit 5: Descriptive Statistics** **Objectives:** The main objective is help students to learn several techniques for organizing and summarizing data so that they may more easily determine what information they contain, also to help in calculation of single number that in some way conveys important information about the data from which it was calculated through descriptive measures.		**Susmita Majumder**
1.	**Topic: Statistics and Biological data – basics inclusive of the distributions** **Objective:** To have a brief idea about biostatistics, to understand the concept about biological data, different types of distribution in biostatistics and their applications Class: Introduction to biostatistics, biological data and different types of distribution in it.		
2.	**Topic 2: Measures of central tendency** **Objectives:** To have an idea of how measures of central tendency convey information regarding the average value of a set of values, as we as how the word average can be defined indifferent ways. Class : Introduction to measures of central tendency and it's types - mean, the median, and the mode.		
3.	**Topic: Visual representation of data - leaf and stem diagram, box-plot analysis** **Objective**: To have an idea of how to graphically represent quantitative data sets & use of the quartiles of a data set through stem and leaf display and through box plot analysis respectively Class1: Construction of stem and leaf displays		

	Class 2: Construction of box-plot analysis.		
4.	**Topic: Basics of probability** **Objective**: To provide a context for understanding the elementary properties of probability distributions used in statistical inference, introduces the student to several measures commonly found in the medical literature (e.g., the sensitivity and specificity of a test) and to calculate the probability of an event Class 1: Central concept of Axioms of Probability & it's types Class 2: Probability distributions of discrete variables Class 3: Different types of probability distributions : binomial, Poisson, continuous, normal etc. and their application.		
	Unit 6: Sampling and Analysis		
5.	**Topic: Sampling theory: Statistical inference and hypothesis testing** **Objectives:** Introduction to sampling theory, sampling distribution, a brief idea about hypothesis testing of a single, two or more population mean and the ratio of two population variances Class 1: Sampling theory and statistical inference Class 2: Hypothesis testing		
6.	**Topic: t-tests and applications in biology** **Objective:** To understand the concept t-test, different types : paired, unpaired, and their applications. Class 1: Introduction to t-test, it's types: paired, unpaired and it's applications.		
7.	**Topic: Analysis of variance and experimental designs Non Parametric Tests** **Objective:** To understand how the total variation present in a set of data is partitioned into two or more components through analysis of		

	variance (ANOVA), how to construct experimental designs and concept of non-parametric tests Class 1: Introduction to ANOVA and different types of Experimental designs Class 2: Concept of Non-parametric tests and it's types and applications		
8.	**Topic: Correlations and regression analysis** **Objective:** To be able to find an objective measure of the strength of the relationship between two variables though correlation and to find an objective way to predict or estimate the value of one variable given a value of another variable through regression.		
9.	Class 1: Introduction to correlation model and concept and application of correlation equation Class 2: Introduction to regression model and concept and application of correlation co-efficient		
	Class 1: The cellular mechanism of inter-organellar dynamics and how it drives peroxisomal biogenesis through inter-organellar contact sites and transport pathway.		

PG SEM III Session : 2020-22 Lesson Plan

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER III **Paper code: ZCT 311 (Conservation Biology)** **Unit 4: Conservation at Genetic levels – Problems of Inbreeding and Genetic drift in small populations;** **Measuring Genetic Diversity of populations, Managing Genetic Diversity for conservation.** **Objectives:** The main objective is to help students to understand how conservation occurs at different genetic levels, what are the different problems of inbreeding and genetic drift in small populations. Also how genetic diversity of populations can be measured, and what are the different management techniques of genetic diversity for conservation		**Susmita Majumder**
1.	**Topic 1: Conservation at Genetic levels – Problems of Inbreeding and Genetic drift in small populations** Class 1: Mechanism of conservation at different genetic levels Class 2: Problems of Inbreeding and Genetic drift in small populations		
2.	**Topic 2: Measuring Genetic Diversity of populations, Managing Genetic Diversity for conservation** Class 1: Different ways of measuring Genetic Diversity of populations with examples Class 2: Different management techniques applied in Genetic Diversity for conservation		

PG SEM 4 Session : 2020-22 Lesson Plan

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
	PART I: SEMESTER IV **Paper code: ZCT 429 (Taxonomy and Biostatistics)** **Unit 5: Descriptive Statistics** **Objectives:** The main objective is help students to learn several techniques for organizing and summarizing data so that they may more easily determine what information they contain, also to help in calculation of single number that in some way conveys important information about the data from which it was calculated through descriptive measures.		**Susmita Majumder**
1.	**Topic: Statistics and Biological data – basics inclusive of the distributions** **Objective:** To have a brief idea about biostatistics, to understand the concept about biological data, different types of distribution in biostatistics and their applications Class: Introduction to biostatistics, biological data and different types of distribution in it.		
2.	**Topic 2: Measures of central tendency** **Objectives:** To have an idea of how measures of central tendency convey information regarding the average value of a set of values, as we as how the word average can be defined indifferent ways. Class : Introduction to measures of central tendency and it's types - mean, the median, and the mode.		
3.	**Topic: Visual representation of data - leaf and stem diagram, box-plot analysis** **Objective**: To have an idea of how to graphically represent quantitative data sets & use of the quartiles of a data set through stem and leaf display and through box plot analysis respectively Class1: Construction of stem and leaf displays		

	Class 2: Construction of box-plot analysis.		
4.	**Topic: Basics of probability** **Objective**: To provide a context for understanding the elementary properties of probability distributions used in statistical inference, introduces the student to several measures commonly found in the medical literature (e.g., the sensitivity and specificity of a test) and to calculate the probability of an event Class 1: Central concept of Axioms of Probability & it's types Class 2: Probability distributions of discrete variables Class 3: Different types of probability distributions : binomial, Poisson, continuous, normal etc. and their application.		
	Unit 6: Sampling and Analysis		
5.	**Topic: Sampling theory: Statistical inference and hypothesis testing** **Objectives:** Introduction to sampling theory, sampling distribution, a brief idea about hypothesis testing of a single, two or more population mean and the ratio of two population variances Class 1: Sampling theory and statistical inference Class 2: Hypothesis testing		
6.	**Topic: t-tests and applications in biology** **Objective:** To understand the concept t-test, different types : paired, unpaired, and their applications. Class 1: Introduction to t-test, it's types: paired, unpaired and it's applications.		
7.	**Topic: Analysis of variance and experimental designs Non Parametric Tests** **Objective:** To understand how the total variation present in a set of data is partitioned into two or more components through analysis of		

8.	variance (ANOVA), how to construct experimental designs and concept of non-parametric tests Class 1: Introduction to ANOVA and different types of Experimental designs Class 2: Concept of Non-parametric tests and it's types and applications **Topic: Correlations and regression analysis** **Objective:** To be able to find an objective measure of the strength of the relationship between two variables though correlation and to find an objective way to predict or estimate the value of one variable given a value of another variable through regression. Class 1: Introduction to correlation model and concept and application of correlation equation Class 2: Introduction to regression model and concept and application of correlation co-efficient Class 1: The cellular mechanism of inter-organellar dynamics and how it drives peroxisomal biogenesis through inter-organellar contact sites and transport pathway.		
	PART II: SEMESTER IV **Paper code: ZCT 430 (Animal Behaviour and Evolutionary Biology)** **Unit 5: Mechanisms producing genetic diversity (mutation, migration and genetic drift), Phenotypic variation and plasticity, Molecular evolution, Speciation** **Objectives:** The main objective is to help students to understand the different type of mechanisms that effect genetic diversity with special reference to mutation, migration and		

9. 10.	genetic drift and also to have an idea of phenotypic variation, plasticity, molecular evolution and speciation. **Topic: Mechanisms producing genetic diversity (mutation, migration and genetic drift)** Class 1: Mechanisms producing genetic diversity through mutation with examples Class 2: Mechanisms producing genetic diversity through migration with examples Class 3: Mechanisms producing genetic diversity through genetic drift with examples **Topic 2: Introduction to phenotypic variation and plasticity with examples** Class: Concept of phenotypic variation and phenotypic plasticity with examples Class: Speciation, different and examples		

Serial no.	Name of topic with details of sub-topics	No. of classes	Name of teachers
1.	**PART I: SEMESTER I** **Paper code: ZOOA-CC1-2-TH (Molecular Biology)** **Unit 4: Translation** **Topic: Genetic code, Degeneracy of the genetic code and Wobble Hypothesis. Mechanism of protein synthesis in prokaryotes** **Objective :** To understand the key concepts of degeneracy of the genetic code, central dogma & Wobble hypothesis. Also the molecular mechanism of protein synthesis in Prokaryotes. Class 1 : Introduction to Genetic code, it's degeneracy and Wobble hypothesis Class 2: Mechanism of protein synthesis in Prokaryotes.		**Susmita Majumder**
2.	Part I : Semester II **Paper code : ZOOA-CC2-3-TH (Non-Chordates II – Coelomates)** **Unit 2: Annelida** **Topic: Metamerism in Annelida** **Objective:** To understand the concept of metamerism in animals, it's evolutionary significance with special reference to Annelides Class : Metamerism in Annelida		
3.	**Paper code: ZOOA-CC2-4-TH (Cell Biology)** **Unit 6: Cell cycle** **Topic: Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras. Process of Proto-oncogene activation** **Objective:** To understand the molecular mechanism of cell cycle, it's regulation, Definition and types of cancer with special reference to oncogene & tumor suppressor genes, p53, retinoblastoma and Ras, and the molecular mechanism of proto-oncogene activation Class 1: Cell cycle and its regulation Class 2: Types of cancer with special reference to oncogene & tumor suppressor genes Class 3: Role of p53, Retinoblastoma & Ras in cell		

	cycle Class 4: Molecular mechanism of proto-oncogene activation		
4.	**Part II : SEMESTER 3** **Paper code : ZOOA-CC3-5 (Chordata)** **Unit 8 : Mammals** **Topic: General characters and classification up to living sub classes (Young, 1981)** Class : To have an idea of different general identifying characteristics of mammals & their classification up to living sub classes (Young, 1981) with representative species of each subclasses		
5.	**PART II: SEMESTER 3** **Paper code : ZOOA-CC3-6-TH (Animal Physiology: Controlling and Co-ordinating Systems)** **Unit 1: Tissues** **Topic: Structure, location, classification and functions of epithelial tissue, connective tissue** **Objectives:** To understand the structure, location, classification and functions of epithelial tissue, connective tissue		
6.	**PART II: SEMESTER 3** **Paper code : ZOOA-CC3-7-TH (Fundamentals of Biochemistry)** **Unit 5: Oxidative Phosphorylation** **Topic: Redox systems; Mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System** **Objectives**: To understand the concept of redox systems, molecular mechanism of mitochondrial respiratory chain, different types of inhibitors and un-couplers of Electron Transport System Class 1: Mitochondrial respiratory chain & redox systems Class 2: Inhibitors and un-couplers of Electron transport system		
7.	**PART II: SEMESTER 4** **Paper Code: ZOOA-CC4-8-TH (CORE COURSE Comparative Anatomy of Vertebrates)** **Unit 3: Respiratory System** **Topic : Accessory respiratory organs (ARO) in fishes, Air sacs in birds** **Objectives:** To understand the structure and function of different types of ARO in fishes and Air sacs in birds respectively		

	Class : ARO in fishes and Air sacs in birds **PART II: SEMESTER 4** **Paper Code : ZOOA-CC4-9-TH (Animal Physiology: Life Sustaining Systems)**		
8.	**Topic : Haematopoiesis; Basic steps and it's regulation** **Objectives:** To understand the process of haematopoiesis; it's basic steps and it's regulation Class : The process of haematopoiesis, basic steps and it's regulation		
	PART II: SEMESTER 4 **Paper Code : ZOOA-CC4-10-TH (Immunology)**		
9.	**Unit 6: Cytokines** **Topic : Types, properties and functions of cytokines.** **Objectives:** To understand the concept of cytokines, it's different types, basic properties and functions. Class : Properties, types and functions of cytokines		
	PART II: SEMESTER 4 **Paper code: ZOOA-SEC(B)-4-1-TH (Aquarium Fish Keeping)**		
10.	**Unit 1: Introduction to Aquarium Fish Keeping** **Topic: The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes** **Objectives:** To understand the concept of aquarium fish keeping, what are the potential major scopes of aquarium fish industry as a cottage industry , what kind of endemic and exotic species of aquarium fishes are used in this regard, and what are their applications. Also to understand the different scopes to develop entrepreneurship on the indigenous fish and plant species having ornamental value, and also what are the different scopes for the development of industry on live food and artificial feed and aquarium accessories required for ornamental fish keeping Class: The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes		
	PART III: SEMESTER 5 **Paper Code : ZOOA-CC5-12-TH (Principle of Genetics)**		
11.	**Unit 3: Mutations** **Topic: Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with onesuitable example from *Drosophila* and Human of**		

	each), variation in chromosome number; Non-disjunction of X chromosome in *Drosophila*; Non-disjunction of Human Chromosome 21.Molecular basis of mutations in relation to UV light and chemical mutagens. Mutation detection in*Drosophila* by attached X method. Biochemical mutation detection in *Neurospora*. **Objectives:** To understand concept of gene mutations and it's types, to be to have an idea about chromosomal aberrations (Classification with one suitable example from *Drosophila* and Human of each), to understand how variation in chromosome number occurs, how non-disjunction of X chromosome in *Drosophila* and in human chromosome 21 occurs. To be able to understand the molecular basis of mutations in relation to UV light and chemical mutagens and the mutation detection mechanism in *Drosophila* by attached X method. Biochemical mutation detection in Neurospora. Class 1: Types of gene mutations (Classification) Class 2: Types of chromosomal aberrations (Classification with one suitable example from *Drosophila* and Human of each) Class 3: Variation in chromosome number; Non-disjunction of X chromosome in *Drosophila*; Non-disjunction of Human Chromosome 21 Class 4: Molecular basis of mutations in relation to UV light and chemical mutagens. Class 5: Mutation detection in *Drosophila* by attached X method. Biochemical mutation detection in *Neurospora*.		
12.	**Unit 5: Extra Chromosomal Inheritance** **Topic: Kappa particle in *Paramoecium*, shell spiralling in snail** **Objectives: T**o understand the basic concept of extra chromosomal inheritance, to have an idea of how Kappa particle in Paramoecium& shell spiralling in snail occurs with special reference to their extra chromosomal inheritance		
13.	**Unit 6: Genetic fine structure** **Topic: Complementation test in Bacteriophage (Benzer's experiment on rII locus)** **Objectives:** To have an idea about the concept of complementation test in Bacteriophage with special reference to Benzer's experiment on rII locus		
14.	**Unit 7: Transposable genetic elements** **Topic: IS element in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, LINE, SINE, Alu lements in humans** **Objectives:** To understand the concept of Transposable genetic elements, structure and function of IS element in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, LINE, SINE, Alu elements in humans		

