ACADEMIC CALENDAR FOR SEMESTER I AND II (HONOURS & GENERAL) (2019-2020)

Honours Course

		SEMESTER-I			
Month	No. of Teaching days available	Topic		Class teaching in hours of each core	Tutorial In hours
		ZOOACOR01T Marks:50+25=75 **NON-CHORDATE I**	ZOOACOR02T Marks:50+25=75 **ECOLOGY**		
July,19	26	**Unit 1: Protista, Parazoa & Metazoa** i)Characteristic and classification up to classes ii) study of *Euglena*, *Amoeba* and *Paramoecium* iii)Locomotion and reproduction in protista **Unit 2: Porifera** i)characteristic and classification upto classes ii)Canal system and spicules in sponges **Unit 3: Cnidaria** i)characteristic and classification upto classes ii) coral and coral reefs	**Unit -1 : Introduction to Ecology** i)History of ecology, Autecology and synecology, Laws of limiting factors **Unit -2: Population** i)Unitary and Modular populations, Demographic factors, life tables, fecundity tables. **Unit -3: Community** i)Species diversity, abundance, dominance	22	4

		PRACTICAL 1.Study of whole mount of *Euglena, Amoeba, Paramoecium*. 2. Binary fission and Conjugation in Paramoecium 3. Examination of freshwater pond water collected from different places for diversity of protists in it.	**PRACTICAL** 1.Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. 2.Determination of population density of a natural/hypothetical population.		
August,19	24	**Unit 1: Protista, Parazoa & Metazoa** iv) Evolution of symmetry and segmentation of Metazoa. v) Life cycle and pathogenicity of *Giardia, Leishmania*, **Unit 3: Cnidaria** iii) Polymorphism in Cnidaria **Unit 6: Nemathelminthes** i)General characteristics and Classification upto classes ii) Origin and evolution of parasitic helminthes.	**Unit -1 : Introduction to Ecology** ii**)** levels of organization, study of physical factors, the Biosphere. **Unit -2: Population** ii)survivorship curves, dispersal and dispersion, iii) Geometric, exponential and logistic growth: equation and patterns, r and k strategies. Density dependent and density independent factor iv)Population interactions, Gause,s Principle with laboratory and field example, Lotka-Volterra equation for competition. **Unit -3: Community** ii)Richness, vertical stratification, Ecotone and edge effect.	22	4

		PRACTICAL 4.Study of *Sycon, Hyalonema, Euplectella, Spongilla.* 5. Study of *Obelia, Physalia, millepora, Aurelia, Tubipora, Corallium.* 6. Examination of freshwater pond water collected from different places for diversity of protists in it. 7. One specimen/slide of any Ctenophore	**PRACTICAL** 3. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. 4. Sampling of Phytoplankton and zooplankton. 5.Study of species diversity. Shannon-Weiner index		
September,19	22	**Unit-1: Protista, Parazoa & Metazoa** vi) Life cycle and pathogenicity of *Entamoeba* and *Plasmodium* **Unit 3: Cnidaria** iv) Metagenesis in Obelia. **Unit 6: Nemathelminthes** iii) Life cycle and pathogenicity of *Ascaris*	**Unit -3: Community** iii)Ecological succession and one example of it. **Unit -5: Applied Ecology** i)Wildlife Conservation (in situ and ex-situ conservation) ii)Management strategies for tiger conservation. iii)Wildlife Protection act (1972) .	18	4

		PRACTICAL viii) Study of *Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora* ix) study of adult *Fasciola hepatica, Taenia solium* and their life cycles. x) Study of adult *Ascaris lumbricoides* and its life stages	**PRACTICAL** 6. Measurement of temperature, turbidity/penetration of light. 7. Determination of pH 8. Study of species diversity. Shannon-Weiner index		
October,19	3	**Unit – 4: Ctenophora** i)General characteristic	**Unit -4: Ecosystem** i)Types of ecosystem with an example in detail,	3	-
		PRACTICAL	**PRACTICAL**		
November,19	24	**Unit -5: Platyhelminthes** i)General characteristics and Classification upto classes. ii) Life cycle and pathogenicity of *Fasciola*. **Unit 6: Nemathelminthes** iv) Life cycle and pathogenicity of *Ancylostoma* and *Wuchereria*	**Unit 4: Ecosystem** **ii)** Food chain, Detritus and grazing food chain. Linear and Y-shaped food chain. iii) Food web, energy flow through ecosystem, Ecological pyramids. Ecological efficiencies	20	4

		PRACTICAL **xi) Field trip** xii)Preparation of field report	**PRACTICAL** **8.** Determination of Dissolve oxygen content 9. COD 10. Field Trip and preparation of report.		
December,19	20	**Unit – 4: Ctenophora** ii)General characteristic **Unit -5: Platyhelminthes** Life cycle and pathogenicity of *Taenia solium*	**Unit 4: Ecosystem** iii)Nutrient and biogeochemical cycle with an example of Nitrogen cycle. Human modified ecosystem.	16	4
		PRACTICAL xiii)Preparation and submission of field report	**PRACTICAL** 11. Determination of free CO_2 12. Preparation submission of report.		

		SEMESTER-II			
Month	No. of Teaching days available	Topic		Class teaching in hours of each core	Tutorial In hours
		ZOOACOR03T **Marks:50+25=75** **NON-CHORDATE-II**	**ZOOACOR04T** **Marks:50+25=75** **CELL BIOLOGY**		

January'20	21	**Unit 1: Introduction to Coelomates** i)Evolution of Coelom **Unit 3: Arthropoda** i)General characteristics and Classification up to classes.	**Unit 1: Overview of cells** i)Prokaryotic and Eukaryotic cells **Unit 2: Plasma membrane** i)Various models of plasma membrane structure	17	5
		PRACTICAL i)Study of specimens	**PRACTICAL** i)Preparation of temporary stained squash of onion root tip to study various stages of mitosis.		
February,20	20	**Unit 1: Introduction to Coelomates** ii)Evolution of metamerism **Unit 2: Annelida** i)General characteristics and Classification up to classes. ii)Excretion in Annelida. **Unit 3: Arthropoda** i)Vision in Arthropods ii)Respiration in Arthropods **Unit 5: Mollusca** i) General characteristics and Classification up to classes.	**Unit 1: Overview of cells** ii)Virus, Viroids, Mycoplasma, Prions. **Unit 2: Plasma membrane** ii)Transport across membranes: Active and Passive transport, Facilitated transport. iii)Cell junctions: Tight junctions, Desmosomes, Gap junctions iv)Extracellular Matrix-cell interaction. **Unit 6: Nucleus** i)Structure of nucleus: Nuclear envelope,Nuclear pore complex. **Unit 7: Cell division** i)Mitosis	16	4

		PRACTICAL Study of specimens	**PRACTICAL** ii) Preparation of temporary stained squash of onion root tip to study various stages of mitosis. iii)Study of various stages of meiosis. iv) Preparation of permanent slide to show the presence of Barr body in human female blood.		
March,20	24	**Unit 3: Arthropoda** iii)Metamorphosis in insect iv)Social life in bees. **Unit 4: Onychophora** i) General characteristics and Evolutionary significance **Unit 5: Mollusca** ii)Respiration inMollusca	**Unit 3: Endomembrane System** i)Structure and functions: Endoplasmic Reticulum,Golgi Apparatus, Lysosomes. **Unit 6: Nucleus** ii)Nucleolus Chromatin: Euchromatin and heterochromatin. **Unit 7: Cell division** ii) Meiosis	20	4
		PRACTICAL Study of specimens	**PRACTICAL** v) DNA by Feulgen reaction vi) Preparation of permanent slide to show the presence of Barr body in human female blood.		
April,20	24	**Unit 3: Arthropoda** v)Social life in termites **Unit 5: Mollusca** iii)Torsion and detorsion in Gastropoda **Unit 6: Echinodermata** i) General characteristics and Classification up to classes. **Unit 7:Hemichordata** i)General characteristics	**Unit 4: Mitochondria and Peroxisome** i)Mitochondria: Structure, semi-autonomous nature. ii)Endosymbiotic hypothesis iii)Peroxisome **Unit 6: Nucleus** iii)Packaging (Nucleosome) **Unit 7: Cell division** iii)Cell cycle and its regulation.	20	4

