ANNEXURE – I

ACCEPTED CORE AND ELECTIVES PAPERS FOR ZOOLOGY

CORE AND ELECTIVE PAPERS FOR ZOOLOGY MAJOR				
SEMESTER	**SUBJECT CODE CORE PAPERS**	**CORE PAPERS**	**SUBJECT CODE ELECTIVE PAPERS**	**ELECTIVE PAPERS**
Semester 1	ZOO-I.C-1	Animal Diversity : Non Chordates		
	ZOO-I.C-2	Cell and Molecular Biology		
Semester 2	ZOO-II.C-3	Diversity and Biological Systems of Chordates		
	ZOO-II.C-4	Fundamentals of Animal and Human Genetics		
Semester 3	ZOO-III.C-5	Human Physiology	ZOO-III.E-1	Vertebrate Endocrinology
			ZOO-III.E-2	Basic microbiology and Fundamentals of Animal Biotechnology
			ZOO-III.E-3	Environmental Toxicology
			ZOO-III.E-4	Parasitology
Semester 4	ZOO-IV.C-6	Biochemistry and Metabolic Regulation	ZOO-IV.E-5	Animal cell culture and Applications
			ZOO-IV.E-6	Aquaculture and Fisheries
			ZOO-IV.E-7	Immunology
			ZOO-IV.E-8	Evolutionary Biology
Semester 5	ZOO-V.C-7	Developmental Biology	ZOO-V.E-9	Molecular Genetics and Forensic Science
			ZOO-V.E-10	Economic Zoology
			ZOO-V.E-11	Ecology and Ethology
			ZOO-V.E-12	Fish Preservation and Processing
Semester 6	ZOO-VI.C-8	Wildlife Biology	ZOO-VI.E-13	Health and Nutrition
			ZOO-VI.E-14	Basic and Applied Entomology

			ZOO-VI.E-15	**Laboratory Techniques in Pathology**
			ZOO-VI.E-16	**Bio Entrepreneurship**

CORE PAPERS FOR ZOOLOGY MAJOR - MINOR		
Semester 1	ZOO-I.C-1	Animal Diversity : Non Chordates
Semester 2	ZOO-II.C-3	Diversity and Biological Systems of Chordates
Semester 3	ZOO-III.C-5	Human Physiology
Semester 4	ZOO-IV.C-6	Biochemistry and Metabolic Regulation
Semester 5	ZOO-V.C-7	Developmental Biology
Semester 6	ZOO-VI.C-8	Wildlife Biology

CORE PAPERS FOR ZOOLOGY DOUBLE MAJOR		
Semester 1	ZOO-I.C-1	Animal Diversity : Non Chordates
Semester 1	ZOO-I.C-2	Cell and Molecular Biology
Semester 2	ZOO-II.C-3	Diversity and Biological Systems of Chordates
Semester 2	ZOO-II.C-4	Fundamentals of Animal and Human Genetics
Semester 3	ZOO-III.C-5	Human Physiology
Semester 4	ZOO-IV.C-6	Biochemistry and Metabolic Regulation
Semester 5	ZOO-V.C-7	Developmental Biology
Semester 6	ZOO-VI.C-8	Wildlife Biology

ANNEXURE – II

PAPER TITLE:	**HUMAN PHYSIOLOGY**
PAPER CODE:	**ZOO-III.C-5**
SYLLABUS PREPARED BY:	**DR. NANDINI VAZ FERNANDES**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	**The primary goal of this course is to offer an in-depth presentation of the function of the major organs and organ systems of the human body. The course is designed to expand physiological concepts presented in prerequisite courses.**
LEARNING OUTCOME:	**Upon successful completion of the course, students will be able to:** • **describe and explain the normal function of the cells, tissues, organs, and organ systems of the human body** • **develop understanding of the functional relationships of anatomical structures to one another**

	TOPICS	CONTACT HOURS
UNIT 1: HISTOPHYSIOLOGY OF DIGESTION AND RESPIRATION (15 Hrs)		
	1: *DIGESTIVE SYSTEM* • **Structural organization, histology and functions of gastrointestinal tract and its associated glands** • **Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins** • **Role of gastrointestinal hormones on the secretion and control of enzymes of Gastrointestinal tract**	08
	2: *RESPIRATORY SYSTEM* • **Histology of trachea and lung** • **Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities** • **Transport of oxygen in the blood oxygen- hemoglobin & myoglobin , dissociation curve and the factors influencing it Carbon monoxide poisoning; Carbon dioxide transport in the blood** • **Buffering action of blood and haemoglobin Control of respiration**	07
UNIT 2: HISTOPHYSIOLOGY OF EXCRETION AND CIRCULATION (15 Hrs)		
	3: *EXCRETORY SYSTEM* • **Structure of kidney and its histological details, Renal blood supply; Mechanism urine** • **Formation and its regulation, Regulation of acid-base balance**	05
	4: *CIRCULATORY SYSTEM* • **An outline structure of heart; Coronary circulation; structure of conducting and working** • **Myocardial fibers. Origin and conduction of cardiac impulses functions of AV node; Cardiac cycle; Cardiac output and its regulation-Frank-Starling Law of the heart, nervous and chemical regulation of heart rate; Blood pressure and its regulation; Electrocardiogram** • **Components of blood and their functions; Structure and functions of haemoglobin; Haemopoiesis; Haemostasis *(overview and significance)*; Disorders of blood(*nutritional anemia, Leukemia)***	10
UNIT 3: HISTOPHYSIOLOGY OF NERVOUS SYSTEM, MUSCLES AND REPRODUCTIVE SYSTEM (15 hrs)		
	5: *NERVOUS SYSTEM* • **Structure of neuron, resting membrane potential , Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers;** • **types of synapsis, Synaptic transmission and, Neuromuscular junction; Reflex action & its types -reflex arc** • **Physiology of hearing and vision**	06
	6: *MUSCLE* • **Histology of different types of muscle;** • **Ultra structure of skeletal muscle;** • **Molecular and chemical basis of muscle contraction;** • **Characteristics of muscle twitch; Motor Unit, summation & tetanus**	04
	7: *REPRODUCTIVE SYSTEM* • **Histology of male and female gonads.** • **Overview- Physiology of male and female reproduction.**	05

REFERENCE BOOKS:

Essential books:

1. *Singh HD(2011):Textbook of Human Physiology, S Chand Publishers, New Delhi.*
2. *Widmaier, Raff, & Strang(2008), Vander's Human Physiology: The Mechanisms of Body Function, 12th edition, McGraw Hill,. ISBN 978-0-07-337810-7*
3. *Tortara G J and Derrickson BH(2009). Principles of Anatomy and physiology, 12th Edition. John Wiley & sons, Inc.*
4. *Guyton Ac and Hall JE(2011). Textbook of Medical Physiology, 12th Edition, Harcourt Asia Pvt Ltd, WB Saunders Company*.