	Class 1: Structure and function of the following Transposable genetic elements: IS element in bacteria, Ac-Ds elements in maize Class 2: Structure and function of the following Transposable genetic elements: P elements in Drosophila, LINE, SINE, Alu elements in humans **PART III: SEMESTER 6** **CORE COURSE 14.Evolutionary Biology** **ZOOA-CC6-14-TH** **Unit 1 Origin of Life**		
15.	**Topic : Origin of life (Chemical basis), RNA world hypothesis** **Objectives**: To understand the chemical basis of origin of life and concept of the RNA world hypothesis Class 1: Chemical basis of origin life, hypothesis of Oparin & Haldane Class 2: Urey and Miller's experiment in origin of life and RNA world hypothesis **PART III: SEMESTER 6** **Paper Code : ZOOA-DSE(A)-6-2-TH (Animal Biotechnology)**		
16.	**Unit 1: Introduction to E. *coli* and *Drosophila* genome** **Topic : Organization of E. *coli* and *Drosophila* genome.** **Objectives**: To understand the concept of genome and it's organization in E. *coli* and *Drosophila* and their significance Class : Organization of E. *coli* and *Drosophila* genome.		
17.	**Unit 2: Molecular Techniques in Gene manipulation** **Topic : Construction of Genomic libraries and cDNA libraries** **Objectives:** To understand the concept of genomic library and cDNA library , different steps in their construction mechanism and their application, advantages and disadvantages		
18.	**Unit 3: Genetically Modified Organisms** **Topic : Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection.Applications of transgenic animals: Production of pharmaceuticals, production of donor organs,knock-out mice.** **Objectives**: To provide the students with up-to-date knowledge intransgenesis and related technologies. To provide an overview of how production of cloned and transgenic animal occurs, to provide an idea about Nuclear Transplantation, Retroviral Method and DNA Microinjectio. To understand the Applications of transgenic		

	animals: Production of pharmaceuticals, production of donor organs, knock-out mice. Class 1: Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method Class 2: DNAmicroinjection. Applications of transgenic animals: Production of pharmaceuticals CLASS 3: Production of donor organs, knock-out mice, and it's construction & applications		

Topic Serial	Name of topic with details of sub-topics	No. of classes	Name of teachers
1.	**SEMESTER 1 ZCT 101 TH** INVERTEBRATE FUNCTIONAL FORMS AND ADAPTATION **Topic 8: Regeneration in Cnidaria and Annelida** **Objective**: Regeneration capacity stands for the ability of the adult organisms to restore lost parts of the body by de novo growth due to cell proliferation and/or reorganization of somatic tissues. Regeneration study throws light on normal embryological development and differentiation and hence is an important model to study normal differentiation in animals Class1,2: Regeneration in Cnidaria and Annelida. Somatic, physiological, endocrinological and genetic aspects	**2**	**Dr. Mausumi Bhattacharyya**
2.	**SEMESTER 1 ZCT 103 TH** Cell Biology **Topic 1: Plasma membrane-structure and functional inter -relationship, including membrane assembly** **Objective**: The plasma membrane is a selectively permeable membrane which plays an important role in facilitating communication and signalling between cells. Plasma membrane plays a vital role in anchoring the cytoskeleton to provide shape to the cell and also maintain the cell potential. So, study of structure and function of cell membrane is important to understand the physiological functioning of human body Class3,4: Ultrastructure and composition of Plasma Membrane: Lipid Bilayer(Phospholipid and Cholesterol),Peripheral and Integral Proteins, Glycolipids and Glycoproteins , Glycocalyx Class 5: Fluid Mosaic Model and Lipid Rafts, Mobility of membrane lipids (FRAP assay) and Mobility of membrane proteins (Fry-Eddin Experiment) Class 6: Lipid Anchored Proteins: Acyl Anchors and	**09**	

	Prenyl Anchors, GPI Anchors. Class 7: Transmembrane Protein Examples: Structures and mode of functioning of Glycophorin A, Bacteriorhodopsin. Peripheral Protein Examples: Spectrin, Detergent and micelles, Liposomes Class 8, 9: Membrane properties and functions, Factors on which membrane fluidity depends on		

Topic Serial	Name of topic with details of sub-topics	No. of classes	Name of teachers
1.	**SEMESTER 1 ZCT 101 TH** Non-Chordate Biology **Topic 10: Regeneration in Cnidaria and Annelida** **Objective**: Regeneration capacity stands for the ability of the adult organisms to restore lost parts of the body by de novo growth due to cell proliferation and/or reorganization of somatic tissues. Regeneration study throws light on normal embryological development and differentiation and hence is an important model to study normal differentiation in animals Class1,2: Regeneration in Cnidaria and Annelida. Somatic, physiological, endocrinological and genetic aspects	**02**	**Dr. Mausumi Bhattacharyya**
2.	**SEMESTER 1 ZCT 103 TH** Cell Biology **Topic 1: Plasma membrane-structure and functional relationship, including membrane assembly** **Objective**: The plasma membrane is a selectively permeable membrane which plays an important role in facilitating communication and signalling between cells. Plasma membrane plays a vital role in anchoring the cytoskeleton to provide shape to the cell and also maintain the cell potential. So, study of structure and function of cell membrane is important to understand the physiological functioning of human body Class3,4: Ultrastructure and composition of Plasma Membrane: Lipid Bilayer (Phospholipid and Cholesterol), Peripheral and Integral Proteins, Glycolipids and Glycoproteins , Glycocalyx Class 5: Fluid Mosaic Model and Lipid Rafts, Mobility of membrane lipids (FRAP assay)and Mobility of membrane proteins (Fry-Eddin	**09**	

	Experiment) Class 6: Lipid Anchored Proteins: Acyl Anchors and Prenyl Anchors, GPI Anchors. Class 7: Transmembrane Protein Examples: Structures and mode of functioning of Glycophorin A , Bacteriorhodopsin. Peripheral Protein Examples:Spectrin, Detergent and micelles, Liposomes Class 8,9 ,: Membrane properties and functions, Factors on which membrane fluidity depends on		
3 **4** **5**	**SEMESTER 2 ZCT 208 TH** Structure and Function of Chordates **Topic 1: Protochordata** **1.1 Fine structure of notochord in Amphioxus** **Objective**: Structure and function of notochord Amphioxus gives us an insight on phylogeny and development of Vertebrate vertebral column and also throws light on Chordate Evolution Class 1: Fine structure of Notochord in Amphioxus and its evolutionary significance **Topic 2: Integumentary System** **Objective:** Integumentary organs and structures serve as first line of defence. They help in protection, sensation, regulation, absorption, excretion, Vitamin D synthesis and aesthetic and social functions. Hence the study of integumentary system throws light on anatomical and physiological functioning of the body. Class 2,3,4: Integumentary cell association, Integumentary glands of Mammals, Integumentary glands of Non-Mammalian Vertebrates **Topic 3: Skeletal System**	**15**	

	Objective: Advent of jaw is a very significant step in Vertebrate evolution. With evolution of jaws herbivory and carnivory became exploitable options. Sound conduction in terrestrial Vertebrates evolved along with jaw evolution as origin of all three middle ear ossicles, both originated from Visceral arches. So, jaw evolution and modification are important in terms of study of Vertebrate anatomy as well as Vertebrate evolution. Class 5,6: Evolution of Visceral Arch, Functional and evolutionary significance of Visceral Arch, Phylogeny of Jaw Suspension, Role of Dlx gene in jaw suspension, Class 7: Cranial Kinesis		
6	**Topic 4: Circulatory System** **4.1: Heart and circulation in foetal and neonatal mammal** **4.2: Evolution of portal system** **Objective:** The fetus gets life support from the mother through the placenta. This topic is important to understand how circulation pattern changes with birth and non-functional lungs of fetus becomes the primary respiratory organ in neo-natal condition Class 8,9: Fetal circulation, shunts in fetal circulation, changes in circulation in neonatal condition Class 10: Oxygen-haemoglobin dissociation curve and its difference in fetal and post-natal condition, uniqueness of the structure and function of haemoglobin in foetus Class 11: Evolution of portal system		
7	**Topic 5: Nervous System and Sense organ** **5.1: Sensory receptors and classification** **5.2: Organ of olfaction and taste** **Objective:** A major role of sensory receptors is to help us learn about the environment around us, or abut the state of		

	our internal environment, Sensory system function allows organisms to perceive, respond to, interact with their environments. Gustatory receptors and olfactory receptors are chemoreceptors of vital important for sensing taste and smell**.** Hence the study of sensory receptors throws light on physiological response of the body to stimulus Class 12: Classification of receptors Class 13: Fine structure of neuromasts. Rheoreceptor, Location of Neuromast Organs: Lateral Line Sense Organ, Vestibular Apparatus, Auditory System Class 14: Organ of Olfaction Class 15: Organ of taste **SEMESTER 2 ZCT 213 TH** Aquatic Biology **Topic 3: Respiration and energy yield as survival strategies in fauna inhabiting extremities of aquatic environments** **Objective:** Respiration is one of the most important physiological activities of living animals. Water is not an ideal respiratory medium and piscine gill is considered to be an engineer's marvel. Students get an insight how fish respire and take oxygen from a medium which is not a suitable oxygen reserve. So, adaptation and subsequent evolutionary significance is studied. Class 1: Comparison of Air and Water as a respiratory medium, Structure of a piscine gill Class 2: Ventilatory mechanism in Chondrichthyes and Osteichthyes Class 3: Fick's law of diffusion and aquatic respiration Class 4: Counter current mechanism of respiration in fish		
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9	**SEMESTER 3 ZCT 316(CORE) TH** Animal Behaviour and Wildlife Biology **Topic 6: Protected Area Concept** **Objective:** Protected areas, when governed and managed appropriately and embedded in development strategies, can provide nature-based solutions to ecosystems and natural resources, and take their place as an integral component of sustainable development**.** Class 1: Protected area network in India Class 2: SLOSS Debate and concept of Island Biogeography, Planning of Reserve Design Class 3: Rescue effect, Isolation, Managing Habitat Connectivity (structural and functional) , corridor concept Class 4: Joint Forest Management	**04**	
10	**SEMESTER 3 ZET 322(ELECTIVE) TH** Topic 1.Biodiversity Monitoring 1c. Threats to Species Divesity Objective: Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated habitat fragments. Habitat fragmentation contribute to population decline, biodiversity loss, and alteration of community structure and ecosystem functioning in anthropogenically modified landscapes. So, in today's scenario when conservation is the call of the day mitigation of the impacts of habitat fragmentation and related issues are of extreme importance to save our environment Class 1: Biodiversity and its components Class 2: Habitat fragmentation and its impact: Population Bottleneck, Genetic Drift, Inbreeding Depression, Loss of	**11**	

	Genetic Diversity, Unequal sex ratio Class 3: Metapopulation Class 4: Extinction, Concept of Island Biogeography, Species-Area Curve, Extinction Vortex Class 5: Endemism and biodiversity		
11	Topic 2. Biodiversity and Ecosystem Function 2a: Theories on relation between Biodiversity and Ecosystem Function Objective: Ecosystem function is the biological, geochemical and physical processes that take place within an ecosystem. It is a subset of the interactions between biophysical structures, biodiversity or ecosystem processes and is based on the type of ecosystem. Ecosystem function controls fluxes of energy, nutrients and organic matter through the environment, including primary production and nutrient recycling, decomposition and recycling of organic waste. Ecosystem functioning reflects the collective life activities of plants animals and microbes and their effects on the physical and chemical conditions of the environment. So, to understand the significance of biodiversity it is necessary to study Ecosystem functioning and its relation with biodiversity. Class 6: Ecosystem Functioning and Ecosystem Services Class 7: Different attributes of Ecosystem Functioning: Species Complementarity, Sampling Effect, Redundancy. 2d : Insurance Hypothesis Class 8: Concept of Insurance Hypothesis, the effect of habitat fragmentation and dispersal on ecosystem functioning		
12	Topic 3. Landscape Ecology Topic 3c. Processes in the landscape **Objective:** Landscape ecology emphasizes the interaction between spatial pattern and ecological process, that is, the causes and consequences of spatial heterogeneity across a range of scales. Landscape ecology combine the spatial		

	approach of the geographer with the functional approach of the ecologist. So, concept of Landscape Ecology is very essential to assimilate the wholesome concept of Biodiversity and Ecosystem Functioning Class 9: Landscape dynamics and disturbances Class 10: Habitat fragmentation and landscape ecology Class 11: Connectedness, connectivity and corridor concept from landscape perspective **SEMESTER 4 ZCT 434 TH**		
13	Topic 4. Physiology of Excretion **Objective:** Renal function is one of the most important physiological activities of living animals. The kidney regulates plasma osmolarity by modulating the amount of water, solutes and electrolytes in blood. Renal function is essential for homeostasis. Class 1: Structure of kidney, types of nephrons, Renal Blood Flow Class 2,3,4: Mechanism of Urine Formation (Analysing structure and function of the nephron and their role in urine formation), Physiology of ultrafiltration, reabsorption, tubular secretion Class 5: Juxtaglomerular Apparatus: Structure and function Class 6: Counter current mechanism of urine formation Class 7: Regulation of urine formation	**07**	

Topic Serial	Name of topic with details of sub-topics	No. of classes	Name of teachers
1.	**SEMESTER 1 ZCT 101 TH** Invertebrate Function Form and Adaptation **Topic 10: Regeneration in Cnidaria and Annelida** **Objective**: Regeneration capacity stands for the ability of the adult organisms to restore lost parts of the body by de novo growth due to cell proliferation and/or reorganization of somatic tissues. Regeneration study throws light on normal embryological development and differentiation and hence is an important model to study normal differentiation in animals Class1,2: Regeneration in Cnidaria and Annelida. Somatic, physiological, endocrinological and genetic aspects	**2**	**Dr.Mausumi Bhattacharyya**
2.	**SEMESTER 1 ZCT 103 TH** Cell Biology **Topic: Plasma membrane-structure and functional relationship** **Objective**: The plasma membrane is a selectively permeable membrane which plays an important role in facilitating communication and signalling between cells. Plasma membrane plays a vital role in anchoring the cytoskeleton to provide shape to the cell and also maintain the cell potential. So, study of structure and function of cell membrane is important to understand the physiological functioning of human body Class1,2: Ultrastructure and composition of Plasma Membrane: Lipid Bilayer(Phospholipid and Cholesterol),Peripheral and Integral Proteins, Glycolipids and Glycoproteins , Glycocalyx Class 3: Fluid Mosaic Model and Lipid Rafts, Mobility of membrane lipids (FRAP assay)and Mobility of membrane proteins (Fry-Eddin	**6**	