		PRACTICAL i)Study of specimens ii)Dissection of Digestive system of Periplaneta	**PRACTICAL** vii)Mucopolysaccharides by PAS reaction. viii)Cell viability by Trypan Blue staining.		
May,20	22	**Unit 5: Mollusca** iv)Pearl formation in bivalves. **Unit 6: Echinodermata** ii)Water-vascular system in Asteroidea **Unit 7:Hemichordata** ii)Phylogenetic relationship with non-chordates and chordates.	**Unit 4: Mitochondria and Peroxisome** iv)Mitochondrial Respiratory chain, Chemiosmotic hypothesis. **Unit 7: Cell division** iv)Cancer (Concept of oncogenes and tumour suppressor genes) **Unit 8: Cell signaling** i)Cell signaling pathways. ii)Types of signaling molecules and receptors. iii)GPCR and role of second messenger (cAMP)	18	4
		PRACTICAL i)Digestive system, septal nephridia and pharyngeal nepridia of earthworm. ii)Nervous system of Periplaneta. iii)Prepare Project report	**PRACTICAL** ix)Proteins by Mercurobromophenol blue/Fast Green. x) Cell viability by Trypan Blue staining.		
June,20	24	**Unit 5: Mollusca** v)Evolutionary significance of trochophore larva. **Unit 6: Echinodermata** iii)Larval forms in Echinodermata. iv)Affinities with chordates.	**Unit 5: Cytoskeleton** i)Structure and functions: Microtubules, Microfilaments and Intermediate filaments. **Unit 7: Cell division** v)Mechanisms of cell death	10	2

		PRACTICAL i)T.S. through pharynx, gizzard and typhlosolar intestine of earthworm. ii)Mount of mouth parts of Periplaneta. Preparation and submission of Project report.	**PRACTICAL** i)Proteins by Mercurobromophenol blue/Fast Green. ii)Mucopolysaccharides by PAS reaction. iii)Cell viability by Trypan Blue staining.		

General Course

		SEMESTER-I	
Month	No. of Teaching days available	Topic	Class teaching in hours of each core
		ZOOGCOR01T Marks:50+25=75 **Animal Diversity**	

July,19	26	**Unit-1 Kingdom Protista** i)General characters and classification of Subkingdom Protozoa. ii)Locomotory organelles and locomotion in Protozoa **Unit-4 Phylum Platihelminthes** i)General characters and classification up to classes. ii)Life history of *Taenia solium*. **Unit-8 Phylum Mollusca** i)General characters and classification up to classes. ii)Respiration in *Pila* **PRACTICAL** i)Spot identification of the specimens	16
August,19	24	**Unit-2 Phylum Porifera** i)General characters and classification up to classes. ii)Canal system in *Sycon*. **Unit-3 Phylum Cnidaria** i)General characters and classification up to classes. ii)Polymorphism in Hydrozoa **Unit-7 Phylum Arthropoda** i) General characters and classification up to classes. **Unit-5 Phylum Nematoda** i) General characters and classification up to classes. ii)Life history of *Ascaris lumbricoides* and its parasitic adaptation. **Unit-6 Phylum Annelida** i) General characters and classification up to classes. **PRACTICAL** Spot identification of the specimens	16

September,19	22	**Unit-7 Phylum Arthropoda** i)Vision in insect. ii)Metamorphosis in insects. **Unit-6 Phylum Annelida** i)Nephridia in Annelida **Unit-12 Pisces** i)General characters and classification up to Subclasses. ii)Osmoregulation in Fishes . **PRACTICAL** Spot identification of the specimens	12
October,19	3	**Unit-13 Amphibia** i)General characters and classification up to classes. **PRACTICAL** -	2
November,19	24	**Unit-9 Phylum Echinodermata** i)General characters and classification up to classes. ii)Water-vascular system in Asterias **Unit-10 Protochordates** i)General features **Unit-13 Amphibia**	16

		i)Metamorphosis in Toad **Unit-14 Reptiles** i)General features and classification up to living Subclasses. ii)Biting mechanism in snakes, Poisonous and nonpoisonous snakes **PRACTICAL** **i)** ii)Study of the permanent slides ii)Identification of poisonous and non-poisonous snakes iii)Preparation of Animal album	
December,19	20	**Unit-10 Protochordates** i)Feeding in Branchiostoma **Unit-11 Agnatha** i) General characters and classification up to classes. **Unit-15 Aves** i)General characters and classification up to orders. ii)Flight adaptations in birds **Unit-16 Mammals** i)Classification up to Subclasses. ii)Origin and distribution of Cranial nerves in Cavia	6
		PRACTICAL i)Preparation and submission of Animal album	

		SEMESTER-II

Month	No. of Teaching days available	Topic	Class teaching in hours of each core
		ZOOGCOR02T Marks:50+25=75 Physiology and Biochemistry	
January,20	21	**Unit-1: Nerve and muscle** i)Structure of neuron **Unit-2:Digestion** i)Physiology of digestion in the alimentary canal. **Unit-9: Protein: Structure and Metabolism** i)Proteins and their biological functions, functions of amino acids, ii)Physiochemical properties of amino acids, Peptides – structure and properties. iii)Primary, secondary, tertiary and quaternary structure of proteins. iv)Transamination, Deamination. v)Urea cycle.	14
		PRACTICAL i)Preparation of Haemin crystals ii)Identification of permanent histological slides iii)Qualitative tests to identify functional groups of carbohydrates. iv)Lowry`s method for quantitative test of protein	

February,20	20	**Unit-1: Nerve and muscle** ii)Resting membrane potential, Graded potential, Origin of action potential iii)Propagation of action potential through myelinated and unmyelinated nerve fibers. iv)Ultra-structure of skeletal muscle. **Unit-2:Digestion** ii)Absorption of carbohydrates, proteins and lipids. **Unit-5:Cardiovascular system** i)Composition of blood, Homeostasis. ii)Structure of heart. iii)Origin and conduction of the cardiac impulse. iv)Cardiac cycle.	14
		PRACTICAL i)Preparation of Haemin crystals ii)Identification of permanent histological slides iii)Qualitative tests to identify functional groups of carbohydrates. iv)Lowry`s method for quantitative test of protein	

March,20	24	**Unit-1: Nerve and muscle** v)Molecular and chemical basis of muscle contraction. **Unit-3: Respiration** i)Pulmonary ventilation, Respiratory volumes and capacity. **Unit-6: Reproduction and Endocrine gland** i)Physiology of male reproduction: hormonal control of spermatogenesis. ii)Physiology of female reproduction: hormonal control of menstrual cycle. **Unit-7: Carbohydrate: Structure and Metabolism** i)Introduction to Carbohydrates, Structure and Types of Carbohydrates, Isomerism, ii) Glycolysis	16
		PRACTICAL i)Preparation of Haemin crystals ii)Identification of permanent histological slides iii)Qualitative tests to identify functional groups of carbohydrates. iv)Lowry`s method for quantitative test of protein	

April,20	24	**Unit-3: Respiration** ii)Transport of Oxygen. iii)Transport of Carbon-di-oxide. **Unit-6: Reproduction and Endocrine gland** iii)Structure and function of Pituitary. iv) Structure and function of Thyroid v) Structure and function of pancreas vi) Structure and function of adrenal **Unit-7: Carbohydrate: Structure and Metabolism** iii)Krebs cycle iv)Pentose phosphate pathway **Unit-10: Enzymes** i)Introduction, Classification of Enzymes ii)Mechanism of action iii)Enzyme kinetics iv)Inhibition and Regulation	16
		PRACTICAL i)Preparation of Haemin crystals ii)Identification of permanent histological slides iii)Qualitative tests to identify functional groups of carbohydrates. iv)Study of activity amylase under optimum conditions.	
May,20	22	**Unit-4: Excretion** i)Structure of nephron. ii)Mechanism of urine formation iii)Counter-current Mechanism **Unit-7: Carbohydrate: Structure and Metabolism** v) Gluconeogenesis vi)Electron Transport Systen	12

		Unit-8: Lipid structure and Metabolism i)Introduction to lipids: Definitions; fats and oils; classes of lipids. ii)Biosysthesis of palmitic acid iii) B-oxidation of palmitic acid.	
		PRACTICAL i)Preparation of Haemin crystals ii)Identification of permanent histological slides iii)Qualitative tests to identify functional groups of carbohydrates. iv)Study of activity amylase under optimum conditions.	
June,20	24	-	0

,

.