Supplementary Reading:

5. *Openstax College (2013). Anatomy and Physiology. Vol II. Mainstreet MS, Houston Texas(Ebook)*
6. *Forciea B (2012). An eText of Human Anatomy and Physiology(Ebook).*
7. *Wingerd B(2008). The Human Body, Essential Anatomy and Physiology. University Readers, SanDiego CA.*

PRACTICAL COMPONENT OF ZOO-III.C-5: (DURATION -02 HRS /WEEK) : HUMAN PHYSIOLOGY

SR. NO	PRACTICAL	NO. OF PRACTICALS
1.	Enumeration of red blood cells / WBC using haemocytometer	02
2.	Estimation of haemoglobin using Sahli's haemoglobinometer	01
3.	Histochemical localization of digestive enzymes (Amylase, Pepsin, Trypsin and Lipase)	02
4.	Temporary preparation of Striated muscle fibers and nerve cells.	02
5.	Urine analysis (for organic, inorganic and abnormal components)	03
6.	Examination of sections of mammalian tissues: - Lung - Kidney - Gonads - Small Intestine - Muscles*(Cardiac, Skeletal, Smooth)* - Bone and cartilage	02

REFERENCE BOOKS FOR PRACTICALS:

1. *Openstax College (2013). Anatomy and Physiology. Vol II. Mainstreet MS, Houston Texas(Ebook)*
2. *Forciea B (2012). An eText of Human Anatomy and Physiology(Ebook).*
3. *Wingerd B(2008). The Human Body, Essential Anatomy and Physiology. University Readers, SanDiego CA.*

ANNEXURE – III

PAPER TITLE:	**Vertebrate Endocrinology**
PAPER CODE:	**ZOO-III.E-1**
NAME OF FACULTY:	**Dr. SOCORRINHA D'COSTA**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	• **To study the endocrine organs of vertebrates** • **To understand the underlying principles of hormone functions** • **To gain an insight into the current and important issues in endocrinology**
LEARNING OUTCOME:	**At the end of the course, the students will be familiar with all the endocrine organs and their functions in body growth, metabolism, reproduction and development. They will be able to appreciate better the contemporary issues in endocrinology.**

UNIT	TOPICS	CONTACT HOURS
UNIT 1:	**Unit 1:** **1.1 Aim and scope of endocrinology,** **1.2 techniques in endocrinology - histology, histochemistry, immunocytochemistry, in situ hybridisation, radio immune assay, surgical techniques,** **1.3 regulation of hormone secretion: feedback mechanisms - positive, negative, short loop, long loop**	15
	1.4 Anatomy and histology of endocrine glands- Pituitary, Pineal gland, Thyroid, Parathyroid, Thymus, Adrenal, Endocrine pancreas, GI tract, Endocrine hypothalamus, Gonads, Placenta	
UNIT 2:	**2.1 Classification of hormones** **2.2 Hormone structure** **2.3 Biological actions of hormones**	15
	2.4 Mechanisms of hormone action **2.5 Receptor and it regulation** **2.6 Steroid and peptide hormones actions**	
	2.7 Hormones and Homeostasis - Calcium and glucose	
UNIT 3:	**3.1 Biosynthesis and secretion of hormones - steroid hormones, thyroid hormones**	15
	3.2 Growth factors - neurotropic growth factors, hematopoietic growth factors, other peptide growth factors	
	3.3 Endocrine disorders - goitre, gigantism, dwarfism, cretinism, diabetes mellitus, insepidus	

REFERENCE BOOKS:

1. David, N.O. and J.A. Carr (2013) Vertebrate Endocrinology. Academic press publications 5th edition.
2. Hadley, M. and Levine, J (2006) Endocrinology. Benjamin Cummings 6th edition.
3. Kovacs, J.W. and S.R. Ojeda (2011) Textbook of endocrine physiology 6th edition. Oxford university press.
4. Yadav, P.R. (2004) Endocrinology. Discovery Publishing House, New Delhi.

PRACTICAL COMPONENT OF ZOO-III.E-1: Vertebrate Endocrinology (DURATION -02 HRS /WEEK)		
Sr. No	**Practical**	**No. of Practicals**
1.	Histological slides of Endocrine hypothalamus, Gonads, Placenta pituitary, Pineal gland, thyroid gland, Parathyroid, Thymus, adrenal gland, pancreas, ovary, testis	04
2	Display of Pituitary and gonads in fishes/chick	03
3	Preparation of histological slides using microtomy	05

ANNEXURE IV

PAPER TITLE:	**BASIC MICROBIOLOGY AND FUNDAMENTALS OF ANIMAL BIOTECHNOLOGY**
PAPER CODE:	**ZOO-III-E-2**
NAME OF FACULTY:	**DR. NANDINI VAZ FERNANDES**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	**To provide a comprehensive survey of microbiology with basic information on bacteria and learn the fundamentals of biotechnological techniques.**
LEARNING OUTCOME:	**Upon successful completion of the course, students will be able to:** • **Gain working knowledge of basic bacterial laboratory techniques, as well as the foundations of biotechnological tools.** • **Students will also master the basic laboratory skills and techniques necessary to work efficiently in a microbiology laboratory and perform techniques of gene insertion and selection of recombinant plasmids.**