	Experiment) Class 4: Lipid Anchored Proteins: Acyl Anchors and Prenyl Anchors, GPI Anchors. Class 4: Transmembrane Protein Examples: Structures and mode of functioning of Glycophorin A , Bacteriorhodopsin. Peripheral Protein Examples:Spectrin, Detergent and micelles, Liposomes Class 5,6,: Membrane properties and functions, Factors on which membrane fluidity depends on		
3 4 **5**	**SEMESTER 2 ZCT 207 TH** Vertebrate Functional Forms and Adaptations **Topic 1: Protochordata** **1.1 Fine structure of notochord in Amphioxus** **Objective**: Structure and function of notochord Amphioxus gives us an insight on phylogeny and development of Vertebrate vertebral column and also throws light on Chordate Evolution Class 1: Fine structure of Notochord in Amphioxus and its evolutionary significance **Topic 2: Integumentary System** **Objective:** Integumentary organs and structures serve as first line of defence. They help in protection, sensation, regulation, absorption, excretion, Vitamin D synthesis and aesthetic and social functions. Hence the study of integumentary system throws light on anatomical and physiological functioning of the body. Class 2,3,4: Integumentary cell association, Integumentary glands of Mammals , Integumentary glands of Non-Mammalian Vertebrates **Topic 3: Skeletal System** **Objective:** Advent of jaw is a very significant step in Vertebrate evolution. With evolution of jaws herbivory and carnivory became exploitable options. Sound conduction in terrestrial Vertebrates evolved along with jaw evolution as origin of all three middle ear ossicles, both originated from Visceral arches. So, jaw evolution	**19**	

	and modification are important in terms of study of Vertebrate anatomy as well as Vertebrate evolution. Class 5,6,7: Evolution of Visceral Arch, Functional and evolutionary significance of Visceral Arch, Phylogeny of Jaw Suspension, Role of Dlx gene in jaw suspension, Cranial Kinesis **Topic 4: Circulatory System** **4.1: Heart and circulation in foetal and neonatal mammal** **Objective:** The fetus gets life support from the mother through the placenta. This topic is important to understand how circulation pattern changes with birth and non-functional lungs of fetus becomes the primary respiratory organ in neo-natal condition Class 8,9: Fetal circulation, shunts in fetal circulation, changes in circulation in neonatal condition Class 10: Oxygen-haemoglobin dissociation curve and its difference in fetal and post-natal condition, uniqueness of the structure and function of haemoglobin in foetus Class 11: Evolution of portal system		
6			
7	**Topic 5: Nervous System and Sensory organ** **5.1: Sensory receptors and classification** **5.2: Organ of olfaction and taste** **Objective:** A major role of sensory receptors is to help us learn about the environment around us, or abut the state of our internal environment, Sensory system function allows organisms to perceive, respond to, interact with their environments. Gustatory receptors and olfactory receptors are chemoreceptors of vital important for sensing taste and smell**.** Hence the study of sensory receptors throws light on physiological response of the body to stimulus Class 12: Classification of receptors Class 13: Fine structure of neuromasts. Rheoreceptor, Location of Neuromast Organs: Lateral Line Sense		

	Organ, Vestibular Apparatus, Auditory System Class 14: Organ of Olfaction Class 15: Organ of taste		
8	**Topic 6: Respiratory System** **6.2: Ventilatory mechanism, Ram Ventilation** **6.3: Structural design of aquatic respiration and functional significance** **Objective:** Respiration is one of the most important physiological activities of living animals. Water is not an ideal respiratory medium and piscine gill is considered to be an engineer's marvel. Students get an insight how fish respire and take oxygen from a medium which is not a suitable oxygen reserve. So, adaptation and subsequent evolutionary significance is studied. Class 16: Comparison of Air and Water as a respiratory medium, Structure of a piscine gill Class 17: Ventilatory mechanism in Chondrichthyes and Osteichthyes Class 18: Fick's law of diffusion and aquatic respiration Class 19: Counter current mechanism of respiration in fish		
9	**SEMESTER 3 ZCT 311 (CORE) TH** Conservation Biology **Topic 6: Conservation of Habitats and Landscapes** **Objective:** Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated habitat fragments. Habitat fragmentation contribute to population decline, biodiversity loss, and alteration of community structure and ecosystem functioning in anthropogenically modified landscapes. So in today's scenario when conservation is the call of the day mitigation of the impacts of habitat fragmentation and related issues are of extreme importance to save our	**11**	

10	environment Class 1: Habitat Fragmentation, edge influence, rescue effect, Isolation, Managing Habitat Connectivity (structural and functional) , corridor Class 2: Protected Area Network Class 3: SLOSS Debate and concept of Island Biogeography, Planning of Reserve Design Class 4: Habitat Management for unreserved land **SEMESTER 3 ZCT 311 TH** Endocrinology and Comparative Animal Physiology **Topic 9: Physiology of Excretion** **Objective:** Renal function is one of the most important physiological activities of living animals. The kidney regulates plasma osmolarity by modulating the amount of water, solutes and electrolytes in blood. Renal function is essential for homeostasis. Class 5: Structure of kidney, types of nephrons, Renal Blood Flow Class 6,7,8: Mechanism of Urine Formation (Analysing structure and function of the nephron and their role in urine formation), Physiology of ultrafiltration, reabsorption, tubular secretion Class 9: Juxtaglomerular Apparatus: Structure and function Class 10: Counter current mechanism of urine formation Class 11: Regulation of urine formation		
11	SEMESTER 3 ZCT 316 (ELECTIVE)(Biodiversity and Ecosystem Functioning) TH Topic 1. Biodiversity Monitoring	**11**	

12	1c. Threats to Species Divesity Objective: Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated habitat fragments. Habitat fragmentation contribute to population decline, biodiversity loss, and alteration of community structure and ecosystem functioning in anthropogenically modified landscapes. So, in today's scenario when conservation is the call of the day mitigation of the impacts of habitat fragmentation and related issues are of extreme importance to save our environment Class 1: Biodiversity and its components Class 2: Habitat fragmentation and its impact: Population Bottleneck, Genetic Drift, Inbreeding Depression, Loss of Genetic Diversity, Unequal sex ratio Class 3: Metapopulation Class 4: Extinction, Concept of Island Biogeography, Species-Area Curve, Extinction Vortex Class 5: Endemism and biodiversity Topic 2. Biodiversity and Ecosystem Function 2c: Theories on relation between Biodiversity and Ecosystem Function Objective: Ecosystem function is the biological, geochemical and physical processes that take place within an ecosystem. It is a subset of the interactions between biophysical structures, biodiversity or ecosystem processes and is based on the type of ecosystem. Ecosystem function controls fluxes of energy, nutrients and organic matter through the environment, including primary production and nutrient recycling, decomposition and recycling of organic waste. Ecosystem functioning reflects the collective life activities of plants animals and microbes and their effects on the physical and chemical conditions of the environment. So to understand the significance of biodiversity it is necessary to study Ecosystem functioning and its relation with biodiversity.		

13	Class 6: Ecosystem Functioning and Ecosystem Services Class 7: Different attributes of Ecosystem Functioning: Species Complementarity, Sampling Effect, Redundancy. Class 8: Insurance Hypothesis **Topic 3: Biodiversity and Landscapes Ecology:** **3c. Processes in the Landscape** **Objective:** Landscape ecology emphasizes the interaction between spatial pattern and ecological process, that is, the causes and consequences of spatial heterogeneity across a range of scales. Landscape ecology combine the spatial approach of the geographer with the functional approach of the ecologist. So, concept of Landscape Ecology is very essential to assimilate the wholesome concept of Biodiversity and Ecosystem Functioning Class 9: Landscape dynamics and disturbances Class 10: Habitat fragmentation and landscape ecology Class 11: Connectedness, connectivity and corridor concept from landscape perspective		

Topic Serial	Name of topic with details of sub-topics	No. of classes	Name of teachers
1.	**PART I: SEMESTER 1 CORE COURSE 1. Non-Chordates I ZOOA-CC1-1-TH** Unit 5: Ctenophora **Topic: Ctenophora** **Objective: Ctenophores constitute the second-earliest branching animal lineage. Ctenophores also serve as a model to study Biradial Symmetry. Several Ctenophores are seasonally abundant in coastal water and thus play an important role in the planktonic food web. So, study of Ctenophores gives students an insight to animal lineage, animal evolution and evolution of body symmetry as also planktonic food web in coastal waters.** Class 1: Concept of biradial symmetry, Difference between Ctenophora and Cnidaria Class 2: General characteristics of Ctenophora	**2**	**Dr. Mausumi Bhattacharyya**
2.	Unit 7: Nematoda **Topic: Life Cycle, pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti*** **Objective**: Considering the health problem scenario, parasites are the major causative agents throughout the world. Major parasites are the representatives of protistan group. Thus, two major protistan parasites are included in the syllabus to understand the nature and virulence of parasites. Class1: Basic concept of parasites and endoparasites Class 2,3: Structure of *Ascaris lumbricoides* followed by the detailing of the Life cycle including the description of its host species, pathogenicity, prophylaxis and treatment. Class 4,5: Structure of *Wuchereria bancrofti* followed by the detailing of the Life cycle including the description of its host species, pathogenicity, prophylaxis and treatment.	**5**	

3	**PART I: SEMESTER 2 CORE COURSE 3. Non-Chordates II ZOOA-CC2-3-TH** Unit 2: Annelida **Topic: General characteristics and Classification up to classes (Rupert Barnes,1994); Metamerism in Annelida** **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically. Metamerism enables understanding of animal's segmentation and also throws light on regeneration study. Class 1: Introduction to the concept of classifications, terminologies and its significance Class 2: Classification of Phylum Annelida (up Class) (Scheme followed: Rupert Barnas, 1994) Class 3, 4: Explanation of the concept of segmentation with special reference to Metamerism, Segmentation in Annelids and segments present from anterior to posterior Class 5,6: Concept of Growth Zone and teloblastic growth in Annelids, Significance of metamerism in Annelida	**06**	
4	**PART I: SEMESTER 2 CORE COURSE 4: Cell Biology ZOOA-CC2-4-TH** Unit 1: Plasma Membrane **Topic:** Ultra-structure and composition of Plasma membrane: Fluid mosaic model, Transport across membrane-Across and Passive transport, Facilitated transport, Cell junctions: Tight junctions, Gap junctions, Desmosomes **Objective:** The plasma membrane is a selectively permeable membrane which plays an important role in facilitating communication and signalling between cells. Plasma membrane plays a vital role in anchoring the cytoskeleton to provide shape to the cell and also maintain the cell potential. So study of structure and function of cell membrane is important to understand the	**07**	

	physiological functioning of human body Class1,2: Ultrastructure and composition of Plasma Membrane Class 3: Fluid Mosaic Model Class 4,5: Transport across membrane-Across and Passive transport, Facilitated transport. Class 6,7: Cell junctions: Tight junctions, Gap junctions, Desmosomes		
5	**PART II: SEMESTER 3 CORE COURSE 5: Chordata ZOOA-CC3-5-TH** Unit 2: Protochordata **Topic:** General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes (Young, 1981). Metamorphosis in *Ascidia*. Chordate Features, structures of pharynx and feeding in *Branchiostoma* **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically. Retrogressive metamorphosis gives insight to different types of developmental processes in Animal Kingdom. Chordate features of *Branchiostoma* throws light on evolution of Chordates, Pharynx structure of *Branchiostoma* has evolutionary significance. Class 1,2: General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes (Young, 1981). Class 3: Explanation of metamorphosis, Types of	**7**	

6	metamorphosis Class 4: Life History of *Ascidea* Class5,6: Retrogressive and Progressive Changes in life history of Ascidea, Causes of Retrogression, Notochord Degeneration in Ascidea: Concept and accepted views, Significance of tadpole larva Class 7: Chordate Features, structures of pharynx and feeding in *Branchiostoma* Unit 4: Pisces **Topic**: General characteristics and classification of Pisces up to sub classes (Young, 1981). Accessory respiratory organ **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically. Respiration is one of the most important physiological activities of living animals. By means of Accessory Respiration fishes are capable of intaking aerial oxygen. So this gives us an insight to adaptation and its relation to anatomical and physiological evolution Class 1: General characteristics and classification of Pisces up to sub classes (Young, 1981). Class 2: Accessory respiratory organ	**2**	
7	Unit 4: Amphibia **Topic**: General characteristics and classification of Amphibia up to living orders (Young, 1981). Metamorphosis, Paedomorphosis **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically. In evolutionary developmental biology, heterochrony is a developmental change in the timings or rate of events leading to changes in size and shape of organs and features over evolutionary time scales. So study of heterochrony gives insight to the adaptive responses to different environment and selective pressures during the entire lifetime of individuals.	**4**	

	Class 1: General characteristics and classification of Pisces up to sub classes (Young, 1981). Class2,3,4: Concept and types of Heterochrony, Peramorphosis & Paedomorphosis, Types of Paedomorphosis with graphical illustrations and examples, Types of Peramorphosis with graphical illustrations and examples.		
8	Unit 6: Reptiles **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically Class1,2: General characteristics and classification of Reptiles up to living Orders (Young, 1981).	**2**	
9	Unit 7: Aves **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically Class1,2: General characteristics and classification of Aves up to living Sub-Classes (Young, 1981).	**2**	
10	Unit 7: Mammals **Objective:** The main objective of classification is to place animals of all categories in different groups in such a way so that their origin, relationship and structural features may be brought out easily and scientifically Class1,2: General characteristics and classification of Aves up to living Sub-Classes (Young, 1981).	**2**	
11	**PART II: SEMESTER 4 CORE COURSE 8: Comparative Anatomy of Vertebrates ZOOA-CC4-8-TH** Unit 3: Respiratory System **Topic:** Gill morphology in fish	**2**	

12	**Objective:** Respiration is one of the most important physiological activities of living animals. Water is not an ideal respiratory medium and piscine gill is considered to be an engineer's marvel. Students get an insight how fish respire and take oxygen from a medium which is not a suitable oxygen reserve. So, adaptation and subsequent evolutionary significance is studied. Class 1,2: Structures and functions of Septal gills of Chondrichthyes and opercular gills of Osteichthyes with special note on their structural and physiological differences **PART II: SEMESTER 4 CORE COURSE 9 Animal Physiology: Life Sustaining Systems-ZOOA-CC4-9-TH** Unit 2: Physiology of respiration **Topic:** Physiology of Respiration **Objective:** Respiration is one of the most important physiological activities of living animals. This topic aims to throw light on structural as well as physiological aspects of human respiration Class 1: Mechanism of respiration, respiratory volumes and capacities Class 2: Structure of human haemoglobin Class 3.4: Transport of oxygen and carbon dioxide in blood. Class 5,6,7,8: Oxygen-Haemoglobin Dissociation curves, Factors affecting Oxygen-Haemoglobin Dissociation curves, Bohr Effect, Reverse Bohr Effect, Root Effect Class 9,10: Carbon monoxide poisoning	**10**	
13	Unit 2: Renal Physiology **Topic:** Structure of kidney and its functional unit, Mechanism of urine formation **Objective:** Renal function is one of the most important physiological activities of living animals. The kidney regulates plasma osmolarity by modulating the amount of water, solutes and electrolytes in blood. Renal function is	**06**	

	essential for homeostasis. Class 1: Structure of kidney, types of nephrons, Renal Blood Flow Class 2,3,4: Mechanism of Urine Formation (Analysing structure and function of the nephron and their role in urine formation) Class 5: Juxtaglomerular Apparatus: Structure and function Class 6: Counter current mechanism of urine formation		
14 15	**PART III: SEMESTER 5 CORE COURSE 11 Ecology-ZOOA-CC5-12-TH** Unit 5: Applied Ecology **Topic:** Concept of corridor, advantages and problem of corridor **Objective:** Students will get an insight on Habitat Fragmentation and the role of corridors to mitigate the impact of Habitat Fragmentation. An idea of significance of conservation and disadvantage of forest fragmentation. Class1: Concept of corridor, Rescue Effect, advantages and disadvantages of corridor **PART III: SEMESTER 6 CORE DSE 2 Fish and Fisheries** **ZOOA-DSE(B)-6-2-TH**	**01**	

	Unit 4: Aquaculture **Topic:** Extensive, semi-intensive and intensive culture of fish, Polyculture, Induced breeding of fish, Management of fin fish hatcheries, Preparation of Compound Diets for fish Preservation and Processing of harvested fish, Fishery by-product **Objective:** Aquaculture has contributed to increasing fish production. And it has emerged as the best alternative food source for many. Students need to understand and assimilate the different aspects of aquaculture in today's scenario. Class 1: Extensive, semi-intensive and intensive culture of fish. Differences between the three systems Class 2: Polyculture: Concept, Process. Principle. Advantages and disadvantages of Polyculture Class 3,4 Induced Breeding : Hypophysation-process, advantages, disadvantages, Linpe Method-GnRH as an inducing agent, Dopamine Blockage, Use of Dopamine antagonists, Ovaprim; Mammalian hormones used in fish breeding Class 5,6 Management of finfish Hatcheries: Types of Hatcheries, Comparative account of different types of hatcheries, Water management in hatcheries Class 7,8,9: Preparation of compound diets for fish: Nutritional requirement of fish, FCR, Balanced Diet, Feed Manufacture (Palletisation and Extrusion), Feed Management, Feeding tray in shrimps, Probiotic Concept Class 10,11: Preservation and processing of fish: Processes of Fish Preservation and processing of fish Class 12: Fishery By- Products: Different Fishery By-Products and their significances.	**12**	