Month	No of teaching days available	SEMESTER-III Honours Course **ZOOACOR05T** **Marks:50+25=75** **CHORDATES**	 **ZOOACOR06T** **Marks:50+25=75** **PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS**	 **ZOOACOR07T** **Marks:50+25=75** **BIOCHEMISTRY**	Class teaching in hours of each core	Tutorial In hours
July,2019	26	Unit 1: Introduction to Chordates: 1.General characteristics and outline classification of phylum Chordata. **Unit 2**: Protochordata 2. general characteristics and classification of Urochordata and Cephalochordata upto Classes. 3. Metamorphosis in Ascidia. 4.chordates features and feeding in Branchiostoma Unit 3: Origin of Chordates 1.Dipleurula concept and the Echinoderm theory of origin of chordates. 2. Advanced features of vertebrates over protochordates.	Unit 1: Tissues 1.Strusture,locations, classification and functions of epithelial tissues. 2.Strusture,locations,classification and functions of connective tissue tissues. 3.Strusture,locations, classification and functions of muscular tissue tissues. 4.Strusture,locations, classification and functions of nerve tissues.	Unit 1: Fundamentals of biochemical reaction and metabolism: 1.Ionization of water, weak acids and bases, buffering and pH changes in living system. 2. catabolism and anabolism, compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as “Energy Currency of cell”; coupled reactions; Use of reducing equivalents and co-factors; intermediary metabolism and regulatory mechanisms.	22	4

		PRACTICAL 1.Protochordata *Herdmania*, *Branchiostoma* Colonial Urochordates; Sections of *Balanoglossus* through proboscis and branchiogenital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions, *Herdmania* spicules, 2. Agnatha *Petromyzon, Myxine*	**PRACTICAL** **1.Recording of simple muscle twitch with electrical stimulation (Virtual)**	**PRACTICAL** 1.Qualitative tests of functional groups in carbohydrate, proteins and lipids.		

August,2019	24	Unit 4: Agnatha 1.General characteristics and classification of cyclostomes up to order. Unit 5: Pisces 1. General characteristics and classification of Chondrichthyes and Osteichthyes upto Subclasses. 2. Accessory respiratory organ 3. Migration of fishes 4. Parental care of fishes. 5. Swim bladder in fishes. Unit 6: Amphibia 1. General characteristics and classification up to living orders 2. Metamorphosis in amphibia.	Unit 2: Bone and Cartilage 1.Structure and types of bones and cartilages, Ossification. Unit 5: Reproductive System 1. Histology of testis 2. Histology of ovary. 3. physiology of reproduction.	Unit 2: Carbohydrates 1.Structure and biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of monosaccharides, 2. Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis. Unit 3: Lipids: 1.Structure and significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Sphingolipids, Steroids, Eicosanoids and terpinoids. 2. Lipid metabolism: beta-oxidation of fatty acids; fatty acid biosynthesis.	22	4
		PRACTICAL 3. Fishes Scoliodon, Sphyrna, pristis, Torpedo, chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetradon, Anabas, Flat fish.	PRACTICAL **2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibers and nerve cells.**	PRACTICAL: 1.Paper chromatography of amino acids 2. Quantitative estimation by Lowry method.		

September,2019	22	Unit 6: Amphibia 3. Parental care in amphibian. Unit 7: Reptilia 1. General characteristics and classification up to living orders. 2. poison apparatus and biting mechanism in Snake. Unit 8: Aves 1. General characteristics and classification up to Sub-classes 2. Exoskeleton in Birds 3. migration in Birds.	Unit 3: Nervous System 1.Structure of neuron 2. Resting membrane potential 3. Origin of action potential and its propagation across the myelinated and unmyalinated nerve fibers. 4. Types of synapse. 5. Reflex action and its type 6. Synaptic transmission and Neuromuscular junction.	Unit 4: Proteins: 1.Amino acid structure, Classification, General and Electrochemical properties of α amino acids. 2.Physiological importance of essential and non-essential amino acids 3.proteins bonds stabilizing protein structure; Levels of organization 4. Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids.	18	12
		PRACTICAL 4. Amphibia: Ichthyophis, Necturus, Bufo, Hyla, Alytes, Salamander, 5. Reptilia: Chelone, Trionix, Hemidactylus, Varanus, Uromastix, Chameleon, Ophiosaurus.	PRACTICAL **3. Study of permanent slides of Mammalian skin, cartilage, bone, Spinal cord, Nerve cell, pituitary**	PRACTICAL 4. Demonstration of protein seperation by SDS-PAGE		
October,2019	3	**Unit-8** **4.** Principles and aerodynamics of flight.	Unit 4: Muscular System 1.Histology of different types of muscle.	Unit 5: 1.Structure: purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids	3	-

		PRACTICAL Mount of weberian Ossicles of Mystus or Grass Carp.	PRACTICAL **3. Study of permanent slides of Pancreas, testis,**			
November,2019	24	Unit 9: Mammals 1. General characteristics and classification up to living orders. 2. Phylogenetic significance of Prototheria 3. Exoskeleton derivatives of mammals. 4. Adaptive radiation in mammals with reference to locomotory appendages.	Unit 4: Muscular System 2. Ultrastructure of skeletal muscle 3. Characteristic of muscle fibers. 4. Molecular and chemical basis of muscle contraction. Unit 5: Reproductive system 1.histology of testis and ovary 2. Physiology of reproduction	Unit 5: 2. Types of DNA and RNA, Complementarity of DNA, Hypo-Hyperchropmaticity of DNA. 3. Otlines of nucleotide metabolism. Unit 6: Enzymes: 1.Nomenclature and classification; Cofactors; Specificity of enzyme action; isozymes; 2. Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reaction	20	4

		PRACTICAL **5.Reptilia** Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus. Identification of poisonous and non-poisonous snakes. 6. Aves Study of six common birds from different orders (Stork, Owl/Falcon, Sun bird, Jacanna, Duck) – types of beaks and claws.	PRACTICAL **3. Study of permanent slides of ovary, adrenal and thyroid** **4. Microtomy: Preparation of permanent slide of any five (lung, salivary gland, stomach, small intestine, large intestine only) mammalian rat tissues**	. PRACTICAL 5. Study of the enzymatic activity of Trypsin and Lipase.		
Decembr,2019	20	Unit 9: Mammals 5. Echolocation in Microchiropterans and Cetaceans. Unit 10: Zoogeography 1.Zoogeographical real. 2. Plate tectonic and continental drift theory. 3. Distribution of birds and mammals in different realms.	. Unit 6: Endocrine System 4. Mechanism of hormone action. 5.Signal transduction pathways for Steroidal and Non-steroidal hormones. 6. Hypothalamus – principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system.	Unit 6: 3. Enzyme inhibition; Allosteric enzymes and their kinetics; Strategy of enzyme action-catalytic and Regulatory Unit 7: 1.Redox system; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System.	16	4

		PRACTICAL 7. Mammalia Sorex, Bat, Funambulus, Loris, Herpestes, Erinaceous Power point presentation on study of any two animals from animals from two different classes by students 8. Pecten from Fowl head. Dissection of Fowl head.	**4. Microtomy: Preparation of permanent slide of any five (lung, salivary gland, stomach, small intestine, large intestine only) mammalian rat tissues**	PRACTICAL 6. Performing the Acid and alkaline phosphatise assay from serum/tissue.		

ACADEMIC CALENDER FOR SEMESTER-IV (2019-2020) (HONOURS)

Month	No of teaching days available	**SEMESTER-IV**			Class teaching in hours of each core	Tutorial In hours
		Honours Course				
		ZOOACOR08T **Marks:50+25=75** **COMPARATIVE ANATOMY**	**ZOOACOR09T** **Marks:50+25=75** **PHYSIOLOGY: LIFE SUSTAINING SYSTEM**	**ZOOACOR10T** **Marks:50+25=75** **IMMUNOLOGY**		

January'2020	21	Unit 1: Integumentary System Structure, function and derivatives of integument in amphibian, birds and mammals	Unit 1: Physiology of Digestion 1.Structural organization and functions of Gastrointestinal tract and Associated gland; 2.Mechanical and chemical digestion of food, 3. Absorption of carbohydrates, Lipids, Proteins and Nucleic acids 4. Digestive enzymes	Unit 1: Overview of Immune System 1.Basic concepts of health and diseases. 2. Historical perspective of immunology. 3. Organs (primary and secondary lymphoid organs and its importance) and cells of the immune system. 4. Concept of Haematopoiesis and development of progenitor cells of the immune system Unit 2: Innate and Adaptive Immunity 1.Principle of Innate and Adaptive Immunity 2. Components of innate immunity	17	5
		PRACTICAL 1.Study of placoid, cycloid and ctenoid scales through permanent slides/ photographs.	PRACTICAL 1.Determination of ABO blood group.	PRACTICAL 1.Demonstration of lymphoid organs		

February,2020	20	Unit 2: Skeletal system Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches	Unit 2: Physiology of Respiration 1.Mechanism of Respiration 2. Respiratory volumes and capacities 3. Transport of Oxygen and Carbon dioxide in blood. 4. Dissociation curve and the factors influencing it. 5. respiratory pigments 6. Carbon monoxide poisoning.	Unit 2: Innate and Adaptive Immunity 3. Component of adaptive immunity Unit 3: Antigen, Antigen presentation and MHC 1.Concept of Antigen, Immunogen, Allergen and Pathogen 2. Adjuvants and haptens, 3. Factors influencing immunogenicity, Epitope 4. Types of Antigen Presenting Cells (APCs) 5. Structure of Major Histocompatibility Complex (MHC) molecules.	16	4
		PRACTICAL 2.Study of disarticulated skeleton of toad, pigeon and guineapig	PRACTICAL 2. Enumeration of red blood cells and white blood cells using haemocytometer	PRACTICAL 2. Histological study of spleen, thymus and lymph nodes through slides/photographs		