MODULE	TOPICS	CONTACT HOURS
UNIT 1: Microbiology (15 hrs)		
	1: Introduction to Microorganisms-Bacteria ○ **Structure and Identification of bacteria(morphological types)** ○ **Nutritional types** ○ **Nutritional requirements**	**08**
	2: Isolation and Culture of Bacteria: ○ **Cultivation of bacteria** ○ **Different methods of isolation and maintenance of pure cultures** ○ **Culture characteristics**	**04**
	3: Use of microorganisms in biotechnology-An overview: ○ **Production of valuable substances** ○ **Fuel Production, recovery of minerals and oils** ○ **Microorganisms in bioassays** ○ **Food and agriculture sector** ○ **Medicine and health**	**03**
UNIT 2: Tools in Biotechnology (15 hrs)		
	4: Scope and importance of Biotechnology ○ **Definition** ○ **Contribution and importance of biotechnology**	**03**
	5: Nucleic Acid Enzymology: ○ **Restriction enzymes, Ligases, Alkaline phosphatase** ○ **Polynucleotide kinase, Terminal Transferases, S1 Nuclease** ○ **Polymerases, Reverse transcriptase**	**07**
	6: Gene Cloning vectors: ○ **Plasmids, Bacteriophage, cosmids** ○ **Shuttle and expression vectors**	**05**
UNIT 3: Genetic Engineering (15 hrs)		
	7: Techniques in genetic engineering: ○ **Gene transfer methods** ○ **Methods of Labeling Nucleic acids** ○ **Nucleic acid Hybridization** ○ **Polymerase chain reaction**	**05**
	8: Recombinant DNA technology: ○ **Procedure / Technique**	**04**
	9: Blotting Techniques: ○ **Southern Blotting** ○ **Northern Blotting** ○ **Western Blotting**	**03**
	10: DNA sequencing techniques: ○ **Chemical Degradation method** ○ **Chain termination method** ○ **Automated Sequencing**	**03**

REFERENCE BOOKS:

Essential books:

1) *Pelczar MJ, Chan ECS, Krieg NR(2009). Microbiology. Tata Mc Graw Hill, New York.*
2) *Dubey RC and Maheshwari DK (2012). A test book of Microbiology. S Chand Publishers, New Delhi.*
3) *Prave P, Faust U, Sittig W and Sukatsh DA(2004). Fundamentals of Biotechnolgy.*
4) *Purohit SS(2008). BiotechnologyFundamentals and applications. Agrobios, Jodhpur India.*
5) *Ranga MM(2012): Animal Biotechnology. Agrobios, Jodhpur India.*

Supplementary reading:

6) *Black JG(2005). Microbiology principles and explorations. John Wiley and sons Inc.*
7) *Sullia SB and Shantharam S(2006). General Microbiology. Oxford and IBH Publishing Co Pvt Ltd, NewDelhi.*

PRACTICAL COMPONENT OF ZOO-III-E-2: DURATION - 02 HRS /WEEK BASIC MICROBIOLOGY & FUNDAMENTALS OF ANIMAL BIOTECHNOLOGY		
SR. NO	**PRACTICAL**	**NO. OF PRACTICALS**
1.	**Preparation of culture media for bacteria (Plates, Slants, deeps, Broth).**	**02**
2.	**Staining of Microorganisms (Gram staining, negative staining).**	**02**
3.	**Isolation of pure colonies of Bacteria (streak plate method – 3 Quadrant And 5 Quadrant methods)**	**02**
4.	**Identification of Products of metabolic pathways of microbial cells.**	**01**
5.	**Bacteriological testing of Milk.**	**01**
6.	**DNA sequencing - Analysis of prints.**	**01**
7.	**Isolation of Plasmid DNA (Demonstration)**	**02**
8.	**Transformation of bacteria (Selection by blue-white colony method – demonstration practical**	**02**

REFERENCE BOOKS FOR PRACTICALS*:*

1) *Gunasekaran P(2009). Lab Manual in Microbiology. New Age International Ltd. Publishers, New Delhi.*

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ANNEXURE V

PAPER TITLE:ENVIRONMENTAL TOXICOLOGY

PAPER CODE: ZOO-III.E-3

NAME OF FACULTY:K.N.MISHRA

MARKS :100[75-Theory; 25 – Practical]

CREDITS: 04[3 –Theory; 01 –Practical]

CONTACT HOURS : Theory : 45 Hours (03 Lec./ Week)
Practical :30 Hours (01 Practical/Week)

COURSE OBJECTIVE :

- To study the different environmental pollutants and their toxicity.
- To know the physiological effects of toxicant exposure.

LEARNING OUTCOME:

After completion of the course students are expected to be able to:

- Distinguish, classify and characterize a variety of environmental pollutants based on their biological and physical properties.
- Identify the main sources and types of environmental pollutants and assess their potential environmental fate.
- Will learn mechanisms of detoxification of various varieties of toxicants.
- Will learn bio-indicators of exposure to specific environmental contaminants.
- Identify potential solutions to anthropogenic pollution

	TOPIC	CONTACT HOURS
UNIT1:	**1.1INTRODUCTION TO TOXICOLOGY:** o Definition and History of Toxicology and Toxicity o Disciplines of Toxicology o Biouptake,Bioaccumulation,Biotransfer and Biological Magnification o Relationship to Other Sciences. o Scope and importance of Toxicology **1.2: CLASSES OF TOXICANT:** • Define Toxicant and Toxins • Toxicants and their classification • Toxicants in Air • Toxicants in Water and Soil • Toxicants in Domestic and • Occupational Settings • Synthetic drugs:Solvents, • Therapeutic drugs, Drugs of abuse, Combustion products,Cosmetics • Movement and fate of Toxicants in the environment	**15**