Name of Teacher: Ruksa Nur
Department: Zoology
M.sc

- **Lesson Plan (2023-2025 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/ Learning outcomes
1	SEM 1	ZCT-102, Unit- 1 **Ecological Theories**	**Ecological Theories** **Topic**: Population growth models ***Sub Topic:*** Mathematical Interpretations, Population fluctuations and Explanatory models (Beverton – Holt, Ricker), Synthesis of population regulation theories.	6	To know about the population size, population density, geographic range, exponential growth and carrying capacity. To get the comparison and distinguish between exponential and logistic population growth equations and interpret the resulting growth curves.
2		ZCT-102, Unit- 2 **Community Ecology**	**Community Ecology** **Topic**: Community structure, Species coexistence, Interspecific Interactions ***Sub topic:*** Understanding community structure, Species coexistence – maintenance of species diversity, Island Biogeography theory, Biodiversity and Ecosystem Function, Interspecific Interactions – Competition, predation, mutualism	6	To understand the ways that organisms interact with each other in the natural environment. To understand how factors such as size and location of habitat influence the number of species found in a given area. To distinguish between fundamental and realized ecological niche. To explain the equilibrium model of island biogeography including the relationships between island size, distance from mainland, colonization rates, and extinction rates on maintaining an equilibrium number of species on an island.
3		ZCT-102, Unit- 3 **Ecological Theories**	**Ecological crises and Management** **Topic:** Agroecology and Ecological Restoration ***Sub Topic:*** Domains of agroecology – science, practice and movement	4	To understand the contribution of Agroecology to the sustainable development goals by increasing water-use efficiency, ensuring sustainable consumption and production.
4		ZCT-102, Unit- 4 **Ecological Theories**	**Behavioural Ecology** **Topic:** Ecological specialization and generalization ***Sub Topic:*** Trade-off Hypothesis, Effects of Gene	4	Interpret examples of how behaviours are encoded by genes and can evolve by natural selection. Define and differentiate between proximate and ultimate drivers of behavior. Explain how behavior generates evolution of life history strategies through an evolutionary cost-benefit analysis.

			Flow, Habitat selection and Assortative Mating, Kinds of costs and Trade-offs		
5		ZCT-102, Unit-4 **Ecological Theories**	**Behavioural Ecology** **Topic:** Evolution of Sex ***Sub Topic:*** Sex and sex allocation, Evolution of Hermaphroditism, variation in sex allocation related to size or age, Haplodiploidy and local mate competition, Mating systems habitat and diet	6	Explain how mate choice plays a role in reproductive success and the different mating systems found among animals. To understand Fisher's theory of sex ratio To understand the various hypotheses regarding the origin of female choice
6	SEM 2	ZCT 206, Unit-1 **Vertebrate Functional Forms and Adaptations**	**Protochordata** **Topic:** Modern interpretation of origin of early chordata. ***Sub Topic:*** Phylogeny of the Chordata, Evolution of the chordate Central Nervous System	2	The characteristics of the phylum Chordata. Urochordates are called tunicates. Name of the organisms are found in subphylum Cephalochordata. The Structures that form notochord. To explain the difference between notochord and backbone
7		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Structural elements of body and their properties ***Sub Topic*:** Properties of supportive materials, stress and stress line, use and design of structural elements, union of structural elements	3	To learn about the properties of bone, cartilage, muscle, tendon and ligament in their suitability for the various structural support of the body, as these living tissues display growth and repair.
8		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Mechanics of support and movement ***Sub Topic:*** Force and work of Muscles, Mechanics of support and movement, Force vectors and their resolution,	2	To explain how support structures are related to the environment of the animal. To describe skeletal modification in different vertebrates To make understand, how the skeletal connective tissues adapt to their particular mechanical requirements during development

			magnitude and direction of forces, bone-muscle systems as machines, mechanics of support and movement, mechanics of Body support, mechanics of motion		
9		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Swimming adaptation. ***Sub Topic:*** Advantages of swimming and diving, vertebrates that dive and swim, requirements of swimmers and divers, drag, propulsion, control of vertical position, stability, braking and steering and other adaptations of secondary swimmers	2	To know various **vertebrate** secondary **adaptations** to an aquatic life, like a streamlined design, flippers, and a **swim** bladder, which acts like a ballast including shortening of neck
10		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Cursorial adaptation ***Sub Topic:*** Advantage of speed and endurance, Cursorial and saltatorial vertebrates, general requirements of Cursors, Length of Stride, body mass, endurance and design for economy of effort, stability and maneuverability, gaits	2	***Learn about adaptations for running in both predators and prey*** To get the knowledge about various modification like attainment of digitigrade from plantigrade condition, elongation of the limbs, reduction of number of digits, reduction of ulna and fibula and attainment of bipedality
11		ZCT-207, Unit-2 **Developmental Biology & Neurobiology**	**Developmental Biology** **Topic:** Metamorphosis and organogenesis in model organisms ***Sub Topic***: Drosophila: Axes, compartment and pattern formation, HOX gene and their regulation.	6	To learn about the genes regulating pattern formation in *Drosophila* operate according

12		ZCT-207, Unit-2 **Developmental Biology & Neurobiology**	**Developmental Biology** **Topic:** *Caenorhabditis elegans*: Early development and vulva formation. ***Sub Topic:*** Cleavage and axis formation in *C. elegans*, Gastrulation in *C. elegans*, paracrine and juxtacrine signalling in coordination for vulva induction in *C. elegans*	6	To learn about the *C. elegans* development regulated by both autonomous and conditional specification and vulva formation due to paracrine and juxtacrine signalling

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B.sc (Honours and General)

- **Lesson Plan (CBCS System- 2018-2023)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/Learning outcomes
1	SEM 1(H)	ZOOA-CC1-1TH, Unit-1 **Non-Chordates I: Protista to Pseudocoelomate**	**Basics of Animal Classification:** **Topic**: Definitions: Classification, Systematics and Taxonomy ***Sub topic***: Discuss in details about Taxonomic Hierarchy, Taxonomic types, Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy, Concept of classification – three kingdom concept of Carl Woese, 1977 and five kingdom concept of Whittaker, 1969	5	To understand the animal kingdom To understand the taxonomic position, codes of ICZN nomenclature To understand the general characteristics of animals
2		ZOOA-CC1-2TH, Unit-6 **Molecular Biology**	**Gene Regulation**: **Topic**: Epigenetic Regulation ***Sub topic***: DNA Methylation, Histone Methylation & Acetylation.	2	To understand the epigenetic mechanisms and their role in diverse biological processes
3	SEM 2(H)	ZOOA-CC2-3 TH, Unit-3 **Non-Chordate II (Coelomate Phyla) Theory**	**Onychophora:** **Topic**: General characteristics ***Sub topic***: Forms, distribution, feeding, reproduction affinities and Evolutionary significance	2	To know about discontinuous distribution and example of connecting link between two phyla i.e. Annelida and Arthropoda
4		ZOOA-CC2-3 TH, Unit-6 **Non-Chordate II (Coelomate Phyla) Theory**	**Echinodermata:** **Topic**: Classification, type study and larval forms ***Sub topic***: General characteristics Details classification upto classes with example, Water vascular system in *Asterias*, Echinoderm larva and affinities with chordates	6	Define echinoderms as a phylum, including their common characteristics Discuss and debate the evolution, adaptations, and roles of echinoderms. Present information on echinoderms in a clear and useful manner.
5		ZOOA-CC2-3 TH, Unit-7 **Non-Chordate II (Coelomate**	**Hemichordata:** **Topic**: General characteristics of phylum Hemichordata; ***Sub topic***: Details classification upto	2	Describe the characteristics of hemichordates, including their development and ecological role Compare the two body types of hemichordates

		Phyla) Theory	classes with example, Relationship with non-chordates and chordates		
6		ZOOA-CC2-4 TH, Unit-7 **Cell Biology**	**Cytoplasmic organelles II**: **<u>Topic:</u>** Mitochondria: ***Sub topic:*** Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemiosmotic hypothesis; Peroxisomes: Structure and Functions	7	To describe the structure and functions of, Mitochondria, Peroxisomes, Centrosome along with microtubule organization and reorganization. Discuss about Electron Transport Chain, Krebs Cycle. Describe about Oxidative Phosphorylation pathway and ATP Synthesis Discuss about Peroxisome structure and its deficiency disease. Discuss about Centrosome and its organisation.
7	SEM 3(H)	ZOOA-CC3-5 TH, Unit-3 **Chordata**	**Agnatha:** **<u>Topic</u>**: General characteristics and classification of cyclostomes up to order (Young, 1981)	2	To know about the life of agnathans; diversity; natural selection; evolutionary history.
8		ZOOA-CC3-5 TH, Unit-4 **Chordata**	**Pisces:** **<u>Topic</u>**: General characteristics and classification up to living sub classes (Young, 1981); ***Sub Topic***: Accessory respiratory organ, Migration in fishes; Parental care in fishes	5	To know about simple division of superclass Pisces into three classes- Placodermi, Chondrichthyes, and Osteichthyes. To learn about Accessory respiratory organ, Migration and Parental care in fishes
9		ZOOA-CC3-6 TH, Unit-3 **Animal Physiology: Controlling & Co-ordinating system Theory**	**Nervous System:** **<u>Topic</u>**: Neuron and chemical coordination ***Sub Topic***: Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and non-myelinated nerve fibres; Types of synapse, Synaptic transmission and Neuromuscular junction	10	To learn to name and describe functions of the Nervous System. To define key terms, like neurons and motor functions. demonstrate knowledge of the nervous system.
10		ZOOA-CC3-7 TH, Unit-4 **Fundamentals of Biochemistry**	**Nucleic Acids:** **<u>Topic</u>**: Nucleosides and Nucleotides ***Sub Topic***: Nucleosides and Nucleotides	4	Students will get acquainted with the knowledge of Nucleic acid: classification, nomenclature, mechanism of action

11	SEM 4(H)	ZOOA-CC4-8 TH, Unit-5 **Comparative Anatomy of Vertebrates**	**Urinogenital System:** **<u>Topic:</u>** Succession of kidney in different vertebrate groups; evolution of urino-genital ducts ***Sub Topic***: Different types of kidney and their evolution	5	To obtain comprehensive knowledge of comparative anatomy of different types of kidney and to recognize their evolutionary trends
12		ZOOA-CC4-8 TH, Unit-1 **Comparative Anatomy of Vertebrates**	**Nervous system and sense organs:** **<u>Topic:</u>** Comparative account of brain in vertebrates; cranial nerves; ***Sub Topic***: Comparative account of brain in vertebrates; cranial nerves; Olfactory and auditory receptors in vertebrates	8	To obtain comprehensive knowledge of comparative brain in vertebrates and cranial nerves and to recognize their evolutionary trends To explain the structure of neuron and its propagation To get the detailed view of olfactory and auditory receptors
13		ZOOA-CC4-9 TH, Unit-1 **Animal Physiology: Life sustaining system**	**Physiology of Digestion:** **<u>Topic:</u>** Mechanical and chemical digestion of food ***Sub Topic***: Mechanical and chemical digestion of food	2	To describe the digestion and absorption of carbohydrate, fats and protein.
14		ZOOA-SEC(A)4-1 TH, Unit-4 **Aquarium Fisheries**	**Fish Transportation:** **<u>Topic</u>**: Live fish transport ***Sub Topic:*** Fish handling, packing and forwarding techniques.	3	To provide a general idea of Fish transportation and management.
15		ZOOA-SEC(A)4-1 TH, Unit-4 **Aquarium Fisheries**	**Maintenance of Aquarium:** **<u>Topic</u>**: General Aquarium maintenance ***Sub Topic:*** Budget for setting up an Aquarium Fish Farm as a Cottage Industry	3	To provide an overview of aquarium fish keeping, aquarium setup and accessories. Aquarium fishes, their food and feeding. Maintenance of aquarium.

16	SEM 5(H)	ZOOA-CC5-11 TH, Unit-2 **Ecology**	**Population:** **Topic:** Population ecology ***Sub Topic:*** Unitary and Modular populations Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion. Geometric, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - densitydependent and independent factors, Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.	8	To know about population; types; knowledge about growth of population; interaction. To provide detailed concepts on What is - Natality, mortality, fecundity, population density? Describe- 'j' and 's' shaped growth curve. Describe life table with graph Write short notes on r and k selected species. Give and account on population dispersion and dispersal.
17		ZOOA-CC5-12 TH, Unit-1 Principle of Genetics	**Mendelian Genetics and its Extension:** **Topic:** Chromosomal aberrations and mutation ***Sub topic***: Principles of inheritance, Incomplete dominance and co-dominance, Epistasis, Multiple alleles, Isoallele (White eye mutations), Pseudoallele (Lozenge Locus) & Cis-trans test for allelism, Lethal alleles, Pleiotropy, Penetrance & Expressivity	8	To know about chromosomal abnormalities and disorder; detection; observation of mutation in different organism with experiment and their application in research field. Briefly describe different types of mutation.
18	SEM 6(H)	ZOOA-CC6-13 TH, Unit-1 **Developmental Biology**	**Planes and patterns of cleavage:** **Topic:** Fertilization ***Sub Topic:*** Planes and patterns of cleavage	1	State the role of yolk on plane and cleavage patterns.
19		ZOOA-CC6-14 TH, Unit-2 **Evolutionary Biology**	**Evolutionary Theories:** **Topic:** Historical review of Evolutionary concepts ***Sub Topic:*** Lamarkism, Darwinism and Neo Darwinism	3	To Gain conceptual understanding of evidences, theories and mechanisms of evolution based on evolutionary theories

20		ZOOA-DSE(B) 6-2-TH, Unit-1 **Fish and Fisheries**	**Fisheries** **<u>Topic:</u> Introduction and Classification** ***Sub Topic:*** Feeding habit, habitat and manner of reproduction. Classification of fish (upto Subclasses) (Romar, 1959)	4	To give the students the necessary basic information about fishery and aquaculture.
21		ZOOA-DSE(B) 6-2-TH, Unit-3 **Fish and Fisheries**	**Fisheries** **<u>Topic:</u> Fisheries** ***Sub Topic:*** Inland Fisheries; Marine Fisheries; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations	10	Provide the technical and general knowledge necessary for competent fisheries management. To exchange and circulate information, ideas and practical experience on all matters relating to fisheries and their management.
22		ZOOA-DSE(B) 6-2-TH, Unit-4 **Fish and Fisheries**	**Fisheries** **<u>Topic:</u> Aquaculture** ***Sub Topic:*** Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic	10	To discuss advantages and disadvantages with the two aquatic food primary production systems, fishery and aquaculture.
23		ZOOA-DSE(B) 6-2-TH, Unit-1 **Fish and Fisheries**	**Fisheries** **<u>Topic:</u> Fish in research** ***Sub Topic:*** Transgenic fish Zebra fish as a model organism in research	4	To discuss important factors for performing a sustainable fishery and a sustainable aquaculture.
24	SEM 1(G)	ZOOG - CC1-1 TH, Unit-11 **Animal diversity**	**Agnatha:** **<u>Topic</u>**: General characteristics and classification of cyclostomes up to order (Young, 1981) ***Sub Topic***: Define parental care, Types of parental care and example, diagrammatic representation of parental care.	2	To know about the life of agnathans; diversity; natural selection; evolutionary history.