March,2020	24	Unit 3: Digestive System Comparative anatomy of stomach; dentition in mammals Unit 4: Respiratory System Respiratory organs in fish, amphibian	Unit 3: Physiology of Circulation: 1.Components of blood and their function 2. Structure and functions of hemoglobin 3. Haemostasis 4. Blood clotting system. 5. Fibrinolytic system 6. Haemopoesis 7. Basic steps and its regulation. 8. Blood groups; ABO and Rh factor.	Unit 3: Antigen, Antigen presentation and MHC 6. Mechanism of antigen presentation and involvement of MHC molecules in details 7. Co-stimulatory molecules on APC Unit 3: T Cell development 1.Structure of T cell receptors, Co-stimulatory molecules on T cells 2. Concept of synapse between APC and T cells in details 3. Central differentialtion of T cells; 4. T cell selection in thymus. 5. Peripheral differentiation of T cells; Th1 and Th2	20	4
		PRACTICAL 3. Demonstration of carapace and plastron of turtle.	PRACTICAL 3. Estimation of haemoglobin using Sahli,s Haemoglobinometer	PRACTICAL 3. Preparation of stained blood film to study various types of blood cells		

April,2020	24	Unit 4: Respiratory system Respiratory organs of birds and mammals Unit 5: Circulatory System General plan of Circulation, Comparative account of heart and aortic arches	Unit 4: Physiology of Heart 1.Structure of mammalian heart. 2. Coronary circulation, 3. Structure and working of conducting myocardial fibers 4.Origin and conduction of cardiac impulses 5. Cardiac cycle and cardiac output. 6. Blood pressure and its regulation.	Unit 4: Immunoglobulin 1.Structure and functions of different classes of immunoglobulins 2. Antigen-antibody interaction 3. Immunoassay (ELISA and RIA) 4. Hybridoma technology Monoclonal antibody production Unit 7: Complement system 1.Components and pathways of complement activation	20	4
		PRACTICAL 4. Identification of mammalian skulls: one herbivororous (Guineapig) and one carnivorous (dog)	PRACTICAL 4. Preparation of haemin and haemochromogen crystals	PRACTICAL 4. ABO blood group determination		
May,2020	22	Unit 6: Urinogenital System: Succession of kidneys, Evolution of urinogenital ducts, Types of mammalian uteri Unit 7: Nervous System Comparative account of brain	Unit 5: Thermoregulation and Osmoregulation 1.Physiological classification based on thermal biology 2. Thermal biology of endotherms 3. Osmoregulation in aquatic vertebrates; 4. Extra-renal osmo-regulatory organs in vertebrates	Unit 6: Cytokines and Chemokines 1.Brief concept on types of Cytokines and chemokines 2. Cytokines (source and function of IL-1,2,4,5,6,8,10,12, interferons, TNF, TGF, GM-CSF, M-CSF) 3. Chemokines (source and function of CCL2, CCL3, CCL4, CCL5, CxCL8, CxCL10)	18	4

		PRACTICAL 5. Dissection of Tilapia: circulatory system, brain	PRACTICAL 5. Recording of blood pressure using a sphygmomanometer/ digital meter	PRACTICAL 5. Demonstration of ELISA using kit		
June,2020	24	Unit 7: Nervous System: Cranial nerves in mammals Unit 8: Sense organs Classification of receptors, Brief account of auditory receptors in vertebrate.	Unit 6: Renal Physiology 1.Structure of kidney and its functional unit 2. Mechanism of urine formation, 3. Regulation of acid-base balance.	Unit 8: Hypersensitivity 1.Gell and Coombs classification and brief description of various types of hypersensitivity. Unit 9: Immunology of diseases 1.Malaria, Visceral Leishmaniasis, Filariasis, Dengue and Tuberculosis Unit 10: Vaccines 1.Various types of vaccines. 2. Active and passive immunization (artificial and natural)	10	2
		5. Dissection of Tilapia: Urinogenital system, pituitary	5. Practice and repeat of previous practicals	5. Practice and repeat of previous practicals		

ACADEMIC CALENDAR FOR SEMESTER III,IV (2019-2020) (GENERAL)

Month	No. of Teaching days	**SEMESTER-III** Topic	Class teaching in hours of each core

		ZOOGCOR03T Marks:50+25=75 **Insect, Vectors & Diseases**	**ZOOSSEC01M** **Aquarium Fish Keeping**	
July,19	26	**Unit-1 Introduction to Insects** i)General features of insects Morphological features, Head-Eyes, Types of antennae, Mouth parts with respect to feeding habit **Unit-7 Hemiptera as Disease Vectors** Bugs as insect vectors; Blood-sucking bugs, Chaghas disease. **PRACTICAL** 1.Mounting and study of different kinds of mouth parts of insects	**Unit-1 Introduction to Aquarium Fish Keeping** The potential scope of aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes	16
August,19	24	**Unit-3 Insects as vector** Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera. **Unit-7 Hemiptera as Disease Vectors** Bed bugs as mechanical vectors, Control and prevention measures. **PRACTICAL** 2. Spot identification of following insect vectors through permanent slides/photographs: *Aedes, Culex, Anopheles, Pediculus humanuscapitis, Pediculus humanuscorporis,*	**Unit-2 Diversity of Aquarium fishes and their biology** Common characters and sexual dimorphism of Fresh water and Marine aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, angel fish, Blue morph, Anemone fish and Butterfly fish	16

September,19	22	**Unit-2 Concept of Vectors** Brief introduction to vectors (mechanical and biological) Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity. . **PRACTICAL** 2. Spot identification of following insect vectors through permanent slides/photographs: *Phithiruspubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica.*	**Unit-2 Diversity of Aquarium fishes and their biology** Indigenous fishes suitable aquaria, problems of natural population depletion. Problem with exotic fishes	12
October,19	3	**Unit-4 Dipteran as Disease Vectors** Study of important Dipteran vectors – Mosquitoes.	-	2
November,19	24	**Unit- 4 Dipteran as Disease Vectors** Study of important Dipteran vectors – Sand fly, Housefly Study of mosquito born diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis, Control of mosquitoes. Unit – 6 Siphunculata as disease vectors Human louse (head, body and pubic louse) as important insect vectors; Control of human louse **PRACTICAL** 3. Study of different diseases transmitted by above insect vectors	**Unit-3 Food and feeding of aquarium fishes** Use of live fish feed organism Preparation and composition of formulated fish feeds, Aquarium fish as larval predator. **Unit-4 Fish transportation** Live fish keeping, breeding, transport – Fish handling, packing and forwarding techniques	16

December,19	20	**Unit-Siphonaptera as disease vectors** Fleas as important insect vectors; Host-specificity, Study of flea borne diseases – plague, Typhus fever, Contrl of fleas **PRACTICAL** 4. Submission of a project report on any of the insect vectors and disease transmitted	**Unit-5 Maintenance of Aquarium** General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry	6
		SEMESTER-IV		
		Topic		
Month	No. of Teaching days	**ZOOGCOR03T** Marks:50+25=75 **Environment and Public Health**	**ZOOSSEC02M** **Vermicompost Production**	
January2020	**21**	**Unit-1 Introduction** Sources of environmental hazards, Hazard identification and accounting, Fate of toxic and persistence substances in the environment, Dose response evaluation, Exposure assessment **PRACTICAL** To determine pH, Cl, SO4, NO3 in soil and water sample from different location.	**Unit-1 Introduction to Vermicompost Production** Natural role of earthworms in soil fertility, Concept of Vermicompost – the need for it **Unit-5 Properties of the Vermicompost** **Unit-6 benefits of vermicompost**	14
February 2020	**20**	**Unit-2 Climate Change** Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health. **PRACTICAL** To determine pH, Cl, SO4, NO3 in soil and water sample from different location.	**Unit-2 Production** Suitable worm species and their availability-for large scale/small scale, Climate and temperature, Feedstock- for small scale and home farming/ large scale or commercial	14

March 2020	**24**	**Unit-4 Waste management technologies** Sources of waste, types and characteristics, sewage disposal and its management, solid waste disposal **PRACTICAL** To determine pH, Cl, SO4, NO3 in soil and water sample from different location.	**Unit-3 Operations and maintenance** Smells, Moisture, Pest species, Worms escaping, Nutrient levels **Unit-4 Harvesting**	16
April 2020	**24**	**Unit-4 Waste management technologies** Biomedical waste handling and disposal, Nuclear waste handling and disposal, waste from thermal plants. **Unit-5 Diseases** Cause, symptoms and control of tuberculosis, Asthma, Cholera, **PRACTICAL** To determine pH, Cl, SO4, NO3 in soil and water sample from different location.	**Unit-7 Use as soil conditioner** **Unit-8 Application of**	16
May 2020	**22**	**Unit-5 Diseases** Cause, symptoms and control of Minamata disease, typhoid **Unit-3 Pollution** Air, water, noise pollution sources and effects, Pollution control. **PRACTICAL** To determine pH, Cl, SO4, NO3 in soil and water sample from different location.	**Unit-9 Visit to Vermicompost centre and Submission of Report**.	12