UNIT2:	**2.1: TOXICITY OF HEAVY METALS:** • Toxicity of Arsenic,Lead,Mercury, • Cadmium,Copper,Zinc,Aluminium,Iron and Manganese • Sources and portals of heavy metal pollutants • Toxicity of substances on Human and Animals **2.2: AGRO-CHEMICAL PESTICIDES AND THEIR ENVIRONMENTAL IMPACT MITIGATION** • Definition and Classification • Organochlorine Insecticides • Organophosphate Insecticides • Carbamates • Pyrethroid Insecticides • Dinitrophenols • Herbicides • Fungicide • Control of Pesticide Pollution • Integrated Pest management	**15**
UNIT3:	**3.1:TOXINS:** • History • Classes of Toxicants : • Microbial,Mycotoxins,Algaltoxins, • Planttoxins,Animaltoxins, **3.2: FOOD ADDITIVES:** • General account of Food Additives: • Incidental or Indirect additives • Intentional or Direct additives **a.**Antioxidants b. Emulsifiers c. Enzymes d. Flavouring agents e. Colour and preservatives f. Artificial sweetening agents i)Saccharine ii)Urea derivatives	**15**

REFERENCE BOOKS FOR THEORY:

1. Ernst Hodgson(2004) A Text Book of Modern Toxicology ,A John Wiley and sons Inc,Publication.
2. Gupta P.K.(2010) Modern Toxicology, Pharma Med Press, Hyderabad.
3. Omkar(2007) Concepts of Toxicology ,Vishal Publishing Co, Jalandhar
4. Pandey K,Shukla J.P. and Trivedi S.P. (2011)Fundamentals of Toxicology,New Central Book Agency(P) Ltd.
5. P.D.Sharma (2011)Environmental Biology and Toxicology (Third edition),Rastogi Publications,Meerut-250002.

PRACTICAL COMPONENT OF ZOO-III.E-3:ENVIRONMENTAL TOXICOLOGY (DURATION-02 HRS/WEEK)		
Sr.No.	**Practical**	**No.of Practicals**
1.	To determine the effect of temperature on the toxicity of a pollutant	01
2.	To determine the effect of pH on the toxicity of a pollutant.	01
3.	To Separate and analyse the residues of carbamate pesticides by thin layer chromatography.	01
4.	To evaluate qualitatively the presence of pesticide residues in vegetable samples.	01
5.	Estimation of total dissolved solids in given water sample.	01
6.	To determine Lc^{50} of a pollutant on mosquito larvae .	02
7.	Effect of pesticides on Oxygen consumption in fish	01
8.	Estimation of Phosphorus in given water sample by Spectrophotometer	01
9.	Estimation of Boron from given water/soil sample by spectrophotometer	01
10.	Estimation of Fluorides in given water sample	01
11.	Determination of Nitrates from given water sample.	01

REFERENCE BOOKS FOR PRACTICALS:

1. Adam Wooley (2008) A Guide to Practical Toxicology:Evaluation,Prediction,and Risk IInd Edition,Informa Healthcare U.S.A.,Inc. New York.
2. Rao K.S. (1998) Practical Ecology,Anmol Publications Pvt. Ltd. New Delhi.
3. Subramanian M.A. (2004) Toxicology Principles and Methods(Second Revised Edition),M.J.P. Publishers,Triplicane Chennai.
4. Sunita Hooda and Sumanjeet Kaur (1999) Laboratory Manual for Environmental Chemistry,S.Chand and Comp.Ltd. New Delhi.
5. Trivedi R.K.,Goel P.K. and Trishal C.L.(1987) Practical Methods in Ecology and Environmental Science, Enviro Media Publications,Karad (India).

ANNEXURE – VI

PAPER TITLE:	**PARASITOLOGY**
PAPER CODE:	**ZOO-III.E-4**
NAME OF FACULTY:	**Dr. SOCORRINHA D'COSTA**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	• **To be familiar with the parasite host interactions.** • **To gain knowledge on diagnosis of parasite infections and also to learn about the preventive measures.**
LEARNING OUTCOME:	**At the end of the course the learner will be acquainted with dimensions of public health viz a viz parasitic diversity, epidemiology and community prophylaxis**

UNIT	TOPICS	CONTACT HOURS
UNIT 1: **Basic Principles of Parasitology and parasitic protozoans**	**1.1 Parasite systematics, Ecology and Evolution** **1.2 Immunology and Pathology** **1.3 Symbiosis and parasitism** **1.4 Parasite host interactions** **Form, function, classification, life cycle, diagnosis and preventive measures** **1.5 *Trypanosoma gambiens*** **1.6 Amoebas -*Entamoeba histolytica*** **1.7 Malaria organisms - *Plasmodium vivax*** **1.8 Sexually transmitted parasite - *Trichomonas vaginalis***	15
UNIT 2: **Parasitic Platyhelmithes and Nematodes**	**Form, function, classification, life cycle, diagnosis and preventive measures** **2.1 Trematoda (liver fluke - *Fasciola hepatica*, intestinal fluke - *Fasciolopsis buski*, lung fluke - *Paragonimus westermani*);** **2.2 Cestoda (Tape worm - *Taenia solium*)** **2.3 Hook worms- *Ancyclostoma duodena*** **2.4 Guinea worm- *Dracanculus medinensis*** **2.5 Round worm *Ascaris lumbricoids, Enterobias vermicularis*** **2.6 *Wuchereria bancrofti***	15
UNIT 3: **Parasitic arthropods and Parasites of domestic livestock**	**Form, function, classification , life cycle, diagnosis and preventive measures** **3.1 Copepods** **3.2 Barnacles** **3.3 Amphipods** **3.4 Isopods** **3.5 Flea** **3.6 Ticks** **3.7 Mites** **3.8 Head and pubic lice**	15

REFERENCE BOOKS:

1. **Chatterjee, K.D. (2009) Parasitology (Protozoology and Helminthology) with two hundred fourteen illustrations. CBS, 13th edition.**

2. **Dey, N.C., Dey, T.K. and D.M. Sinha (1995) Medical Parasitology. New Central book agency private limited, Calcutta.**
3. **Paniker, J.C.K. (2007) Textbook of medical parasitology. Jaypee Brothers, New Delhi.**
4. **Schmidt, G.D. (1990) Essentials of Parassitology. Universal Book Stall, New Delhi.**