25		ZOOG - CC1-1 TH, Unit-12 **Animal diversity**	**Pisces:** **Topic**: General features and Classification up to orders (Young, 1981); Osmoregulation in Fishes ***Sub Topic***: Structure and types exoskeleton with diagram, Example. Different layers of skin, Details about hair with diagram, Others integumentary structure of mammals , Discuss about horn and antler.	5	To know about simple division of superclass Pisces into three classes- Placodermi, Chondrichthyes, and Osteichthyes. To learn about Accessory respiratory organ, Migration and Parental care in fishes
26	SEM 2(G)	ZOOG - CC2-2 TH, Unit-2 **Comparative Anatomy & Developmental Biology**	**Digestive System:** **Topic:** Dentition ***Sub Topic***: Dentition	2	To learn about the dental formula of different vertebrates and different modification of teeths
27		ZOOG - CC2-2 TH, Unit-2 **Comparative Anatomy & Developmental Biology**	**Late Embryonic Development:** **Topic: Metamorphosis in Frog** ***Sub Topic***: Metamorphic events in frog life cycle and its hormonal regulation	3	To describe the history and different post events of frog embryonic development and its implications
28	SEM 3(G)	ZOOG - CC3-3 TH, Unit-8 **Physiology and Biochemistry**	**Lipid metabolism:** **Topic**: Beta oxidation ***Sub Topic***: Beta oxidation of Palmitic acid {saturated (C 16:0)} and Linoleic acid {unsaturated (C 18:2)}	4	To provide an overview of oxidation of lipids: beta oxidation, oxidation of unsaturated and odd chain fatty
29	SEM 4(G)	ZOOG - CC4-4 TH, Unit-6 **Genetics and Evolutionary Biology**	**Evolutionary Theories:** **Topic:** Theories of Evolution ***Sub Topic***: Lamarckism, Darwinism, Neo-Darwinism	4	To Gain conceptual understanding of evidences, theories and mechanisms of evolution based on evolutionary theories

30	SEM 5(G)	ZOOG - DSE-A-5-1 TH, Unit-10 **Applied Zoology**	**Fish Technology:** **Topic**: Fish Genetics and seed transportation ***Sub Topic:*** Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed	4	To discuss important factors for performing a sustainable fishery and a sustainable aquaculture through genetic improvement of fish.
31	SEM 6(G)	ZOOG - SEC-B-6-4 TH, Unit-1 **Medical diagnosis**	**Medical diagnosis:** **Topic:** Diagnostics Methods Used for Analysis of Blood ***Sub Topic:*** Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentation Rate (E.S.R)	10	Identify the primary functions of blood, its fluid and cellular components, and its physical characteristics Identify the most important proteins and other solutes present in blood plasma. Describe the formation of the formed element components of blood To Find out how well organs such as your kidneys, liver, heart, or thyroid are working. Help diagnose diseases such as cancer, diabetes, coronary heart disease, and HIV/AIDS.

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M. Sc.

- **Lesson Plan (2018-2020 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/ Learning outcomes
1	SEM 1	ZCT-102, Unit- 1 **Ecological Theories**	**Population Ecology** **Topic**: Population growth models (Beverton Holt, Ricker, Time lag) ***Sub topic:*** Life tables, fecundity tables, survivorship curves, dispersal and dispersion. Geometric, exponential and logistic growth, equation and patterns, r and K strategies	6	To know about the population size, population density, geographic range, exponential growth and carrying capacity. To get the comparison and distinguish between exponential and logistic population growth equations and interpret the resulting growth curves.
2		ZCT-102 , Unit- 2 **Ecological Theories**	**Ecological Communities** **Topic:** Species abundance models ***Sub Topic:*** Population regulation – density dependent and independent factors, understanding of relative abundance plots.	6	Understand the ways that organisms interact with each other in the natural environment. Understand how factors such as size and location of habitat influence the number of species found in a given area.
3		ZCT-102, Unit- 2 **Ecological Theories**	**Ecological Communities** **Topic:** Niche and competition theories (Lotka Volterra model, Isoclines, Niche prediction) ***Sub Topic:*** Population Interactions, Gause's Principle with laboratory and	8	To distinguish between fundamental and realized ecological niche. To explain the competitive exclusion principle. To explain the equilibrium model of island biogeography including the relationships between island size, distance from mainland, colonization rates, and extinction rates on maintaining an equilibrium number of species on an island.

			field examples, Lotka-Volterra equation for competition.		
4		ZCT-102, Unit-2 **Ecological Theories**	**Ecological Communities** **Topic:** Elements of Landscape ecology ***Sub Topic:*** Basics of theories in landscape ecology, Scale and landscape, Processes in the landscape, Methods in landscape ecology	6	To know about the basics of Hierarchy theory and the structure of the landscape, Importance of parameters at different scales, Remote sensing in landscape ecology, Geographic Information System
5		ZCT 102, Unit-3 **Ecological Theories**	**Evolutionary and Behavioral Ecology** **Topic:** Ecological specialization and generalization ***Sub Topic:*** Trade-off Hypothesis, Effects of Gene Flow, Habitat selection and Assortative Mating, Kinds of costs and Trade-offs	4	Interpret examples of how behaviours are encoded by genes and can evolve by natural selection. Define and differentiate between proximate and ultimate drivers of behavior. Explain how behavior generates evolution of life history strategies through an evolutionary cost-benefit analysis.
6		ZCT-102, Unit-3 **Ecological Theories**	**Evolutionary and Behavioral Ecology** **Topic:** Evolution of sex and sex ratio ***Sub Topic:*** Sex and sex allocation, Evolution of Hermaphroditism, variation in sex allocation related to size or age, Haplodiploidy and local mate comprtition, Mating systems habitat and diet	6	Explain how mate choice plays a role in reproductive success and the different mating systems found among animals. To understand Fisher's theory of sex ratio To understand the various hypotheses regarding the origin of female choice

7	SEM 2	ZCT-208, Unit-1 **Chordate Biology**	**Protochordata** **Topic:** Modern interpretation of origin of early chordata. ***Sub Topic:*** Phylogeny of the Chordata, Evolution of the chordate Central Nervous System	2	The characteristics of the phylum Chordata. Urochordates are called tunicates. Name of the organisms are found in subphylum Cephalochordata. The Structures that form notochord. To explain the difference between notochord and backbone
8		ZET-208, Unit- 6 **Chordate Biology**	**Structural Adaptation** **Topic:** Mechanics of support and movement ***Sub Topic:*** Force and work of Muscles, Mechanics of support and movement, Force vectors and their resolution, magnitude and direction of forces, bone-muscle systems as machines, mechanics of support and movement, mechanics of Body support, mechanics of motion	2	To explain how support structures are related to the environment of the animal. To describe skeletal modification in different vertebrates To make understand, how the skeletal connective tissues adapt to their particular mechanical requirements during development
9		ZET-208, Unit- 6 **Chordate Biology**	**Structural Adaptation** **Topic:** Swimming adaptation. ***Sub Topic:*** Advantages of swimming and diving, vertebrates that dive and swim, requirements of swimmers and divers, drag, propulsion, control of vertical position, stability, braking and steering and	2	To know various **vertebrate** secondary **adaptations** to an aquatic life, like a streamlined design, flippers, and a **swim** bladder, which acts like a ballast including shortening of neck

			other adaptations of secondary swimmers		
10		ZET- 208, Unit- 6 **Chordate Biology**	**Structural Adaptation** **Topic:** Cursorial adaptation ***Sub Topic:*** Advantage of speed and endurance, Cursorial and saltatorial vertebrates, general requirements of Cursors, Length of Stride, body mass, endurance and design for economy of effort, stability and maneuverability, gaits	2	**Learn about adaptations for running in both predators and prey** To get the knowledge about various modification like attainment of digitigrade from plantigrade condition, elongation of the limbs, reduction of number of digits, reduction of ulna and fibula and attainment of bipedality
11		ZET-208, Unit- 6 **Chordate Biology**	**Structural Adaptation** **Topic:** Flying mechanism. ***Sub topic:*** Origin and advantages of flying and gliding, Vertebrates that parachute, glide and fly, general requirements of flyers, gliding, soaring and formation flying, flapping flight, flight control, wing structure and their modification	2	Learn about requisites for Volant life like Organs for flight, Lightness and rigidity, Energy and power, Speed, Balancing and Controlling Modification of limbs into wings

12	SEM 2	ZCT-209, Unit-2 **Developmental Biology**	**Developmental Biology** **Topic:** *Drosophila*: Axes, compartment and pattern formation, HOX gene and their regulation. ***Sub Topic:*** Early Drosophila Development, Genetics mechanisms patterning the *Drosophila* body, segmentation genes,	6	To learn about the genes regulating pattern formation in *Drosophila* operate according
13		ZCT-209, Unit-2 **Developmental Biology**	**Developmental Biology** **Topic:** *Caenorhabditis elegans*: Early development and vulva formation. ***Sub Topic:*** Cleavage and axis formation in *C. elegans*, Gastrulation in *C. elegans*, paracrine and juxtacrine signalling in coordination for vulva induction in *C. elegans*	6	To learn about the *C. elegans* development regulated by both autonomous and conditional specification and vulva formation due to paracrine and juxtacrine signalling
14	SEM 3	ZCT-315, Unit-1 **Taxonomy & Biostatistics**	**Taxonomy** **Topic: Characters and character states** ***Sub Topic:*** Types of character: primitive and advanced, missing, polymorphic, micro, cryptic and Internal, Character state transition, environmental effect and their significances, Artifacts and special characters	4	To learn about different types of species identifying characters and their states

15		ZCT-315, Unit-2 **Taxonomy & Biostatistics**	**Taxonomy** **Topic: Taxa and species** ***Sub Topic:*** ICZN-nomenclature rules, Species concept, Phylogenetic nomenclature	4	To learn about different species concepts, different codes of nomenclatures and their amendments
16		ZCT-315, Unit-3 **Taxonomy & Biostatistics**	**Taxonomy** **Topic: Approaches in classification** ***Sub Topic:*** Cladistics, Phenetics, DNA Barcoding	4	To learn about classification approaches like cladistics and phonetics, UPGMA method and finding best possible phylogenetic tree
17		ZET 322 Unit-1 **Biodiversity and Ecosystem Functioning**	**Biodiversity and Ecosystem Functioning** **Topic: Biodiversity Monitoring** ***Sub Topic:*** Local and regional biodiversity-niche assembly theories, Unified Neutral theory	4	To describe and apply theories about the importance of biodiversity for ecosystem functioning To describe and apply theories regarding variation in biodiversity over time and space and its implications for food webs and ecosystems
18		ZET 322 Unit-2 **Biodiversity and Ecosystem Functioning**	**Biodiversity and Ecosystem Functioning** **Topic: Biodiversity and Ecosystem function** ***Sub Topic:*** Decline of global biodiversity and loss of ecosystem function, Biodiversity and stability in soil ecosystem: pattern processes and the effect of disturbance, The economics of biodiversity and ecosystem function.	12	To apply and critically evaluate methods to The overall focus is to provide in-depth knowledge of ecosystems. The students are prepared for professional activities and research in fields where understanding of the interaction between organisms, their abiotic environment and human influence is required.
19	SEM 4	ZCT 432 Unit 3	**Applied Ecology**	4	To help understand the key theories in population ecology, especially those related

		Applied Ecology	**Topic:** Ecosystem services ***Sub Topic:*** Ecosystem services, biodiversity and ecological economics, Biological control- theory and application, Harvesting populations- theory and applications		to the growth and regulation of animal and plant populations, demography and dynamics of structured populations and species interactions.
20		ZCT 432 Unit 3 **Applied Ecology**	**Applied Ecology** **Topic:** Biological control ***Sub Topic:*** Biological control- theory and application	2	To learn the application of population ecology principles to conservation and management challenges

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M.sc

- **Lesson Plan (2020-2022 Syllabus)**

Topic Serial	Class	Paper & Unit	Name of topic with details of sub-topics	No. of Classes	Learning objective of the course/ Learning outcomes
1	SEM 1	ZCT-102, Unit- 1 **Ecological Theories**	**Population Ecology** **Topic**: Population growth models ***Sub Topic:*** Mathematical Interpretations, Population fluctuations and Explanatory models (Beverton – Holt, Ricker), Synthesis of population regulation theories.	6	To know about the population size, population density, geographic range, exponential growth and carrying capacity. To get the comparison and distinguish between exponential and logistic population growth equations and interpret the resulting growth curves.
2		ZCT-102, Unit- 2 **Ecological Theories**	**Community Ecology** **Topic**: Community structure, Species coexistence, Interspecific Interactions ***Sub topic:*** Understanding community structure, Species coexistence – maintenance of species diversity, Island Biogeography theory, Biodiversity and Ecosystem Function, Interspecific Interactions – Competition, predation, mutualism	6	To understand the ways that organisms interact with each other in the natural environment. To understand how factors such as size and location of habitat influence the number of species found in a given area. To distinguish between fundamental and realized ecological niche. To explain the equilibrium model of island biogeography including the relationships between island size, distance from mainland, colonization rates, and extinction rates on maintaining an equilibrium number of species on an island.
3		ZCT-102, Unit- 3 **Ecological Theories**	**Ecological crises and Management** **Topic:** Agroecology and Ecological Restoration ***Sub Topic:*** Domains of agroecology – science, practice and movement	4	To understand the contribution of Agroecology to the sustainable development goals by increasing water-use efficiency, ensuring sustainable consumption and production.