June 2020	**24**		.	0

ACADEMIC CALENDER FOR III YEAR HONOURS 2019-2020

Month	No. of Teaching days available	PART-III (HONOURS) TOPIC	Class teaching in hours of each core	Tutorial In hours
July,19	26	**PAPER-VII** **MODULE 701: ANIMAL PHYSIOLOGY** **1.transport across cell surface membrane, Donan membrane equilibrium** **2. Function of mammalian blood: Oxygen transport and CO2 transport.** **3. Neurophysiology** **MODULE 703: HISTOLOGY** **1.Basic tissue types** **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** **1.outlines of historical concepts and experiments in the emergence of developmental biology.** **MODULE 802: ENVIRONMENTAL POLLUTION AND TOXICOLOGY** **1.Environmental pollution: water, soil, air and sound pollution**	22	4

		PRACTICAL **GROUP-A** **1.Blood slide preparations to identify and study the characteristic features of different types of WBC, total count of WBC.** **GROUP-B** **1.identification of chick,s embryonic stages (at 24,48 and 96 hrs).** **2. Identification of fry stages of a carp fish**		
August,19	24	**PAPER-VII** **MODULE 701: ANIMAL PHYSIOLOGY** 4. Respiration 5. General architecture of skeletal muscle and smooth muscle. **MODULE 703: HISTOLOGY** 2. Membrane specializations of epithelia. 3. Exocrine glands **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** 2. Germ layers and its contributions to the development of different tissues in vertebrates. 3. origin of germ layers, structural features of sperms and eggs in sea urchins and in mammals, gametogenesis in mammals. **MODULE 802: ENVIRONMENTAL POLLUTION AND TOXICOLOGY** 2. Environmental laws: major ones applicable in West Bengal.	22	*4*
		PRACTICAL **GROUP-A** **2.Determination of haemoglobin content of goat/rat blood by Sahli`s hemoglobinometer** **3. Human BP and pulse measurement** **GROUP-B** **3. Morphometric study**		

September,19	22	**PAPER-VII** **MODULE 701: ANIMAL PHYSIOLOGY** 6.Swim bladder and its functions in teleosts. 7. water and osmotic regulations. **MODULE 703: HISTOLOGY** 4. Principle of tissue fixation, staining 5. Histological structure of mammalian nephron and functions of each regions. **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** 4. Fertilization 5. cleavage **MODULE 802: ENVIRONMENTAL POLLUTION AND TOXICOLOGY** 3. Toxicology: including its significance as a branch of science. 4. Dose-response relationship.	18	4
		PRACTICAL **GROUP-A** **4. Determination of soil and water ph.** **5. Quantification of free CO2** **GROUP-B** **Morphometric study**		
October,19	3	**PAPER-VII** **MODULE 701: ANIMAL PHYSIOLOGY** 8. bioluminescence **MODULE 802: ENVIRONMENTAL POLLUTION AND TOXICOLOGY** 5. In vivo and in vitro toxicity test	3	

November,19	24	**PAPER-VII** **MODULE 701: ANIMAL PHYSIOLOGY** 9. Urine formation in human kidney **MODULE 702: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** 1.Classification of vertebrate hormones based on chemical nature and mechanism of action. 2. Hormone delivery system 3. Feedback control of hormone secretion **MODULE 703: HISTOLOGY** 6. Histology of stomach, pancreas, testis, ovary, thyroid, lynph node **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** 6. Gastrulation **MODULE 802: ENVIRONMENTAL POLLUTION AND TOXICOLOGY** 6. Introduction to the concepts of detoxification mechanism.	20	
		PRACTICAL **GROUP-A** **6. Quantification of dissolved O2 (Winkler`s method)** **GROUP-B** **Medical entomology**		4

December,19	20	**PAPER-VII** **MODULE 702: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** **4. Hormone biosynthesis** **5. Physiologic function s of hormones: insulin, glucagon, T3 and T4** **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** **7. Organogenesis: development brain in chick.** **MODULE 805: MEDICAL ZOOLOGY** **1.Mosquito-borne diseases: malaria and filarial- causative agents, their life cycle, modes of infections in man, major modes of treatments, major vector species in India, their ecology and life cycles, control measures.** **MODULE 006: ECONOMIC ZOOLOGY** **1.Fish and Fishery**	16	
		PRACTICAL **GROUP-A** **7. Microtomy** **GROUP-B** **Medical entomology**		4

January,2020	21	**PAPER-VII** **MODULE 702: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** **6. Hormonal control of spermatogenesis** **7. Hormonal control of mammalian ovarian cycle, difference between menstrual and estrous cycle.** **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** **8. Conceptual outlines of cell potency and stem cells. HOX genes in development.** **MODULE 805: MEDICAL ZOOLOGY** **2.Mosquito-borne diseases: Dengue and DHF, Chikungunya – causative virus, symptoms and treatments.** **MODULE 006: ECONOMIC ZOOLOGY** **2. Sericiulture** **3. Apiculture**		
		PRACTICAL **GROUP-A** **7. Microtomy** **GROUP-B** **Repeats and practice**	17	**5**

February,2020	20	**PAPER-VII** **MODULE 702: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** **8. Mechanism of hormone actions** **PAPER VIII** **MODULE 801: DEVELOPMENTAL BIOLOGY** **9. Sex determination in Drosophila and Man** **10. Environmental sex determination in reptiles.** **MODULE 805: MEDICAL ZOOLOGY** **3. Visceral Leishmaniasis-causative species and vectors in West Bengal** **MODULE 006: ECONOMIC ZOOLOGY** **4. Lac culture** **5. Cattle, goats and lambs: different breeds, their advantages and disadvantages, importance of indigenous breeds.**		
		PRACTICAL **GROUP-A** **7. Microtomy** **GROUP-B** **Repeats and practice**	16	**4**
March,2020	24	**PAPER-VII** **MODULE 702: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY** **9. Endocrine disorders(symptoms and causes only): diabetes insipidus; IDDM and NIDDM, Hypothyroidism and hyperthyroidism, Conn,s and Cushing,s sysdrome.** **MODULE 805: MEDICAL ZOOLOGY** **4. Common ticks and mites in human surroundings and diseases caused by them.** **MODULE 006: ECONOMIC ZOOLOGY** **6. Poultry birds: different breeds, their advantages and disadvantages, importance of indigenous breeds.**		
		PRACTICAL **-**	20	**4**

April,2020	24	--	20	

ACADEMIC CALENDER FOR III YEAR (GENERAL) 2019-2020

Month	No. of Teaching days	**PART - III (GENERAL)** Topic	Class teaching in hours of each core
July,19	26	**PAPER-IV A:** **AQUACULTURE** 1.Principles, definition and scope. Fisheries sources of India. Exotic fishes – their merits and demerits. Induced breeding and its importance. **WILD-LIFE AND BIODIVERSITY** Conservation of wild life – important and strategies, Concept of biosphere reserve, National Park and Wild life sanctuary	16
		PRACTICAL 1.Identification of specimen 2. Estimation of dissolved O2 content water	

August,19	24	**PAPER-IV A:** **AQUACULTURE** Basic principle of different aquaculture system (Polyculture and integrated farming). Marine pearl culture **WILD-LIFE AND BIODIVERSITY** Basic concept of biodiversity, Biodiversity hotspot **PRACTICAL** 1.Identification of specimen 2. Estimation of dissolved CO2 content water	16
September,19	22	**PAPER-IV A:** **AQUACULTURE** Culture of prawn and shrimp **WILD-LIFE AND BIODIVERSITY** Endangered Indian mammals, Animal Cruelty Prevention Act **PRACTICAL** 1.Identification of specimen 2. Pedigree analysis	12
October,19	3	**PAPER-IV A** **SERICULTURE** Characteristics of sericulture industry and its scope	2
November,19	24	**PAPER-IV A** **SERICULTURE** Kinds of silk worm, host plants. Life history and rearing of Bombyx mori, harvesting and processing of cocoon, reeling and extraction of silk. **BIOTECHNOLOGY AND IMMUNOLOGY** Basic concept of genetic engineering and cloning	16