PRACTICAL COMPONENT OF ZOO-III.E-4: PARASITOLOGY (DURATION -02 HRS /WEEK)		
Sr. No	**Practical**	**No. of Practicals**
1.	Study of *Trypanosoma gambiens, Entamoeba histolytica, Plasmodium vivax, Trichomonas vaginalis, Fasciola hepatica, Taenia solium, Ancyclostoma duodena, Dracanculus medinensis, Ascaris lumbricoids, Wuchereria bancrofti* , copepod, barnacle, amphipod, isopod from permanent slides with respect to parasitic adaptations.	06
2.	Preparation of peripheral blood smear from the perspective of detection of haemoparasites	01
3.	Study of parasites of domestic livestock(parasite, pathogenicity)	04
4.	Study of fish parasites	01

REFERENCE BOOK:

1. Halton, D.W., Behnke, J.M. and I. Marshall (2005) Practical exercises in parasitology. Cambridge University Press.

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ANNEXURE – VII

PAPER TITLE:	**BIOCHEMISTRY AND METABOLIC REGULATION**
PAPER CODE:	**ZOO-IV.C-6**
NAME OF FACULTY:	**Dr. SOCORRINHA D'COSTA**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	• **To understand the basic principles that govern the functioning of living systems** • **To know the structure of biomolecules and the role they play in governing life processes through the pathways** • **To be familiar with enzymes and their activities**
LEARNING OUTCOME:	**At the end of the course, the students will be able to understand better the chemical basis in life. They will appreciate better the interactions between the biological molecules.**

UNIT	TOPICS	CONTACT HOURS
UNIT 1: **Fundamentals of biochemistry and Carbohydrate metabolism**	**1.1 Principles of pH, buffer, thermodynamics** **1.2 Enzymes: classification, properties of enzyme, enzyme kinetics, MichaelisMenten Equation, enzyme inhibition** **1.3 Carbohydrate structure, aerobic and anaerobic glycolysis, Citric acid cycle, glycogenesis, glycogenolysis, Pentose phosphate pathway,** **1.4 Diabetes mellitus**	15
UNIT 2: **Lipid and Protein metabolism**	**2.1: Lipid:** **-structure and classification,** **-fatty acid synthesis** **-fatty acid oxidation(saturated and unsaturated),** **- metabolism of glycerophospholipids, sphingolipids, cholesterol** **- disorders: fatty liver types (NAFL, AFL)** **2.2 Protein:** **- structure (primary, secondary, tertiary) and classification** **- amino acid biosynthesis, nucleotide biosynthesis,** **- amino acid catabolism, urea cycle, Fate of carbamoyl P,** **- Hyper uricemia**	15
UNIT 3: **Nucleotide metabolism and integration of metabolism**	**3.1 Biosynthesis of purine and pyrimidine (de novo and salvage pathway)** **3.2 Degrdation of purine and pyrimidine** **3.3 Interconversions between the three principal components** **3.4 Metabolism in starvation: Carbohydrate, lipid, proteins (The feed/fast cycle)**	15

REFERENCE BOOKS:

1. **David, L.N. and Cox, M. Michael (2008) Lehninger principles of biochemistry. W.H. Freeman and Company, New York.**
2. **Delvin, T.M. (1997). Textbook of biochemistry with clinical correlations. Wiley liss.**
3. **Harvey, A.R. and Ferrier, D. (2011). Lippincott's Illustrated Reviews Biochemistry. Wolters Kluwer, Lippincott Williams and Wilkins. 5th Edition.**

4. **Pratt, W.C. and K. Cornely 2003 Essential Biochemistry Wiley Publications third edition.**

PRACTICAL COMPONENT OF ZOO-IV.C-6: BIOCHEMISTRY AND METABOLIC REGULATION (DURATION -02 HRS /WEEK)		
Sr. No	**Practical**	**No. of Practicals**
1.	Principle and working of spectrophotometer	01
2.	Estimation of reducing sugars DNSA method	01
3.	Estimation of protein – Folin Lowry's method	01
4.	Estimation of fatty acids by titration method	01
5.	Separation of lipids by thin layer chromatography	02
6.	Colorimetric estimation of liver glycogen of chick by Anthrone method	02
7.	Effect of substrate concentration on amylase activity	01
8.	Estimation of DNA by DPA method	01
9.	Isolation of lecithin and cholesterol from yolk	02

REFERENCE BOOKS FOR PRACTICALS:

Plummer, M. and D.T. Plummer (1988) Introduction to practical biochemistry.Tata McGraw Hill Education ,UK.

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ANNEXURE VIII

PAPER TITLE:	**ANIMAL CELL CULTURE AND APPLICATIONS**
PAPER CODE:	**ZOO-IV-E-5**
NAME OF FACULTY:	**DR. NANDINI VAZ FERNANDES**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	**This course is an introduction to the theory, standard practices, and methodologies of animal cell culture. The laboratory emphasizes the principles and practices of initiation, cultivation, maintenance of cell lines.**
LEARNING OUTCOME:	**Upon successful completion of the course, students will be able to:** - **operate, calibrate, and maintain standard equipment found in an animal cell culture laboratory;** - **Prepare and sterilize media and solutions used in cell culture.** - **Demonstrate an understanding of the concepts and applications of mammalian cell culture.** - **Recognize and employ biosafety guidelines and practices.**