4		ZCT-102, Unit- 4 **Ecological Theories**	**Behavioural Ecology** **Topic:** Ecological specialization and generalization ***Sub Topic:*** Trade-off Hypothesis, Effects of Gene Flow, Habitat selection and Assortative Mating, Kinds of costs and Trade-offs	4	Interpret examples of how behaviours are encoded by genes and can evolve by natural selection. Define and differentiate between proximate and ultimate drivers of behavior. Explain how behavior generates evolution of life history strategies through an evolutionary cost-benefit analysis.
5		ZCT-102, Unit-4 **Ecological Theories**	**Behavioural Ecology** **Topic:** Evolution of Sex ***Sub Topic:*** Sex and sex allocation, Evolution of Hermaphroditism, variation in sex allocation related to size or age, Haplodiploidy and local mate competition, Mating systems habitat and diet	6	Explain how mate choice plays a role in reproductive success and the different mating systems found among animals. To understand Fisher's theory of sex ratio To understand the various hypotheses regarding the origin of female choice
6	SEM 2	ZCT 206, Unit-1 **Vertebrate Functional Forms and Adaptations**	**Protochordata** **Topic:** Modern interpretation of origin of early chordata. ***Sub Topic:*** Phylogeny of the Chordata, Evolution of the chordate Central Nervous System	2	The characteristics of the phylum Chordata. Urochordates are called tunicates. Name of the organisms are found in subphylum Cephalochordata. The Structures that form notochord. To explain the difference between notochord and backbone

7		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Structural elements of body and their properties ***Sub Topic*:** Properties of supportive materials, stress and stress line, use and design of structural elements, union of structural elements	3	To learn about the properties of bone, cartilage, muscle, tendon and ligament in their suitability for the various structural support of the body, as these living tissues display growth and repair.
8		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Mechanics of support and movement ***Sub Topic:*** Force and work of Muscles, Mechanics of support and movement, Force vectors and their resolution, magnitude and direction of forces, bone-muscle systems as machines, mechanics of support and movement, mechanics of Body support, mechanics of motion	2	To explain how support structures are related to the environment of the animal. To describe skeletal modification in different vertebrates To make understand, how the skeletal connective tissues adapt to their particular mechanical requirements during development
9		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Swimming adaptation. ***Sub Topic:*** Advantages of swimming and diving, vertebrates that dive and swim, requirements of swimmers and divers, drag, propulsion, control of vertical position,	2	To know various **vertebrate** secondary **adaptations** to an aquatic life, like a streamlined design, flippers, and a **swim** bladder, which acts like a ballast including shortening of neck

			stability, braking and steering and other adaptations of secondary swimmers		
10		ZCT-206, Unit-7 **Vertebrate Functional Forms and Adaptations**	**Structural Adaptation** **Topic:** Cursorial adaptation ***Sub Topic:*** Advantage of speed and endurance, Cursorial and saltatorial vertebrates, general requirements of Cursors, Length of Stride, body mass, endurance and design for economy of effort, stability and maneuverability, gaits	2	***Learn about adaptations for running in both predators and prey*** To get the knowledge about various modification like attainment of digitigrade from plantigrade condition, elongation of the limbs, reduction of number of digits, reduction of ulna and fibula and attainment of bipedality
11		ZCT-207, Unit-2 **Developmental Biology & Neurobiology**	**Developmental Biology** **Topic:** Metamorphosis and organogenesis in model organisms ***Sub Topic:*** Drosophila: Axes, compartment and pattern formation, HOX gene and their regulation.	6	To learn about the genes regulating pattern formation in *Drosophila* operate according

12		ZCT-207, Unit-2 **Developmental Biology & Neurobiology**	**Developmental Biology** **Topic:** *Caenorhabditis elegans*: Early development and vulva formation. ***Sub Topic:*** Cleavage and axis formation in *C. elegans*, Gastrulation in *C. elegans*, paracrine and juxtacrine signalling in coordination for vulva induction in *C. elegans*	6	To learn about the *C. elegans* development regulated by both autonomous and conditional specification and vulva formation due to paracrine and juxtacrine signalling
13		ZCT-311, Unit- 1 **Conservation biology**	**Conservation biology** **Topic:** Introduction to Conservation Biology ***Sub Topic:*** Emergence of Global conservation, multilateral treaties, Conservation driven by shared commercial interests; International protection of migratory species, forums for International Conservation.	2	To learn the application of population ecology principles to conservation and management challenges
14		ZET-316, Unit- 1 **Biodiversity and Ecosystem Functioning**	**Biodiversity Monitoring** **Topic:** Measuring global biodiversity ***Sub Topic:*** Measuring global biodiversity and its decline with special reference to mammals, birds,herpetofauna, fish and insects, Local and regional biodiversity-niche assembly theories,	2	To describe and apply theories about the importance of biodiversity for ecosystem functioning To describe and apply theories regarding variation in biodiversity over time and space and its implications for food webs and ecosystems

			Unified Neutral theory		
15		ZET-316, Unit- 2 **Biodiversity and Ecosystem Functioning**	**Biodiversity and Ecosystem Function** **Topic:** Economics of biodiversity and ecosystem function ***Sub Topic:*** Decline of global biodiversity and loss of ecosystem function, The economics of biodiversity and ecosystem function.	12	To apply and critically evaluate methods to The overall focus is to provide in-depth knowledge of ecosystems. The students are prepared for professional activities and research in fields where understanding of the interaction between organisms, their abiotic environment and human influence is required.
16	SEM 4	ZCT-429, Unit-1 **Taxonomy & Biostatistics**	**Taxonomy** **Topic:** Characters and character states ***Sub Topic:*** Types of character: primitive and advanced, missing, polymorphic, micro, cryptic ,and internal, Character state transition, environmental effect and their significances, Artifacts and special characters	4	To learn about different types of species identifying characters and their states
17		ZCT-429, Unit-2 **Taxonomy & Biostatistics**	**Taxonomy** **Topic:** Taxa and species ***Sub Topic:*** ICZN-nomenclature rules, Species concept,	4	To learn about different species concepts, different codes of nomenclatures and their amendments

			Phylogenetic nomenclature		
18		ZCT-429, Unit-3 **Taxonomy & Biostatistics**	**Taxonomy** **Topic:** Approaches in classification ***Sub Topic:*** Cladistics, Phenetics, DNA Barcoding	4	To learn about classification approaches like cladistics and phonetics, UPGMA method and finding best possible phylogenetic tree

Name of Teacher: Dr. Swapna Bandyopadhyay

Department : Zoology

M.Sc

- **Lesson Plan (2023-2025 Syllabus)**

Topic serial	Name of topic with details of sub-topics	Objective	No. of classes
1	**SEMESTER 1, ZCT 103, TH** Cell Biology Topic 3: Cytoskeleton Cellular transport and extra cellular transport	*Define the cytoskeleton and its classification *Describe the structure and organisation of the three major group of cytoskeleton proteins *Explain the assembly and disassembly of microtubules and actin Filaments *Indicate the role of GTP and ATP in polymerization of tubulin and G-actin respectively *Explain the role of microtubules (MTs) and microfilaments in cell division *Describe the families of MTs and Actin based motor proteins *Describe the structure and function of cilia and flagella and	10

		indicate the types of Intermediate Filaments *Techniques for studying the secretory pathway *Molecular mechanisms of vesicular traffic *Early stages of the secretory pathway *Later stages of the secretory pathway *Receptor mediated endocytosis *Directing membrane proteins and cytosolic materials to the lysosome	
2	**SEMESTER 2, ZCT 207, TH** Developmental Biology Topic 1: Principles of developmental biology (potency, commitment, specification, induction, competence)	*Levels of commitment *Cell differentiation commitment *Some differentiated cell types and their major products *Second stage of commitment (determination)	10

		*Cell fate determination *Specification *Autonomous specification *Cytoplasmic determinants and autonomous specification in the tunicate *Conditional specification in the sea urchin embryo *Syncytial specification	
3	**SEMESTER 2, ZCT 208, TH** Biochemistry Topic 2: Outline of metabolic pathways of the major biomolecules with mention of rate limiting steps Glycolysis, TCA cycle, glycogenesis, neoglucogenesis, glycogenolysis Beta oxidation of fatty acids (saturated and unsaturated) Topic 4: Bioenergetics (aerobic and anaerobic respiration, oxidative and substrate level phosphorylation), basic concept of ETC and ATP	*Explain the processes of glycolysis *Describe the pathway of a pyruvate molecule through the Krebs cycle *Summarize the process of gluconeogenesis *Identify the different steps of fatty acid degradation *Describe ketone bodies and their role in metabolism	8

	synthesis, uncouplers, spontaneous reaction	*Explain how fatty acids are synthesised *Explain how fatty acid metabolism is regulated *Learn about major components of respiratory complexes and their energetics	
4	**SEMESTER 3, ZCT 311, TH** Conservation Biology Topic 3: Climate change and biodiversity The global fingerprint of climate change on biodiversity, climate change in ecosystem-species loss and system degradation, conservation planning and climate integrated conservation strategies	*Describe the greenhouse effect and global warming *Explain the concept of climate change *Consider the effects of climate change on extreme weather	6
5	**SEMESTER 3, ZCT 312, TH** Endocrinology and comparative animal physiology Topic 11: Insect sociality and physiology-colony optimisation theories, hypothesis and social algorithms, development and hormonal regulations in insects	*Describe acceleration techniques for ACO based on gradient based reinforcement learning *Applications of ACO *Current ACO trends *ACO successes *Describe regulation of insect metamorphosis,	4

		general pathway of insect metamorphosis	

Name of Teacher: Dr. Swapna Bandyopadhyay

Department : Zoology

B.Sc (Honours and General)

- **Lesson Plan (CBCS System- 2018-2023)**

Topic serial	Name of topic with details of sub-topics	Objective	No. of classes
1	**PART I: SEMESTER 1 CORE COURSE 1. Non-Chordates I ZOOA-CC1-1-TH** Unit 7: Nematoda Topic: Nematoda Sub topic: General characteristics and classification upto classes	After performing this exercise students should be able to: *Identify the genus of the common human intestinal round worm as an example of Phylum Nematoda and give its scientific name *Classify Ascaris limbricoides, upto the level of classes	2
2	**PART I: SEMESTER 1 CORE COURSE 2, Molecular Biology, ZOOA-CC1-2-TH** Unit 6: Gene regulation Topic: Gene Regulation Sub topic: Regulation of transcription in eukaryotes: activators, enhancers, silencers, repressors.	*Describe regulation of gene expression and principles of transcriptional Regulation *Understand the transcriptional regulation in Eukaryotes *Know the process and importance of gene silencing.	6

3	**PART I: SEMESTER 2 CORE COURSE 3, Non-chordates II, ZOOA-CC2-3-TH** Unit 5: Mollusca Topic: Mollusca Sub topic: *General characteristics and classification upto classes *Nervous system in Pila sp. *Torsion in gastropoda *Feeding and respiration in Pila sp.	*Identify different specimens belonging to Phylum Mollusca and give their scientific and common names. *List characters justifying their classification and mention special features *Know about nervous system, feeding and respiration and torsion mechanism in gastropods.	6
4	**PART I: SEMESTER 2 CORE COURSE 4, Cell Biology, ZOOA-CC2-4-TH** Unit 4: Cytoskeleton Topic: Cytoskeleton Sub topic: Type, structure and function of cytoskeleton, accessory proteins of microfilaments and microtubules	*Define the cytoskeleton and its classification *Describe the structure and organisation of the three major group of cytoskeleton proteins *Explain the assembly and disassembly of microtubules and actin Filaments *Indicate the role of GTP and ATP in polymerization of tubulin and G-actin respectively *Explain the role of microtubules (MTs)	5

		and microfilaments in cell division *Describe the families of MTs and Actin based motor proteins *Describe the structure and function of cilia and flagella and indicate the types of Intermediate Filaments	
5	**PART II: SEMESTER 3 CORE COURSE 7, Fundamentals of biochemistry, ZOOA-CC3-7-TH** Unit 1: Carbohydrates Topic: Carbohydrates Sub topic: Structure and biological importance: monosaccharides, disaccharides, polysaccharides; derivatives of monosaccharides	*Classify carbohydrates *Describe the chemical properties of mono, oligo and polysaccharides	5

6	**PART II: SEMESTER 4 CORE COURSE 9, Animal Physiology, ZOOA-CC4-9-TH** Unit 4: Physiology of heart Topic: Physiology of heart Sub topic: Coronary circulation, structure and working of conducting myocardial fibres, origin and conduction of cardiac impulses; cardiac cycle and cardiac output	*Enumerate the various phase of cardiac cycle *Enlist the determinants of cardiac out put and their effect	8
7	**PART III: SEMESTER 5 CORE COURSE 11, Ecology, ZOOA-CC5-11-TH** Unit 4: Ecosystem Topic: Ecosystem Sub topic: Types of ecosystem with an example in detail, foodchain: detritus and grazing foodchain, linear and Y shaped foodchain, foodweb	*Define and discuss ecosystem and its various components *Outline the flow of elements through various components of ecosystem	8

8	**PART III: SEMESTER 6 CORE COURSE 13, Developmental Biology, ZOOA-CC6-13-TH** Unit 1: Early embryonic development Topic: Early embryonic development Sub topic: Types of blastula in frog and chick, fatemap in chick embryo, fatemapping using vital dyes and radioactive technique; gastrulation in frog and chick	*Describe the various stages and processes in the development of frog *Describe the morphogenetic movements during frog gastrulation *Correlate the fate map of frog with its outcome in development *Describe cleavage and formation of blastula in chick egg * Discuss the process and mechanism of chick gastrulation *Compare the development of chick with that of frog	8
9	**PART I: SEMESTER 1 CORE COURSE 1, Animal Diversity, ZOOG-CC1-1-TH** Unit 8: Phylum Mollusca Topic: Phylum Mollusca Sub topic: *General characteristics and classification upto classes *Respiration in Pila sp.	*Identify different specimens belonging to Phylum Mollusca and give their scientific and common names. *List characters justifying their classification and mention special features *Know about respiration of Pila sp.	4

10	**PART I: SEMESTER 2 CORE COURSE 2, Comparative anatomy and developmental biology, ZOOG-CC2-2-TH** Unit 6: Early embryonic development Topic: Early embryonic development Sub topic: Formation of gastrula, types of morphogenetic movements	*Describe the various stages and processes in the development of frog *Describe the morphogenetic movements during frog gastrulation *Correlate the fate map of frog with its outcome in development *Describe cleavage and formation of blastula in chick egg * Discuss the process and mechanism of chick gastrulation *Compare the development of chick with that of frog	6
11	**PART II: SEMESTER 3 CORE COURSE 3, Physiology and biochemistry, ZOOG-CC3-3-TH** Unit 7: Carbohydrate metabolism Topic: Carbohydrate metabolism Sub topic: Glycolysis, Kreb's cycle, glycogenesis, electron transport chain	*Explain how monosaccharides are catabolised to produce energy in the form of ATP through glycolysis and Kreb's cycle *Describe the synthesis of glucose from non-carbohydrate precursors	4

		*Draw metabolic pathways of glucose metabolism which replenish reduced NADP, ribose-5-phosphate and erythrose-4-phosphate	
12	**PART III: SEMESTER 5 DSE A, Applied zoology, ZOOG-DSE A-5-1-TH** Unit 5: Insects of economic importance Topic: Insects of economic importance Sub topic: Biology, control and damage caused by Helicoverpa armigera, Pyrilla pertusilla, Sitophilus oryzae and Tribolium casteneum	*Define a pest *Differentiate between various types of pests *List the salient features of insects and insect pests *Comment on the nature and extent of damage of different types of pests *Describe the socio-economic impact of pests	4

Name of Teacher: Dr. Swapna Bandyopadhyay

Department : Zoology

M.Sc

- **Lesson Plan (2018-2020 Syllabus)**

Topic serial	Name of topic with details of sub-topics	Objective	No. of classes
1	**SEMESTER 1, ZCT 103, TH** Cell Biology Topic 3: Cytoskeleton Cellular transport and extra cellular transport Topic 4: Cell signalling and cell-cell interaction Cell surface receptor and intracellular receptor, signalling pathways and cross talk mechanisms	*Define the cytoskeleton and its classification *Describe the structure and organisation of the three major group of cytoskeleton proteins *Explain the assembly and disassembly of microtubules and actin Filaments *Indicate the role of GTP and ATP in polymerization of tubulin and G-actin respectively *Explain the role of microtubules (MTs) and microfilaments in cell division *Describe the families of MTs and Actin based motor proteins *Describe the structure and function of cilia and flagella and	10

		indicate the types of Intermediate Filaments *Techniques for studying the secretory pathway *Molecular mechanisms of vesicular traffic *Early stages of the secretory pathway *Later stages of the secretory pathway *Receptor mediated endocytosis *Directing membrane proteins and cytosolic materials to the lysosome *Describe general principles of cell signalling *Describe G-protein linked receptors and enzyme linked receptors	
2	**SEMESTER 2, ZCT 207, TH** Developmental Biology Topic 1: Principles of developmental biology (potency,	*Levels of commitment *Cell differentiation commitment	10

	commitment, specification, induction, competence)	*Some differentiated cell types and their major products *Second stage of commitment (determination) *Cell fate determination *Specification *Autonomous specification *Cytoplasmic determinants and autonomous specification in the tunicate *Conditional specification in the sea urchin embryo *Syncytial specification	
3	**SEMESTER 2, ZCT 208, TH** Biochemistry Topic 2: Outline of metabolic pathways of the major biomolecules with mention of rate limiting steps Glycolysis, TCA cycle, glycogenesis, neoglucogenesis, glycogenolysis	*Explain the processes of glycolysis *Describe the pathway of a pyruvate molecule through the Krebs cycle *Summarize the process of gluconeogenesis	8