		PRACTICAL 1.Identification of specimen 2. Determination of ABO blood group and Rh factor	
December,19	20	**PAPER-IV A** **SERICULTURE** Pest on mulberry plants and diseases of Bombyx mori and control measures. **BIOTECHNOLOGY AND IMMUNOLOGY** Concept of immunity	6
		PRACTICAL 1.Identification of specimen	
January2020	**21**	**PAPER-IV A** **APICULTURE** Types of honey bees, modern methods of apiary management, products and its use. Problems and prospects. **BIOTECHNOLOGY AND IMMUNOLOGY** Outline structure and classification of immunoglobulin; antigen-antibody reaction	14
		PRACTICAL 1.Identification of specimen 2. Measurement of pH of water 3. Field trip	

February 2020	**20**	**PAPER-IV A** **PEST AND PEST MANAGEMENT** Pest – definition, types, life history and control i) Scirpophaga ii) Sitophilus and iii) Bandicoota, Concept on IPM **BIOTECHNOLOGY AND IMMUNOLOGY** Basic principle of vaccination.	14
		PRACTICAL 1.Identification of specimen 2. Sampling of zooplankton and extraction of soil micro-arthropods	
March 2020	**24**	**PAPER-IV A** **POULTRY AND POULTRY MANAGEMENT** Duck and fowl – Types of breeds, rearing and disease management.	16
		PRACTICAL 1.Test for food colors/adultaration	
April,2020	**24**	--	16

Month	No of teaching days available	SEMESTER-V				Class teaching in hours of each [illegible]	Tutorial In hours
		Honours Course					
		ZOOACOR11T Marks:50+25=75 MOLECULAR BIOLOGY	**ZOOACOR12T Marks:50+25=75 GENETICS**	**ZOOADSE01T Marks:50+25=75 ANIMAL BEHAVIOUR AND CHRONOBIOLOGY**	**ZOOADSE03T Marks:50+25=75 ENDOCRINOLOGY**		

July,2020	26	**Unit 1: Nucleic acids:** 1.Salient features of DNA and RNA. Watson and Crick model of DNA. **Unit 2: Replication:** 1. Mechanism of DNA replication in prokaryotes . 2. Semi-conservative, bidirectional and discontinuous replication. 3.RNA priming. 4. Replication of telomeres. **Unit 3:Transcription:** 1.Mechanism of transcription in prokaryotes and eukaryotes. 2. Transcription factors. 3. difference between prokaryotes and eukaryotes transcription	**Unit 1: Mendelian Genetics and its extention** 1.Background of Mendel`s experiment 2.Principles of Mendelian inheritance 3.Incomplete dominance and co-dominance, epistasis, multiple alleles, lethal alleles 4.Pleiotropy. Sex-linked, Sex-influenced and sex-limited inheritance, Polygenic Inheritance **Unit 2: Linkage, CrossingOver and Chromosomal Mapping** 1.Linkage and crossing over, Molecular basis of Crossing Over. 2.Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence.	**Unit 1: Introduction to an imal behaviour** 1.A brief history of animal behaviour studies including the works of Fabre, Darwin , Von Frisch, Lorenz, Tinber gen, Jane Goodal, BiruteGa ldikas, Dian Fossey, Salim Ali, Gopal Bhattacharya, M . K. Chandrashekhar, Ragha vendraGadgkar. 2.The objectives of modern animal behaviour studies: T inbergen 4 questions. 3. Methods of studying beh aviour: observation vs watc hing, Ad libitum observatio ns, Focal animal studies, In stantaneous scan	**Unit 1:Introduction to Endocrinology** 1.General Idea of endocrine systems, 2.Classification, 3.Characteristic and transport of hormones, 4.Neurosecretions and neurohormones **Unit2:Epiphysis,Hypothalamo-hypophysial Axis** 1.Structure of pineal gland 2.Secretions and their functions in biological rhythms and reproduction. 3.Structure and functions of hypothalamus and hypothalamic nuclei 3.Regulation of neuroendocrine glands.	22	4

		PRACTICAL 1.Demonstration of polytene chromosome from Drosophila/Chironomid larvae. 2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement).	**PRACTICAL** 1.Chi-suare analyses Statistical tests of data and decision making Chi square test for goodness of fit and student t test for comparing means of two small samples from normal populations (paired/unpaired)	**PRACTICAL** 1.To study nests and nesting habits of the birds and social insects. 2.To study geotaxis behaviour in earthworm.	**PRACTICAL** 1.Dissect and display of endocrine glands in rat 2.study of permanent slides of all the endocrine glands		
August,2020	24	**Unit 4: Translation:** 1.Mechanism of protein synthesis in prokaryotes 2. Ribosome structure and assembly in prokaryotes 3. fidelity of protein synthesis, aminoacyltRNAsynthetase and charging of tRNA. 4. proteins involved in initiation, elongation and termination of polypeptide chain. 5. inhibitors of protein synthesis 6. difference between prokaryotic and eukaryotic translation.	**Unit 3: Mutations** 1.Types of gene mutations (Classification) 2. Types of chromosomal aberrations (Classificatio with one suitable example of each) 3. Chromosomal aberrations, gene mutations and human diseases (Down`s, Klinefelter`s, Turner`s, Cri-du Chat, Sickel cell, Haemophilia, Thalassemia, Albinism. 4.Sex chromosomes and sex-linked inheritance.	**Unit 1: Introduction to animal behaviour** 4.Branches of aimal behavior studies. **Unit 2: Behaviours of Individuals** 1. Reflexes and Orientations 2.Instinct 3. Learning: Imprinting and other Programmed Learning, Habituation, Innovations and Cultural Transmission / Social learning.	**Unit2:Epiphysis,Hypothalamo-hypophysial Axis** 4.Feedback mechanisms 5.Structure of pituitary gland, hormones and their functions, 6.Hypothalamo-hypophysial portal system 7. Disorders of pituitary gland	22	4
		PRACTICAL 3. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement).	**PRACTICAL** 1.Pedigree analysis of some inherited traits in human.	**PRACTICAL:** 1.To study the behavioural responses of wood lice to dry and humid condition 2. To study the phototaxis behavior in insect larvae.	**PRACTICAL** 1.Study of permanent slides of all the endocrine glands 2.Estimation of plasma level of any hormone using ELISA		

September,2020	22	**Unit 4: Translation:** 7. Genetic code, degeneracy of the genetic code and Wobble Hypothesis. **Unit 5: Post Translational Modification and Processing of Eukaryotic RNA:** 1. Capping and Poly A tail formation in mRNA. 2. Spilt genes: concept of introns and exons, splicing mechanism 3. Alternative splicing, exon shuffling 4. RNA editing, Processing tRNA	**Unit 3: Mutations** 5.Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens **Unit 4: Sex determination** 1.Mechanism of sex determination in Drosophila with reference to alternative splicing. 2. Sex determination in mammals. 3. Dosage compensation in Drosophila and Human.	**Unit 3: Social and Sexual Behaviour** 1.Social behaviour: Concept of Society; Communication and the senses Altruism 2.Insect`s society with honey bee as example; Foraging in honey bee and advantages of the waggle dance 3.Sexual behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice)	**Unit 3: Peripheral Endocrine glands** 1.Structure, hormones, functions and regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas	18	3
		PRACTICAL 1.Agarose gel electrophoresis for DNA	**PRACTICAL** 1.Pedigree analysis of some inherited traits in human	**PRACTICAL** 1.Study and actogram construction of locomotor activity of suitable animal model	**PRACTICAL** 1.Estimation of plasma level of any hormone using ELISA		
October,2020	5	**Unit-6 Gene regulation** **1.**Regulation of Transcription in prokaryotes: lac operon	**Unit 5: Extra-chromosomal Inheritance** 1.Criteria for extra chromosomal inheritance	**Unit 3: Social and Sexual Behaviour** 1.Pheromones	**Unit 3: Peripheral Endocrine glands** 2. Structure, hormones, functions and regulation of ovary	3	-

		PRACTICAL 1.Agarose gel electrophoresis for DNA	**PRACTICAL** 1.Pedigree analysis of some inherited traits in human	**PRACTICAL** 1.Study and actogram construction of locomotor activity of suitable animal model	**PRACTICAL** 1.Study of permanent slides of all the endocrine glands		
November,2020	24	**Unit-6 Gene regulation** 2. Regulation of Transcription in prokaryotes: trp operon 3. Regulation of transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing 4.Genetic imprinting **Unit-7 DNA Repair Mechanism** 1.Types of DNA repair mechanism: RecBCD model in prokaryotes. 2.nucleotide and base excision repair	**Unit 5: Extra-chromosomal Inheritance** 2. Antibiotic resistance in Chlamydomonas, Kappa particle in Paramoecium, Shell spiralling in snail. **Unit 6: Recombination in Bacteria and Virus** 1. Conjugation, Transformation, Transduction, Complementation test in Bacteriophage..	**Unit 4: Introduction to Chronobiology** 1. Historical development of chronobiology 2. Biological oscillation: the concept of average, amplitude, phase and period 3.Adaptive significance of biological clock	**Unit 3: Peripheral Endocrine glands** 3. Structure, hormones, functions and regulation of Testis. 4.Hormones in homeostasis, Disorders of endocrine glands. **Unit 4: Regulation of Hormone Action** 1.Mechanism of action of steroidal, non-steroidal hormones with receptors.	20	4
		PRACTICAL REPEAT 1.Demonstration of polytene chromosome from Drosophila/Chironomid larvae. 2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement).	**PRACTICAL** 1.Pedigree analysis of some inherited traits in human 2. Identification of chromosomal aberration in Drosophila from photograph	**PRACTICAL** 1.Visit to forest/Wildlife Sanctuary/Biodiversity Park/ Zoological Park to study behavioural activities of animals and prepare a short report.	**PRACTICAL** 1.Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland		