MODULE	TOPICS	CONTACT HOURS
UNIT 1: LAB REQUIREMENTS FOR CELL CULTURE (15 hrs)		
	1: Historical background of Cell culture:	**01**
	2: Biology of cells in culture: ○ **Origin and characteristics** ○ **Differentiation** ○ **kinetics of cell growth** ○ **Genetics of Cultured cells** ○ **Problems associated with cell culture**	**04**
	3: Lab requirements for animal cell culture: ○ **Lab facilities and setup for cell culture** ○ **Major and minor equipments** ○ **Environmental conditions** ○ **Substrates for Culturing and sub culturing**	**05**
	4: Animal tissue culture media ○ **Natural media – biological fluids, tissue extracts** ○ **Chemically defined media- characteristic and composition** ○ **Media supplements – L Glutamine, serum. Advantages and disadvantages of serum in media / serum free media**	**05**
UNIT 2: CELL CULTURE TECHNIQUES(15 hrs)		
	5: Primary cell culture: ○ **Mechanical disaggregation** ○ **Enzymatic disaggregation** ○ **Protocol for primary cell culture**	**06**
	6: Secondary cell culture/ Sub culturing: ○ **Protocol for sub culturing of suspension culture** ○ **Protocol for sub culturing of adherent** ○ **Established cell lines**	**06**
	7: Scale up of animal cell culture: ○ **Techniques of Scale up of suspension cultures** ○ **Techniques of Scale up of Monolayer cultures**	**03**
UNIT 3: CELL CULTURE APPLICATIONS(15 hrs)		
	8: Cell Hybridoma Technology : ○ **Steps of cell Hybridoma technology** ○ **Procedure** ○ **Production of monoclonal antibodies** ○ **Applications of monoclonal antibodies**	**05**
	9: Valuable Products through cultured cells: ○ **Production of Tissue plasminogen, growth factor, Erythropoietin, Factor VIII, Interferons**	**05**
	10: Other Application: ○ **Vaccines through cultured cells** ○ **Cytotoxicity testing** ○ **Fluorescent In-Situ Hybridization for disease detection** ○ **Cell culture in biomedical research**	**05**

PRACTICAL COMPONENT OF ZOO-IV-E-5: DURATION -02 HRS /WEEK ANIMAL CELL CULTURE AND APPLICATIONS		
Sr. No	**Practical**	**No. of Practicals**
1.	Packing and sterilization of glass and plastic wares for cell culture & Lab Precautions and Biosafety measures	02
2.	Preparation of reagents and media for cell culture. - Reagents - Media / Buffers	02
3.	Quantification of cells (Viable cell count) by trypan blue exclusion dye.	01
4.	Methods used for cell disaggregation – Mechanical and Enzymatic	02
5.	Setting up of primary cell culture - Suspension culture - Adherent cell culture	02
6.	Setting up of chicken embryo fibroblast culture (cold trypsinization / warm trypsinisation)	02
7.	Biological waste disposal methods	01

REFERENCE BOOKS:

Essential books:

1) *Ranga MM(2012). Animal Biotechnology. Agrobios India Ltd. Jodhpur.*
2) *Mathur S(2006). Animal Cell and Tissue Culture. Agrobios India Ltd. Jodhpur.*
3) *Masters W(2005). Animal Cell Culture. Oxford University Press Inc., NewYork*
4) *Gangal S(2010). Principles and practices of Animal Tissue Culture. Second Edition. University Press PVT. LTD., Hyderabad India.*
5) *Freshney I R(2007). Culture of animal Cells: A manual of Basic Techniques. 5th edition, John Wiley & Sons Inc Pte Ltd*

REFERENCE BOOKS FOR PRACTICALS:

1) *E Book- Fletcher L, Goss E. Phelps P and Wheeler A(2014). Introduction to Biotechnology – Laboratory Manual.*
2) *Harisson M A and Rae IF(1997):General Techniques of Cell Culture Handbook in Practical animal cell biology. Cambridge University Press.*
3) *Ebook- Cell Culture basics. From www.invitrogen.com/cellculture basics.*

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ANNEXURE IX

PAPER TITLE : AQUACULTURE AND FISHERIES

PAPER CODE: ZOO-IV.E-6

NAME OF FACULTY: K.N.MISHRA

MARKS:100[75- Theory; 25- Practicals]

CREDITS: 04 [03-Theory;01- Practical)

CONTACT HOURS: Theory :45 Hours(03 LEC/WEEK)

Practicals: 30 Hours(01 PRACTICAL/WEEK)

COURSE OBJECTIVES:

- To improve the understanding of conservation and sustainability of living resources
- To improve the social and economic benefits derived from aquaculture and fisheries.
- To study the role of aquaculture in rural development in solving nutritional security and unemployment.
- Empowerment of fishery and entrepreneurship development

LEARNING OUTCOMES:

- The student may become future aqua culturist, entrepreneur who will provide employment to others.

- Optimum utilization of unutilized and underutilized aquatic resources for fisheries and aquaculture, enhance the fish production, employment generation and even to earn the foreign exchange.

MODULE	TOPIC	CONTACT HOURS
UNIT 1:	**1.1:INLAND FISHERIES:** • fisheries: Fisheries of Ganga and Brahmputra river system • Reservoir fisheries • Lakesterine fisheries: Cat fish, Murrels, Mullets, Major carps • Cold water fisheries: Mahaseer fishery **1.2: MARINE FISHERIES:** • Estuarine fisheries:The catadromous fishes (*Polynemous indicus,P.tetradactylus*) and anadromous fishes(*Hilsa ilisha,Pama pama,Polynemous paradiseus*) • Coastal fisheries or Inshore fisheries: Elasmobrach fishery and Teleost fishery • Offshore and Deep sea fisheries: Pomfrets(*Pampus,Stromateus) Eleutheronema tetradactylus*(rava),*Polydactylus indicus*(dara), ghol(*Pseudosciaena diacanthus*),*scianids*(Kurtus) **1.3: CRUSTACEAN AND MOLLUSCAN FISHERIES:** • Prawn fisheries in Goa: Penaeid and Palaemonid groups. • Crab fisheries in Goa • Edible oyster fisheries in Goa • Mussel fisheries in Goa **1.4 :FISHING METHODS IN INDIA**: • Marine Fishing Crafts and Gears used in Goa • Inland Fishing Crafts and Gears used in Goa	**15**
UNIT 2:	**2.1: INTEGRATED FISH FARMING SYSTEMS:** • Principle of integrated Fish farming • Integration with animal husbandry • Integration with farming systems. **2.2:INDUCED BREEDING:** • Selection of site • Design and Layout of fish farm • Freshwater and brackish water pond • construction • Pond maintenance • Prevention of fish diseases • Control of aquatic weeds • Control of predatory and Weed fishes • Control of Aquatic insect • Harvesting	**15**