	Beta oxidation of fatty acids (saturated and unsaturated) Topic 4: Bioenergetics (aerobic and anaerobic respiration, oxidative and substrate level phosphorylation), basic concept of ETC and ATP synthesis, uncouplers, spontaneous reaction	*Identify the different steps of fatty acid degradation *Describe ketone bodies and their role in metabolism *Explain how fatty acids are synthesised *Explain how fatty acid metabolism is regulated *Learn about major components of respiratory complexes and their energetics	
4	**SEMESTER 3, ZCT 311, TH** Conservation Biology Topic 3: Climate change and biodiversity The global fingerprint of climate change on biodiversity, climate change in ecosystem-species loss and system degradation, conservation planning and climate integrated conservation strategies	*Describe the greenhouse effect and global warming *Explain the concept of climate change *Consider the effects of climate change on extreme weather	6
5	**SEMESTER 3, ZCT 312, TH** Endocrinology and comparative animal physiology Topic 11: Insect sociality and physiology-colony optimisation	*Describe acceleration techniques for ACO based on gradient based reinforcement learning *Applications of ACO	4

	theories, hypothesis and social algorithms, development and hormonal regulations in insects	*Current ACO trends *ACO successes *Describe regulation of insect metamorphosis, general pathway of insect metamorphosis	

Name of Teacher: Dr. Swapna Bandyopadhyay

Department : Zoology

M.Sc

- **Lesson Plan (2020-2022 Syllabus)**

Topic serial	Name of topic with details of sub-topics	Objective	No. of classes
1	**SEMESTER 1, ZCT 103, TH** Cell Biology Topic 3: Cytoskeleton Cellular transport and extra cellular transport	*Define the cytoskeleton and its classification *Describe the structure and organisation of the three major group of cytoskeleton proteins *Explain the assembly and disassembly of microtubules and actin Filaments *Indicate the role of GTP and ATP in polymerization of tubulin and G-actin respectively *Explain the role of microtubules (MTs) and microfilaments in cell division *Describe the families of MTs and Actin based motor proteins *Describe the structure and function of cilia and flagella and	10

		indicate the types of Intermediate Filaments *Techniques for studying the secretory pathway *Molecular mechanisms of vesicular traffic *Early stages of the secretory pathway *Later stages of the secretory pathway *Receptor mediated endocytosis *Directing membrane proteins and cytosolic materials to the lysosome	
2	**SEMESTER 2, ZCT 207, TH** Developmental Biology Topic 1: Principles of developmental biology (potency, commitment, specification, induction, competence)	*Levels of commitment *Cell differentiation commitment *Some differentiated cell types and their major products *Second stage of commitment (determination)	10

		*Cell fate determination *Specification *Autonomous specification *Cytoplasmic determinants and autonomous specification in the tunicate *Conditional specification in the sea urchin embryo *Syncytial specification	
3	**SEMESTER 2, ZCT 208, TH** Biochemistry Topic 2: Outline of metabolic pathways of the major biomolecules with mention of rate limiting steps Glycolysis, TCA cycle, glycogenesis, neoglucogenesis, glycogenolysis Beta oxidation of fatty acids (saturated and unsaturated) Topic 4: Bioenergetics (aerobic and anaerobic respiration, oxidative and substrate level phosphorylation), basic concept of ETC and ATP	*Explain the processes of glycolysis *Describe the pathway of a pyruvate molecule through the Krebs cycle *Summarize the process of gluconeogenesis *Identify the different steps of fatty acid degradation *Describe ketone bodies and their role in metabolism	8

	synthesis, uncouplers, spontaneous reaction	*Explain how fatty acids are synthesised *Explain how fatty acid metabolism is regulated *Learn about major components of respiratory complexes and their energetics	
4	**SEMESTER 3, ZCT 311, TH** Conservation Biology Topic 3: Climate change and biodiversity The global fingerprint of climate change on biodiversity, climate change in ecosystem-species loss and system degradation, conservation planning and climate integrated conservation strategies	*Describe the greenhouse effect and global warming *Explain the concept of climate change *Consider the effects of climate change on extreme weather	6
5	**SEMESTER 3, ZCT 312, TH** Endocrinology and comparative animal physiology Topic 11: Insect sociality and physiology-colony optimisation theories, hypothesis and social algorithms, development and hormonal regulations in insects	*Describe acceleration techniques for ACO based on gradient based reinforcement learning *Applications of ACO *Current ACO trends *ACO successes *Describe regulation of insect metamorphosis,	4

		general pathway of insect metamorphosis	

DR SUTAPA GUPTA

ASSOCIATE PROFESSOR

DEPARTMENT OF ZOOLOGY

MSc 2018-2020	SEM 1 1.Metapopulation Objective The pattern of movement of individuals affects the persistence of a metapopulation. In some cases, small populations within a metapopulation are rescued from extinction by receiving frequent immigrants from larger populations. Populations that are correlated in their response to environrmental fluctuations may suffer reductions in size simultaneously, thus imperiling the entire metapopulation. Metapopulations containing populations that are more or less independent of one another may persist longer than those with populations having correlated dynamics. These concepts will be discussed in detail in class.		DR SUTAPA GUPTA
	2. Life History Strategies Objective Every modification involves a trade-off, meaning that an increase in any one implies a decrease in another. If the resources are limited, then the time, energy, or materials devoted to		DR SUTAPA GUPTA

	one structure or function cannot be allotted to another. Therefore, each individual is faced with the problem of allocation: given that resources are limited, how can the organism best use its time and resources? These concepts will be discussed in detail in class.		
	SEM 2 Pharmacogenomics Objective Pharmacogenomics- an important part of precision medicine. It is the study of how a person's genetic makeup can affect their response to a drug. Health care providers can use pharmacogenomic information to help decide the most appropriate treatment for each individual. Some examples include choosing a drug that is more likely to work, avoiding drugs that might have side effects, adjusting the dose of a drug, or determining if closer monitoring is needed. In addition, pharmacogenomics now plays an important role in the drug development process, opening new opportunities in drug discovery Bioinformatics Objective To uncover the wealth of biological information hidden in the mass of		DR SUTAPA GUPTA

	sequence, structure,literature and biological data. Oxidative Stress Objective Oxidative stress is well known to be involved in the pathogenesis of lifestyle-related diseases, including atherosclerosis, hypertension, diabetes mellitus, ischemic diseases, and malignancies. Oxidative stress has been defined as harmful because oxygen free radicals attack biological molecules such as lipids, proteins, and DNA. However, oxidative stress also has a useful role in physiologic adaptation and in the regulation of intracellular signal transduction. Therefore, a more useful definition of oxidative stress may be “a state where oxidative forces exceed the antioxidant systems due to loss of the balance between them.” The biomarkers that can be used to assess oxidative stress in vivo have been attracting interest because the accurate measurement of such stress is necessary for investigation of its role in lifestyle diseases as well as to evaluate the efficacy of treatment. Gene Therapy Objective: To understand how a popular and emerging treatment option can be to treat diseases at the genetic level. Vitamins Objective use of vitamins and coenzymes with the relevant reaction involved, vitamin deficiencies These concepts will be discussed in detail in class.		

	SEM 3 Basic concept of wildlife Biology Wildlife conservation Indian perspective Conservation Biology of important wild animals Objective Wildlife, being an integral part of any ecosystem, plays a vital role in maintaining ecological balance. Decline or extinction of a component species results in a chain of events which adversely affect a number of other species as well (ripple effect). If a species is lost, it may upset the balance of nature and make the entire system vulnerable which, often results in unfavourable and undesirable outcome that ultimately affects mankind.		DR SUTAPA GUPTA
	SEM 4 Bioremediation, Objective • Bioremediation refers to the use of either naturally occurring or deliberately introduced microorganisms to consume and break down environmental pollutants, in order to clean a polluted site. • It is a process that uses mainly microorganisms but also plants, or microbial or plant enzymes to detoxify contaminants in the soil and other environments. The concept includes biodegradation, which refers to the partial and sometimes total, transformation or detoxification of contaminants by microorganisms and plants. Invasive Species		DR SUTAPA GUPTA

	Objective • An invasive species can be any kind of living organism—an amphibian (like the cane toad), plant, insect, fish, fungus, bacteria, or even an organism's seeds or eggs—that is not native to an ecosystem and causes harm. They can harm the environment, the economy, or even human health. Species that grow and reproduce quickly, and spread aggressively, with potential to cause harm, are given the label "invasive." Those non-native species judged to cause overall economic or environmental harm or harm to human health may be considered invasive, even if they yield some beneficial effects. Society struggles to determine the appropriate course of action in such cases, but in a democratic society that struggle is essential. Many invasive species are examples of "the tragedy of the commons," or how actions that benefit one individual's use of resources may negatively impact others and result in a significant overall increase in damage to the		

	economy, the environment, or public health. Ecological restoration Objective .Restoration of damaged ecosystems is receiving increasing attention worldwide as awareness increases that humanity must sustain ecosystem structure, functioning, and diversity for its own wellbeing. Restoration will become increasingly important because our planet will sustain an increasingly heavy human footprint as human populations continue to increase. Restoration efforts can improve desirable ecological functioning, even when restoration to a historic standard is not feasible with current practice.		
	Elective: Topic : Environmental impact assessment. 2 Class-1 : Introduction to EIA, Objectives Class-2 : EIA process and case studies Objectives : EIA consists of multiple numbers of Scopes in the field works, analytical and sustainable model development. It also gives a benefit to understand the risk factors and the mitigating measures to be taken for future development. 2. Environmental Biomonitoring; 3 Environmental DNA; bioindicators and biomarkers Class-1 : Introduction to Environmental Biomonitoring, Class-2 : Environmental DNA concept		DR SUTAPA GUPTA

	Class-3 : Bioindicator and Biomarkers Objectives : Environmental biomonitoring helps to understand the quality of the health of environmental parameters as well as indicate to the risk factors and marking them for various desired manifestations. Semiochemistry Objective Semiochemistry is the chemical means of communication used by living species. nfochemicals, a component of IPM is being explored in management of insect-pests. But indepth research as well as popularization of infochemicals among the farmers is very limited. To make it a viable component in pest management, it has to be cheap with better efficacy and should be easily available. Endrocrine disruption Objective Many ubiquitous products- including plastics, cosmetics, & pesticides- contain Endocrine disruptors, & animal studies have shown that even low- dose in utero exposure to these chemicals can produce major disabilities later in life. Many ubiquitous products- including plastics, cosmetics, & pesticides- contain Endocrine disruptors, & animal studies have shown that even low- dose in utero exposure to these chemicals can produce major disabilities later in life. Introduction to Toxicology Classification and examples of toxins Objective Toxicology is a study of the interaction between chemicals and biological systems in order to		

	quantitatively determine the potential for chemical(s) to produce injury and results in adverse effects in living organisms,and to investigate the nature,incidence,mechanism of production, factors influencing their development and reversibility of such adverse effects. Xenometabolisim : Phase 1 & Phase 2 reactions Objective Gain insights into the fate of different Xenobiotics.		

DR SUTAPA GUPTA

Associate Professor

Department of Zoology

Topic Serial	Name of Topic with details of sub-topics	No. of Classes	Name of teacher
1	PART 1:SEMESTER 1 CORE COURSE 1 NON CHORDATES ZOOA-CC1 TH(UNDER CBCS) TOPIC General Characters and Classification of Porifera, Canal system, Spicules OBJECTIVE Class 1: General characters and classification of Porifera with examples Gain insight on canal system, types of canal systems, functions Class 2: Skeletal framework,Structure and Types of spicules a. On the basis of deposit on core organic matter b. On the basis of size and function c. On the basis of number of axes and rays Development of spicules	6	DR SUTAPA GUPTA
2	PART 1:SEMESTER 1 CORE COURSE 2 TOPIC Nucleic acids Salient features of DNA, Chargaff's rule, Hypochromic shift and Hyperchromic shift, Watson and Crick Model RNA types and Functions Objective An overview on Deoxyribonucleic acid, or DNA, is a molecule that contains the instructions an organism needs to develop, live and reproduce. These instructions are	3	DR SUTAPA GUPTA

	found inside every cell, and are passed down from parents to their children. Class1:DNA structure, Nomenclature of Nucleic acid Components, Base stacking, antiparallel strands, 3D Structure of DNA,types of DNA, Class 2: Chargaff's rule, Hypochromic shift and Hyperchromic shift, Watson and Crick Model Class 3: Structure of RNA, types, Functions		
3	PART 1 : SEMESTER 2 TOPIC Cancer- Oncogene, Protooncogene activation, tumour suppressor gene, retinoblastoma, p53 Objective Cancer tends to involve multiple mutations. Cancer cells evade growth receptors, resist cell death, enable replicative immortality,induce angiogenesis,deregulate cellular energetics, evade immune destruction.Understanding the mechanism of Protooncogene activation and the role of Tumour suppressor genes is crucial in the current health scenario. **Tumor suppressor genes** are normal **genes** that slow down cell division, repair DNA mistakes, or tell cells when to die (a process known as apoptosis or programmed cell death). When **tumor suppressor genes** don't work properly, cells can grow out of control, which can lead to **cancer**. Class 1 & 2:c Class 3 & 4: Oncogene, naming of oncogenes, Activation of Oncogenes, Mechanism of action of Oncogenes, Methods of Transforming cells with Oncogenes, Mechanisms for the activation of Protooncogenes, Normal role of Oncogenes,Cellular locations and Functions of Oncogene Products	8	DR SUTAPA GUPTA

	Class 5 &6: Ras Protooncogene, RasSignaling, Ras/raf/MEK/ERK cascade, The Mitogen Activated protein kinase signaling pathway, 4 Categories of Ras inhibition strategies Class 7 & 8: **Tumor suppressor genes** – concept, examples, Concept of Gatekeepers and Caretakers, Retinoblastoma,- genetics, Classification of Retinoblastoma based on types of mutations,the two hit hypothesis,Molecular Pathogenesis p53 tumour suppressor gene,what happens when p53 isactivated, how is p53 activated,what happenswhen p53 is inactivated, difference between normal p53 and mutated p53,Role of mdm2		
4	PART II :SEMESTER 3 Unit 6 TOPIC Poisonous and non poisonouusSnakes: Differences Poison apparatus and biting mechanism of snakes Objective: Snakes belong to limbless group (ophidia) of class- Reptilia (Phylum–chordata). Most of the snakes are non poisonous and there are four poisonous genera of snakes, In India every year 30,000 persons die of the Snake bite. Snakes do not chew their food but swallow its whole food. All the poisonous snakes have poison apparatus in their heads, which is not found in non–poisonous snakes. Class1: Constituents of poison apparatus- Poison gland, Poison duct, Fang and its types,Associated Muscles Class2: Biting Mechanism- 4 phases in detail with diagram Class 3:differences between poisonous and nonpoisonous snakes with examples	6	DR SUTAPA GUPTA