Decembr,2020	20	**Unit-7 DNA Repair Mechanism** 3.SOS repair. **Unit 8: Molecular Lab Techniques** 1.PCR 2. Western and Southern blot 3. Sanger DNA sequencing 4. cDNA technology.	.**Unit 7: Transposable Genetics Elements** 1. Transposons in bacteria 2.Ac-Ds elements in Maize and P elements in Drosophila 3. LINE, SINE, Alu elements in humans	**Unit 5: Biological Rhythm** 1. Types and characteristicsof biological rhythm: Short and Long-term rhythm;Circadian rhythms; Tidal rhythm and lunar rhythm 2.Concept of synchronization and masking; Photic and non-photic zeitgebers;Circannual rhythm. 3.Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin.	**Unit 4: Regulation of Hormone Action** 2.Bioassays of hormones using RIA and ELISA. 3.Estrous cycle in rat 4.Menstrual cycle in Human 5.Multifaceted role of Vasopressin and Oxytocin 6.Hormonal regulation of parturirion	16	4
		PRACTICAL REPEAT 1.Agarose gel electrophoresis for DNA	**PRACTICAL** Repeat and practice on the basis of necessary	**PRACTICAL** 1. Study of circadian functions in humans (daily eating, sleep and temperature patterns)	**PRACTICAL** 1.Designing of primers of any hormones		

DINABANDHU MAHAVIDYALAYA, BONGAON

DEPARTMENT OF ZOOLOGY

ACADEMIC CALENDER FOR SEMESTER-VI (2020-2021) (HONOURS)

Month	No of teaching days available	SEMESTER-VI				Class teaching in hours of each core	Tutorial In hours
		Honours Course					
		ZOOACOR13T Marks:50+25=75 DEVELOPMENTAL BIOLOGY	ZOOACOR14T Marks:50+25=75 EVOLUTIONARY BIOLOGY	ZOOADSE04T Marks:50+25=75 FISH AND FISHERY	ZOOADSE05T Marks:50+25=75 PARASITOLOGY		

January'2021	21	**Unit 1: Introduction** Basic concepts: Phases of development, Cell-cell interaction, Differentiation and growth, Differential gene expression **Unit 2: Early embryonic Development** 1.Gametogenesis: Spermatogenesis and Oogenesis 2. Types of eggs and egg membrane	**Unit 1: Origin of Earliest life** 1.Chemogeny, RNA Worls, Biogeny, Origin of photosynthesis 2.Evolution of eukaryotes, three domains of life **Unit 2: Historical Review of Evolutionary Concept** 1. Pre-Darwinan Concepts and theories including Lamarckism 2. Darwinian theory 3.Neo-Darwinian Synthesis 4.Anti-evolutionary ideas of Creationism and their scientific refusal.	**Unit 1: Introduction and Classification** 1.General description of fish 2. Feeding habit, habitat and manner of reproduction 3. Classification of fish (upto Subclasses) with important example **Unit 2: Morphology and Physiology** 1.Types of fins and their modification 2.Locomotion of fishes, Hydrodynamics 3.Types of scales 4.Use of scales in classificationand determination of age of fish	**Unit 1: Introduction to Parasitology** 1.Brief introduction of parasitism and other animal associations 2.Partasites, Parsitoid and Vectors (Mechanical and biological) 3.Host-parasite relationship 4.Zoonosis **Unit 2: Parasitic Protists** 1.Study of morphology, Life cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoebahistolytica, Giardia intestinalis*	17	3
		PRACTICAL 1.Study of whole mount of developmental stages of chick through permanent slides .	**PRACTICAL** 1.Study of fossils from models/photographs – Direct ancestors of horse, Archeopteryx	**PRACTICAL** 1.Morphometric and meristic characters of fishes	**PRACTICAL** 1.Study of life stages of *Entamoebahistolytica, Giardia intestinalis, Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax* through permament slides		

February,2021	20	**Unit 2: Early embryonic Development** 3.Fertilization (External and internal): Changes in gametes, Block to polyspermy. 4.Planes and patterns of cleavage 5.Types of blastula. 6. Fate map (including techniques).	**Unit 3: Evidence in Favour of Evolution** 1.Fossil records: Types of fossils, 2. Geological time scale, transitional forms: example of fossils depicting the evolutionary stages of the modern horse 3. Molecular (universality of genetic code and protein synthesis machinery) evidence. **Unit 4: Sources of Variation** 1.Heritable variations present in natural populations (classical study of Lewontin and Hubby, 1966 in Drosophila, as example)	**Unit 2: Morphology and Physiology** 5. Gills and gas exchange 6.Swim bladder: Types and role in respiration, buoyancy. 7. Osmoregulation in elasmobranchs 8. Reproductive strategies (special reference to Indian fish); Electric organs 9. Bioluminiscence	**Unit 2: Parasitic Protists** 1.Study of morphology, Life cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax, Plasmodium falciparum and Toxoplasma gondii*.	16	4
		PRACTICAL 2.Study of the developmental stages and life cycle of Drosophila from stock culture.	**PRACTICAL** 1. Study of homology and analogy from suitable specimens (from photographs and models)	**PRACTICAL** 1.Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabus	**PRACTICAL** 1.Study of adult and life stages of *Fasciola hepatica, Schistosomahaematobium, Taeniasolium,Hymenolepisnana.*throughpermament slides		

March,2021	24	**Unit 2: Early embryonic Development** 7.Early development of frog and chick upto gastrulation 8.Embryonic induction and organization. **Unit 3: Late Embryonic Development** 1.Fate of germ layers 2.Extraembryonic membranes in birds	**Unit 5: Population Genetics** 1.Concepts of populations and calculation of allele frequencies in a population 2. Hardy-Weinberg Law and equilibrium 3. Evolutionary forces disrupting H-W equilibrium 4. Natural selection: Definition as the non-differential rate of reproductions and survivals of competing alleles, concept of fitness, selection coefficient, Types of natural selection with examples- Disrupting, Stabilizing, Directional.	**Unit 3: Fisheries** 1. Inland fisheries; marine fisheries 2. Environmental factors influencing the seasonal variations in fish catches in the Arabian sea and the Bay 3. Fishing crafts and gears. 4. Depletion of fisheries resources 5. Application of remote sensing and GIS in fisheries 6. Fisheries law and regulation	**Unit 3: Parasitic Platyhelminthes** 1.Study of morphology, Life cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciola hepatica*, *Paragonimuswestermani*, *Schistosomahaematobium*, *Taeniasolium,Echinococcusgranulosus and Hymenolepis nana*.	20	4
		PRACTICAL 1.Study of different sections of placenta	**PRACTICAL** 1. Verification of H-W equilibrium in a population by chi square analysis	**PRACTICAL** 1.Study of different types scales 2.Study of crafts and gears used in fisheries	**PRACTICAL** 1.Study of adult and life stages of *Ascarislumbricoides*, *Ancylostomaduodenale*, *Wuchereriabancrofti*, *Trichinellaspiralis* through permament slides		

April,2021	24	**Unit 3: Late Embryonic Development** 1.Implantation of embryo in humans 2.Placenta (Structure, types and functions of placenta) **Unit 4: Post Embryonic Development** 1.Development of brain and eye in vertebrate.	**Unit 5: Population Genetics** 5.Genetic drift – outline of its mechanism, basic concepts and examples of founder`s effect, bottleneck phenomenon 6.Role of Gene flow and Mutation rates in changing allele frequencies in a population (No mathematical model) **Unit 6: Products of Evolution** 1.Inter-population variations: clines, races, 2. Species concepts and mode of speciation 3.Isolating mechanism 4.Adaptive radiations/macroevolution as exemplified by Galapagos finch.	**Unit 4: Aquaculture** 1.Sustainable aquaculture 2. Extensive, semi-intensive and intensive culture of fish 3. Pen and cage culture 4. Polyculture 5.Composite fish culture 6.Brood stock management 7. Induced breeding of fish 8. Management of finfish hatcheries	**Unit 4: Parasitic Nematodes** 1.Study of morphology, Life cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascarislumbricoides, Ancylostomaduodenale, Wuchereriabancrofti, Trichinellaspiralis* 2.Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode)	20	4
		PRACTICAL 1.Project report on Drosophila culture/chick embryo development	**PRACTICAL** 1. Verification of H-W equilibrium in a population by chi square analysis	**PRACTICAL** 1.Water quality criteria for Aquaculture: Assessment of PH, conductivity, Total solids, Total dissolved solids	**PRACTICAL** 1.Study of plant parasitic root knot nematode, Meloidogyne from the soil sample 2.Study of *Pediculushumanus* (head and body louse*), Xenopsyllacheopis*and *Cimexlectularius* through permament slides		