UNIT 3:	**3.1: FISH CULTURE SYSTEM:** • Mono culture, polyculture, composite culture, raceway culture, extensive, semi intensive, intensive, zero water exchange • Objective of fish culture • Pond preparation • Selection of species • Stocking of seed • Feed and feeding • Harvesting • Bionomics of fish culture **3.2: CAGE AND PEN CULTURE:** • Advantage of Fish culture in cages • Selection of species for cage culture • Installation of cage - shape ,size and types of cages • Pen culture • Maintenance of cage and pen **3.3: PRESERVATION AND PROCESSING:** • Fish marketing • Transportation • Reasons for spoilage of Fishes • Methods of fish preservation-Freeze-drying, • Salting, Refrigeration, Deep Freezing,	**15**

REFERENCE BOOKS FOR THEORY:

1. Bal D.V.,RaoVirbhadra,K (1984) Marine Fisheries, Tata McGraw- Hill Publishing Company Ltd.New Delhi.
2. Cushing D.H. (1975) Marine Ecology and Fisheries , Cambridge University Press.
3. Day,F. (1889) The Fauna of British India including Ceylon and Burma. Fishes. 2Vols.,Taylor and Francis London.
4. Khanna S.S.(1984) An Introduction to Fishes, Central Book Depot Allahabad.
5. Pandey K and Shukla J.P.(2015) Fish and Fisheries. Rastogi Publications Meerut-250002
6. Sakhare B. Viswas (2007) Applied Fisheries.Daya Publishing House Delhi-110035
7. Santhanam R (1990) Fisheries Science,Daya Publishing House Delhi.
8. SanthanamR,Ramanathan N and Jagatheesan G(1990) Coastal Aquaculture in India,CBS Publishers and distributers,Delhi.
9. Shrivastava C.B.L.(1996) A Text Book of Fishery Science and Indian Fisheries. KitabMahal22A,S.N.Marg,Allahabad.
10. Singh B.K.(2008) Applied Fisheries and Aquaculture.Swastik Publishers and distributers,Delhi.

PRACTICAL COMPONENT OF ZOO-IV.E-6: AQUACULTURE AND FISHERIES (DURATION – 02 HRS/ WEEK)		
Sr. No.	**Practical**	**No. of Practicals**
1.	Morphometric and Meristic study : a key for fish Identification	**03**
2.	Identification of important edible shrimps and crabs(any two)	**01**
3.	Identification of important Freshwater and Marine edible fishes (five fishes each from different families)	**02**
4.	Methods of Measuring gonosomatic index of Fish	**01**
5.	Estimation of Fecundity by Frequency Polygon method from a Marine Fish	**01**
6.	Food and Feeding of Fish by analysis of gut content	**01**
7.	Visit to a Fish Landing Center to study different Types of Gear and Craft	**01**
8.	Visit to Fish breeding Center to study Induced Breeding in Indian Carps	**01**
9.	Visit to ICAR/NIMR(National Institute of Malaria Research) Old Goa for Study of Aquarium and Larvivorous Fishes	**01**

REFERENCE BOOKS FOR PRACTICALS:

1. Chandy.M (1970) Fishes,National Book Trust,India,New Delhi.
2. Day.F. (1889) The Fauna of British India including Ceylon and Burma. Fishes. 2Vols.,Taylor and Francis London.
3. R.J.Ranjit Daniels (2002) Freshwater Fishes of Peninsular India, Universities Press (India)Pvt.Ltd. Hyderabad.
4. SakhareViswasB. (2007) Applied Fisheries ,Daya Publishing House Delhi.
5. Sharma U and S.P.Grover (1982) An Introduction to Indian Fisheries,Dehradun India.
6. Srivasava C.B.L.(1986) A Text Book of Fishery Science and Indian Fisheries ,KitabMahal Allahabad.

ANNEXURE – X

PAPER TITLE:	**IMMUNOLOGY**
PAPER CODE:	**ZOO-IV.E-7**
CURRICULUM DESIGNED BY :	**DR. NANDINI VAZ FERNANDES**
MARKS:	**100 [75 –Theory ; 25- Practicals]**
CREDITS:	**04 [03 –Theory; 01- Practical]**
CONTACT HOURS:	**THEORY : 45 HOURS (03 LEC/WEEK)** **PRACTICALS: 30 HOURS (01 PRACTICAL /WEEK)**
COURSE OBJECTIVES:	**Familiarize students and make them learn about the structural features of the components of the immune system as well as their functions, and understand the mechanisms involved in immune system development and responsiveness.**
LEARNING OUTCOME:	**Upon successful completion of the course, students will be able to:** • **Understand the components of the immune system and their function.** • **Be able to explain the mechanisms of immune response.** • **Perform immunoassays to detect the presence of antigens or antibodies(disease detection).**

MODULE	TOPICS	CONTACT HOURS
UNIT 1: INTRODUCTION TO IMMUNOLOGY		
	1: OVERVIEW OF IMMUNE SYSTEM: • **Basic concepts in immunology** • **Components of the immune system**	**05**
	2: INNATE AND ADAPTIVE IMMUNITY. • **Innate immunity-Anatomical barriers/ layers of defense, cells and molecules involved in innate immunity** • **Adaptive immunity-cell mediated and humoral immunity, passive immunity (artificial and natural), Active(artificial and natural), Immune dysfunction**	**10**
UNIT 2: ANTIGENS AND IMMUNOGLOBULINS		
	3: ANTIGENS. • **Antigenicity and immunogenicity, Immunogens, adjuvants and haptens** • **Factors influencing immunogenicity** • **B and T cell epitopes**	**05**
	4: IMMUNOGLOBULINS • **Structure and function of different classes of Immunoglobulin.** • **Antigen-Antibody interactions** • **Immunoassays, monoclonal & polyclonal antibodies**	**07**
	5: MAJOR HISTOCOMPATIBILITY COMPLEX. • **Structure and function of endogenous and exogenous pathways of antigen presentation**	**03**
UNIT 3: IMMUNE RESPONSE		
	6: CYTOKINES AND COMPLEMENT SYSTEM • **Properties and functions of cytokines, cytokine based therapies** • **Components and pathways of complement activation**	**05**
	7: HYPERSENSITIVITIES, AUTOIMMUNITY AND TRANSPLANTATION • **Gell and coombs' classification, types of hypersensitivities(overview)** • **Autoimmune responses against self antigens (SLEs), responses to alloantigens and transplant rejection (graft rejection, types and mechanisms of transplant rejection**	**07**
	8: VACCINES • **Types of vaccines -inactivated, attenuated, toxoid, subunit, conjugate, experimental (DNA and recombinant vaccine), monovalent/polyvalent vaccines**	**03**