5	PART II :SEMESTER 3 Unit 8 TOPIC Echolocation in Microchiropterans Objective: Echolocation is the emission of high frequency sound (ultrasonic sound, about 20 kilohertz) which is utilised for detecting the presence of objects (including food) by the echoes produced. It is a good substitute for vision for those animals, such as bats, which have to hunt in darkness. These high frequency sounds are produced in the larynx (voice box) and are generally restricted in insectivorous bats of the suborder Microchiroptera. The mega-chiropterans, that feed on fruit, flower, nectar etc., generally lack ultrasonic orientation. However, some of its members (Rousettus and, perhaps, Epomophorus wahlbergi) produce orientation sounds that are largely audible and have ultrasonic components that are produced not in the larynx but by clicking the tongue.		DR SUTAPA GUPTA

	Bats are not the only mammals possessing ultrasonic orientation sounds. However, in case of bats, it has reached its peak. All bats, however, possess and utilise low frequency sounds (below 20 kHz — within normal audible range of humans), which are generally used to facilitate social interactions such as territorial spacing among individuals, mother-infant communication, recognition and warning calls. These concepts will be discussed in detail in class. Class1:Anatomical Structure in sound production and reception- role of nose leaf, specialisation of ears, specialisation of brain Class2: Ontogenetic development of echolocation, characteristics of Echolocation sounds, Harmonics of bats Class 3:Echolocation sounds produced by Microchiropterans, Effectiveness of acoustic orientation of bats,Working space and Information content of echoes		
6	PART II :SEMESTER 3 Unit 4 TOPIC	2	DR SUTAPA GUPTA

	Swim Bladder in fishes OBJECTIVE In most of the fishes a characteristic sac-like structure is present between the gut and the kidneys. This structure is called by various names, viz., swim-bladder, or gas-bladder or air-bladder. The connection with the oesophagus may be retained throughout life or may be lost in the adult. The swim-bladder is present in almost all the bony fishes and functions usually as a hydrostatic organ. Starting as a very insignificant cellular extension from the gut, the swim-bladder in fishes leads the whole group through an evolutionary channel. These concepts will be discussed in detail in class. Class 1: Introduction, Basic structure, Types of Swim Bladder Class 2: Modifications in Swinm Bladder Histological Modifications Functions		
7	PART II :SEMESTER 3 Unit 2 TOPIC Bone and cartilage, Ossification Objective Bone is often stereotyped as simply a protective and supportive framework for the	4	DR SUTAPA GUPTA

	body. Though it does perform these functions, bone is actually a very dynamic organ that is constantly remodeling and changing shape to adapt to the daily forces placed upon it. Moreover, bone stores crucial nutrients, minerals, and lipids and produces blood cells that nourish the body and play a vital role in protecting the body against infection. All these functions make the approximately 206 bones of the human body an organ that is essential to our daily existence. These concepts will be discussed in detail in class. Class 1 Structure of Bone Bone Tissue cell types Two modes of bone formation Intramembranous bone formation Endochondral bone formation Functions of bones Class 2 Cartilage- composition Types of cartilage Membranous ossification Endochondral ossification Centres of ossification		
8	PART II :SEMESTER 3 CC7 Unit 2 TOPIC Lipids- Structure and Significance Physiologically important saturated and unsaturated fatty acid Triacyglycerols Phospholipids Sphingolipid Glycolipid	5	DR SUTAPA GUPTA

	Steroid Eicasanoid Terpenoids Beta oxidation Palmitic acid Linoleic acid Fatty acid biosynthesis Objective Lipids are the fourth major group of molecules found in all cells. Unlike nucleic acids, proteins, and polysaccharides, lipids are not polymeric. However, they do aggregate, and it is in this state that they perform their central function as the structural matrix of biological membranes. Lipids exhibit greater structural variety than the other classes of biological molecules. To a certain extent, lipids constitute a catchall category of substances that are similar only in that they are largely hydrophobic and only sparingly soluble in water. In general, lipids perform three biological functions (although certain lipids serve more than one purpose in some cells): 1. Lipid molecules in the form of lipid bilayers are essential components of biological membranes. 2. Lipids containing hydrocarbon chains serve as energy stores. 3. Many intra- and intercellular signaling events involve lipid molecules. In these classes, we examine the structures and physical properties of the most common types of lipids. Lipid biosynthesis requires the participation of a three carbon intermediate , Malonyl-CoA		
9	Part II Sem 4 CC9 Unit 3 Structure and function of Haemoglobin Blood Clotting System Blood groups ABO and Rh factor Objective Hemoglobin(Hb) is a major Hemoprotein of Human body. Hemoglobin has important role in Respiration mechanism. Understanding the Rh factor Sensitization		DR SUTAPA GUPTA

10	Part III, Sem 5 CC11Unit 3 Community Characteristics: species diversity, abundance, dominance, richness Vertical Stratification Ecotone and edge effect Ecological Succession with one example Objective Understanding the characteristics of Community. The stratification of a plant community is the result of long selection and adaptation processes. Through the formation of different layers a given habitat is better utilized. Strongly vertically stratified habitats are very stable ecosystems. The opposite is not true, because several less stratified vegetation types, such as reed beds, can be very stable. It is important to emphasize that the phenomenon of succession is “community controlled”. Each group of organisms changes its physical substrate and the microclimate (e.g., local conditions of light, temperature), thereby making conditions favourable for another group of organisms. In other words, we say that each species alters the environment in such a way that it can no longer grow so successfully as others. When the site has been fully modified by biological processes, an ecological steady state is developed. The species involved,		DR SUTAPA GUPTA

	time taken and the degree of stability achieved depend on the topography or climate of the area, and other physical factors. But the process of succession itself is biological, not physical. Thus, the physical environment determines the pattern of succession but does not cause it.		
11	Part III, Sem 5 CC11Unit 5 Types and level of Biodiversity,megadiversity countries, Biodiversity hotspot,Flagship species, keystone species, Wildlife Conservation- In situ and Ex situ Conservation Threats to survival and Conservation Strategies for Tiger, Olive Ridley turtles and White rumped Vulture Objective Biodiversity forms the foundation of the vast array of ecosystem services that critically contribute to human well-being. Biodiversity is important in human-managed as well as natural ecosystems. Decisions humans make that influence biodiversity affect the well-being of themselves and others. Without biodiversity, the health of the planet is at stake.		DR SUTAPA GUPTA
12	Part III, Sem 6 CC 13 Unit 4: Concept of potency,types and markers Objective Pluripotent cells can give rise to all of the cell types that make up the body; embryonic stem cells are considered pluripotent.		DR SUTAPA GUPTA

13	CC14, UNIT 3: Geological Time Scale Fossil: Types and age determination by Carbon Dating Evolution of Horse Objective The geological time scale is a system of chronological measurement that related stratigraphy (the study of rock strata, especially the distribution, deposition and age of sedimentary rocks) to time, and is used by the geologists, palentologists and other earth scientists to describe the time and relationship between the events that have occurred throughout earth's history. Fossils provide evidence of how life has changed over time.□Fossils help scientists infer how Earth's surface has changed.□Fossils are clues to what past environments were like.		
14	Part III Sem 6 DSE2: Animal Biotechnology Unit 2 Molecular Techniques in gene manipulation Cloning vectors and their features: Plasmid, Phage vectors,cosmids, phagemids,BAC, YAC and HAC, Shuttle and Expression Vectors Objectives Gain insight into the basic tools of Biotechnology		DR SUTAPA GUPTA

MSc 2023-2025	SEM 1 ZCT 102 1.2 Life History Strategies Objective Objective Every modification involves a trade-off, meaning that an increase in any one implies a decrease in another. If the resources are limited, then the time, energy, or materials devoted to one structure or function cannot be allotted to another. Therefore, each individual is faced with the problem of allocation: given that resources are limited, how can the organism best use its time and resources? 1.3 Metapopulation concept, Models of persistence and extinction risks Objective The pattern of movement of individuals affects the persistence of a metapopulation. In some cases, small populations within a metapopulation are rescued from extinction by receiving frequent immigrants from larger populations. Populations that are correlated in their response to environrmental fluctuations may suffer reductions in size simultaneously, thus imperiling the entire metapopulation. Metapopulations containing populations that are more or less independent of one another may persist longer than those with populations having correlated dynamics.		DR SUTAPA GUPTA ASSOCIATE PROFESSOR DEPARTMENT OF ZOOLOGY

	SEM 2 Vitamins and Minerals: use of vitamins and coenzymes with the relevant reaction involved, vitamin deficiencies Objective Gain insight of these concepts is essential for lifestyle management. Chemistry of free radicals and antioxidants Objective Oxidative stress is well known to be involved in the pathogenesis of lifestyle-related diseases, including atherosclerosis, hypertension, diabetes mellitus, ischemic diseases, and malignancies. Oxidative stress has been defined as harmful because oxygen free radicals attack biological molecules such as lipids, proteins, and DNA. However, oxidative stress also has a useful role in physiologic adaptation and in the regulation of intracellular signal transduction. Therefore, a more useful definition of oxidative stress may be “a state where oxidative forces exceed the antioxidant systems due to loss of the balance between them.” The biomarkers that can be used to assess oxidative stress in vivo have been attracting interest because the accurate measurement of such stress is necessary for investigation of its role in lifestyle diseases as well as to evaluate the efficacy of treatment. Gene Therapy and Pharmacogenomics 11.1 Various approaches of gene therapy, Stem cell and micro RNA therapy 11.2 tissue targetedgene therapy 11.3 Concept of pharmacogenomics, use of Pharmacogenetics for disease		DR SUTAPA GUPTA

	prognosis and treatment, response and toxicity Objective Pharmacogenomics- an important part of precision medicine. It is the study of how a person's genetic makeup can affect their response to a drug. Health care providers can use pharmacogenomic information to help decide the most appropriate treatment for each individual. Some examples include choosing a drug that is more likely to work, avoiding drugs that might have side effects, adjusting the dose of a drug, or determining if closer monitoring is needed. In addition, pharmacogenomics now plays an important role in the drug development process, opening new opportunities in drug discovery Bioinformatics and Proteomics Objective To uncover the wealth of biological information hidden in the mass of sequence, structure,literature and biological data.		
	SEM 4 Bioremediation, Objective • Bioremediation refers to the use of either naturally occurring or deliberately introduced microorganisms to consume and break down environmental pollutants, in order to clean a polluted site. • It is a process that uses mainly microorganisms but also plants, or microbial or plant enzymes to detoxify contaminants in the soil and other environments. The concept includes biodegradation, which refers to		DR SUTAPA GUPTA

	the partial and sometimes total, transformation or detoxification of contaminants by microorganisms and plants. Invasive Species Objective • An invasive species can be any kind of living organism—an amphibian (like the cane toad), plant, insect, fish, fungus, bacteria, or even an organism's seeds or eggs—that is not native to an ecosystem and causes harm. They can harm the environment, the economy, or even human health. Species that grow and reproduce quickly, and spread aggressively, with potential to cause harm, are given the label "invasive." Those non-native species judged to cause overall economic or environmental harm or harm to human health may be considered invasive, even if they yield some beneficial effects. Society struggles to determine the appropriate course of action in such cases, but in a democratic society that struggle is essential. Many invasive species are examples of "the tragedy of the commons," or how actions that		

	benefit one individual's use of resources may negatively impact others and result in a significant overall increase in damage to the economy, the environment, or public health. Ecological restoration Objective .Restoration of damaged ecosystems is receiving increasing attention worldwide as awareness increases that humanity must sustain ecosystem structure, functioning, and diversity for its own wellbeing. Restoration will become increasingly important because our planet will sustain an increasingly heavy human footprint as human populations continue to increase. Restoration efforts can improve desirable ecological functioning, even when restoration to a historic standard is not feasible with current practice.		
	Elective: Topic : Environmental impact assessment. 2 Class-1 : Introduction to EIA, Objectives Class-2 : EIA process and case studies Objectives : EIA consists of multiple numbers of Scopes in the field works, analytical and sustainable model development. It also gives a benefit to understand the risk factors and the mitigating measures to be taken for future development. 2. Environmental Biomonitoring; 3		DR SUTAPA GUPTA

	Environmental DNA; bioindicators and biomarkers Class-1 : Introduction to Environmental Biomonitoring, Class-2 : Environmental DNA concept Class-3 : Bioindicator and Biomarkers Objectives : Environmental biomonitoring helps to understand the quality of the health of environmental parameters as well as indicate to the risk factors and marking them for various desired manifestations. Semiochemistry Objective Semiochemistry is the chemical means of communication used by living species. nfochemicals, a component of IPM is being explored in management of insect-pests. But indepth research as well as popularization of infochemicals among the farmers is very limited. To make it a viable component in pest management, it has to be cheap with better efficacy and should be easily available. Endrocrine disruption Objective Many ubiquitous products- including plastics, cosmetics, & pesticides- contain Endocrine disruptors, & animal studies have shown that even low- dose in utero exposure to these chemicals can produce major disabilities later in life. Many ubiquitous products- including plastics, cosmetics, & pesticides- contain Endocrine disruptors, & animal studies have shown that even low- dose in utero exposure to these chemicals can produce major disabilities later in life. Introduction to Toxicology		

	Classification and examples of toxins Objective Toxicology is a study of the interaction between chemicals and biological systems in order to quantitatively determine the potential for chemical(s) to produce injury and results in adverse effects in living organisms,and to investigate the nature,incidence,mechanism of production, factors influencing their development and reversibility of such adverse effects. Xenometabolisim : Phase 1 & Phase 2 reactions Objective Gain insights into the fate of different Xenobiotics.		

M Sc 2020-2022	SEM 1 Metapopulation Spatially Implicit and Explicit Populations Objective The pattern of movement of individuals affects the persistence of a metapopulation. In some cases, small populations within a metapopulation are rescued from extinction by receiving frequent immigrants from larger populations. Populations that are correlated in their response to environrmental fluctuations may suffer reductions in size simultaneously, thus imperiling the entire metapopulation. Metapopulations containing populations that are more or less independent of one another may persist longer than those with populations having correlated dynamics. Bioremediation Objective • The process of bioremediation enhances the rate of the natural microbial degradation of contaminants by supplementing the indigenous microorganisms (bacteria or fungi) with nutrients, carbon sources, or electron donors (biostimulation, biorestoration) or by adding an enriched culture of microorganisms that have specific characteristics that allow them to degrade the desired contaminant at a quicker rate (bioaugmentation). • The goal of bioremediation is to at least reduce pollutant levels to undetectable, nontoxic, or acceptable levels, that is, to within limits set by regulatory agencies or, ideally, to completely mineralize		DR SUTAPA GUPTA ASSOCIATE PROFESSOR

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	SEM 3 ZCT 311 2.Process and Pattern of Biodiversity- Theories explaining global patterns of Biodiversity, Tracking Biodiversity using Indicator species, Taxon based Biodiversity indicators Objective 5. Conservation of Population Concept of EffectivePopulation, MVP, Population Viability Analysis andmaking Consevation decisions, Wildlifepopulation management and restoration Objective An aim of PVA is to predict extreme events (such as extinction) rather that central tendencies such as mean population sizes. Given the environmental circumstances and life history characteristics of a particular rare species, what is the chance it will go extinct in a specified period? Alternatively, how big must its population be to reduce the chance of extinction to an acceptable level? These are frequently the crunch		DR SUTAPA GUPTA

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