May,2021	22	**Unit 4: Post Embryonic Development** 2.Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each) **Unit 5: Implications of Developmental Biology** 1.Teratogenesis: Teratogenic agents and their effects on embryonic development. 2.In vitro fertilization.	**Unit 7: Extinction** 1.Major mass extinctions in the history of life and their impacts on biodiversity on earth **Unit 8: Origin and Evolution of Man** 1. Unique hominin characteristics contrasted with primate characteristics. 2. Primate phylogeny: from Dryopithecus leading to *Homo sapiens.* 3. Molecular evidences of human origin and migrations.	**Unit 4: Aquaculture** 1.Preparation and maintenance of fish aquarium 2. Preparation of compound diets of fish 3. Role of water quality in aquaculture 4. Fish diseases: Bacterial, viral and parasitic 5. preservation and processing of harvested fish 6.Fishery by-products	**Unit 5: Parasitic Arthropods** 1.Mosquitoes and flies as vectors of human pathogen 2.Biology, importance and control of myiasis causing diptera 3.Biology, importance and control of ticks, mites, *Pediculushumanus* (head and body louse*), Xenopsyllacheopis*and *Cimexlectularius*	18	4
		PRACTICAL 1.Project report on Drosophila culture/chick embryo development	**PRACTICAL** 5. Collection of sample of height,weight, age, sex data at least 100 individuals and applying of different statistical analyses.	**PRACTICAL** 1.Project report on a visit to any fish farm/ pisciculture unit/Zebra fish rearing lab	**PRACTICAL** 1.Study of monogenea from gills of fresh/marine fish 2.Study of nematode/cestode parasites from the intestines of Poultry bird		
June,2021	24	**Unit 5: Implications of Developmental Biology** 3.Stem cell (ESC) 4.Amniocentesis	**Unit 9: Molecular Phylogeny** 1.The basic concept of molecular phylogeny 2. Neutral theory of molecular evolution 3. Molecular clock 4.Example of evolution in vertebrate globin genes.	**Unit 5: Fish in Research** 1.Transgenic fish 2. Zebra fish as a model organism in research	**Unit 6: Parasitic Vertebrates** 1.A brief account of parasitic vertebrates; Cookiectter Shark, Candiru, Hood Mocking bird and vampire bat	10	2

		PRACTICAL Repeat and practice on the basis of necessary.	**PRACTICAL** 5. Collection of sample of height,weight, age, sex data at least 100 individuals and applying of different statistical analyses.	**PRACTICAL** 1.Project report on a visit to any fish farm/ pisciculture unit/Zebra fish rearing lab 2.Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias.	**PRACTICAL** 1.Study of nematode/cestode parasites from the intestines of Poultry bird		

Month	No. of Teaching days	**SEMESTER-V** Topic **ZOOGDSE01T** Marks:50+25=75 **APPLIED ZOOLOGY**	**ZOOSSEC02M** **Aquarium Fish Keeping**	Class teaching in hours of each core
July,2020	26	**Unit-1 Introduction to Host-Parsite Relationship** 1.Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis **Unit-2Epidemiology of Diseases** Transmission, prevention and control of diseases: Tuberculosis and Typhoid **Unit-10 Fish Technology** Genetic improvement in aquaculture industry: induced breeding and transportation of fish seed. **PRACTICAL** 1.Study and Identification of *Entamoebahistolytica, Plasmodium vivax,Ancylostomaduodenale and*	**Unit-1 Introduction to Aquarium Fish Keeping** The potential scope of aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes	16

		Wucheriabancrofti. 2. Maintenance of freshwater aquarium		
August,2020	24	**Unit-3 Rickettsia and Spirichetes** Brief account of *Rickettsia Prowazekii, Borreliarecurrentis and Treponemapallidum*. **Unit-4Parasitic Protozoa** Life history and pathogenicity of *Entamoebahistolytica, Plasmodium vivax, Trypanosomagambiense.* **PRACTICAL** 2. Study and Identification of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes and Xenopsylla*	**Unit-2 Diversity of Aquarium fishes and their biology** Common characters and sexual dimorphism of Fresh water and Marine aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, angel fish, Blue morph, Anemone fish and Butterfly fish	16
September,2020	22	**Unit-5 Parasitic Helminthes** Life history and pathogenicity of *Ancylostomaduodenale and Wucheriabancrofti*. **Unit-6 Insects of Economic Importance** Biology, control and damage caused by *Helicoverpaarmigera, Pyrillaperpusilla*, and *Papiliodemoletus, Callosobruchuschinensis.* **PRACTICAL** 1. Study and Identification of insect damage to different plant parts/stored grains through	**Unit-2 Diversity of Aquarium fishes and their biology** Indigenous fishes suitable aquaria, problems of natural population depletion. Problem with exotic fishes	12

		damaged products/ photographs.		
October,2020	5	**Unit-6 Insects of Economic Importance** Biology, control and damage caused by *Sitophilusoryzae* and *Triboliumcastaneum.*	-	3
November,2020	24	**Unit- 7Insects of Medical Importance** Medical importance and control of *Pediculushumanuscorporis, Anopheles, Culex, Aedes, Xenopsyllacheopis*. **Unit – 8Animal Husbandry** Preservation of semen and insemination in cattle **PRACTICAL** 1.Identifying features and economic importance of *Nilaparvatalugens, Apioncorchori, Scirpophagaincertulus, Callosobruchuschinensis, Sitophilusoryzae and Triboliumcastaneum*.	**Unit-3 Food and feeding of aquarium fishes** Use of live fish feed organism Preparation and composition of formulated fish feeds, Aquarium fish as larval predator. **Unit-4 Fishtransportation** Live fish keeping, breeding, transport –Fish handling, packing and forwardingtechniques	16

December,2020	20	**Unit-9 Poultry Farming** Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs **PRACTICAL** 4. Visit to poultry farm/ animal bree ding center/ vector biology/ parasit ology center. Submission of visit re port	**Unit-5 Maintenance of Aquarium** General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry	6
		SEMESTER-VI		
		Topic		
Month	No. of Teaching days	**ZOOGCOR04T** Marks:50+25=75 **IMMUNOLOGY**	**ZOOSSEC02M** **Vermicompost Production**	
January2021	**21**	**Unit-1 Overview of the Immune System** Introduction to basic concept in immunology, Components of immune system, Principles of innate and adaptive immune system **PRACTICAL** 1.Demonstration of lymphoid	**Unit-1 Introduction to Vermicompost Production** Natural role of earthworms in soil fertility, Concept of Vermicompost – the need for it **Unit-5 Properties of the Vermicompost** **Unit-6 benefits of vermicompost**	14

		organs in human through model/photograph.		
February 2021	**20**	**Unit-2 Cells and Organs of the Immune system** Haematopoiesis, Cells of immune system and organs (Primary and Secondary lymphoid organs) of the immune system. Unit -3 Antigens Basic properties of antigens, B and T cell epitopes, haptens and adsjuvants **PRACTICAL** Histological study of spleen, thymus and lymph nodes through slides/ photograph	**Unit-2 Production** Suitable worm species and their availability-for large scale/small scale, Climate and temperature, Feedstock- for small scale and home farming/ large scale or commercial	14
March2021	**24**	**Unit-3Antibodies** Structures, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis. **Unit-5 Working of the immune system** Structure and function of MHC. **PRACTICAL** Preparation of stained blood film to study various types of blood cells.	**Unit-3 Operations and maintenance** Smells, Moisture, Pest species, Worms escaping, Nutrient levels **Unit-4 Harvesting**	16
April 202	**24**	**Unit-5 Working of the immune system** Exogenous and endogenous	**Unit-7 Use as soil conditioner** **Unit-8 Application of**	16

		pathway of antigen presentation and processing, Basic properties and functions of cytokines, Complement system **PRACTICAL** Preparation of stained blood film to study various types of blood cells.		
May 2021	**22**	**Unit-6Immune System in Health and Diseases** Gell and Coomb`s classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency. **PRACTICAL** ABO blood group determination	**Unit-9 Visit to Vermicompost centre and Submission of Report**.	12
June 2021	**24**	**Unit-7 Vaccines** General introduction to vaccines, Types of vaccines	.	2