PRACTICAL COMPONENT OF ZOO-IV-E-7: IMMUNOLOGY (DURATION -02 hrs/WEEK)		
Sr. No	**Practical**	**No. of Practicals**
1	**Preparation of serum from goat blood.**	**02**
2	**Slide Agglutination Reaction(blood groups – A / AB / O with Rh)**	**02**
3	**Differential count of leukocytes**	**01**
4	**Detection of presence of antigen / antibody** - **Simple immunodiffusion**	**01**
5	**Antibody Titre determination** - **Ouchterlony immunodiffusion**	**02**
6	**Antigen –antibody reaction by immunoelectrophoresis**	**02**
7	**Elisa TEST- pregnancy test**	**01**
8	**Phagocytosis – WBC (demonstration)**	**01**

REFERENCE BOOKS:

Essential books:

1) *Abbas KA, Lechtman HA(2007). Basic Immunology, Updated Edition 2006-2007: with STUDENT CONSULT. Access (Paperback).*
2) *David M, Jonathan B, David RB and Ivan R(2006). Immunology. VII Edition, Mosby, Elsevier Publication.*
3) *Abbas KA, Lechtman HA(2003). Cellular and Molecular Immunology. Saunders Publication.*
4) *Kindt TJ, Goldsby RA, Osborne BA and Kuby J(2006). Immunology. VI edition. W H Freeman and company.*

Ebooks:

5) *Frank SA(2002).Immunology and evolution of infectious diseases. Princeton University Press, Princeton and Oxford.*
6) *Zabriskie JB(2009). Essential Clinical Immunology. Cambridge University Press.*

REFERENCE BOOKS FOR PRACTICALS:

1) *Talwar GP and Gupta SK(2012).A handbook of practical and Clinical Immunology, CBS publishers.*

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ANNEXURE XI

PAPER TITLE:EVOLUTIONARY BIOLOGY

PAPER CODE: ZOO-IV.E-8

NAME OF FACULTY: K.N.MISHRA

MARKS: 100 [75-Theory; 25 –Practicals]

CREDITS: 04[03 – Theory; 01 – Practical

CONTACT HOUR : Theory : 45 Hours(03 Lec./Week)

Practicals: 30 Hours(01Practical/Week)

COURSE OBJECTIVE:

- The study aims to discover the history of life and the causes of the diversity and characteristics of organisms.
- To show the important contributions of evolutionary biology to other biological disciplines such as medicine

LEARNING OUTCOME:

- The study will give detail knowledge about many unsolved hypothetical issues to solve it.
- The student will learn that evolution is not a speculation , but a thoroughly supported hypothesis that explains the process of evolution

MODULE	TOPICS	CONTACT HOURS
UNIT 1:	**1.1: EVOLUTIONARY BIOLOGY:AN OVERVIEW** • What Is Evolution? • History Of Evolutionary Biology • Pre Darwinian • Darwin's Evolutionary Theory • Evolutionary Theories After Darwin • Famous contributions to evolutionary Biology:CarlLinneaus,Lamarck,Malthus,Darwin,Thomas Huxley,R.A.Fisher,Haldane,sewall Wright,G.G.Simpson,Dobzanhasky,Ernst Mayr,M.Kimura **1.2: THE NATURAL SELECTION:** • The Nature of Natural Selection • Postulates of natural selection • Evidences of Natural selection • Types of natural selection(Stabilizing,Directional and Disruptive selection) • Natural Selection in action(Darwin's finches, Endler's guppies examples) • Sexual Selection **1.3: RANDOM PROCESS IN EVOLUTION:** • mutation :types of mutation • genetic drift(bottle neck effect,founder's effect) • gene flow(migration/emmigration **1.4: SYNTHETIC THEORY OF EVOLUTION** • Neo-Darwinis	**20**
UNIT 2:	**2.1: NON- DARWINISM** • Neutral theory of evolution • Molecular polymorphism-nucleic acids and proteins • Molecular clocks **2.2: SPECIATION** • different concepts of speciation • Concept Of Biological Speciation(Allopatric/Sympatric) • Consequence Of Speciation • Factors involved in Biological Speciation(pre and post- zygotic mechanisms) **2.3: POPULATION GENETICS** • Hardy-Weinberg's Law(H-W) • Genes And Genotype Frequencies • Factors Affecting H-W **2.4:ADAPTATIONS :** • Definition and kinds of adaptations with some	**15**

	examples. • Pre , Post adaptations • Coadaptations and Parallel adaptations	
UNIT 3:	**3.1: PATTERNS OF EVOLUTION:** • Sequential and Convergent Evolution • Microevolution • Macroevolution(Adaptive radiation) • Megaevolution • Gradualism And Punctuated Equilibrium **3.2: EVOLUTION AND HUMAN HEALTH AND DISEASES** • Design defects • Defence mechanisms-Allergy,morning sickness • Evolution of antibiotic resistance • Evolution of behaviour,Anxiety,fear and depression.	**10**

REFERENCE BOOKS FOR THEORY:

1. Bipin Kumar(2001) Organic Evolution; Campus Books International, New Delhi.
2. Charlotte J. Avers (1989)Process and pattern in Evolution ; New York Oxford University Press.
3. Douglas J. Futuyma(2013) Evolution IIIrd edition; Sinauer Associates,Inc.Publishers Sunderland , Massachusetts U.S.A.
4. E.Peter Volpe(1989) Understanding Evolution Vth edition Universal Book Stall.
5. S.Osawa ,T.Honjo(Eds.)(1991) Evolution of life,Springer-Verlag Tokyo .
6. Savage Jay M (1969) Evolution , Amerind Publishing Co-Pvt. Ltd. New Delhi.
7. Veer Bala Rastogi (2004) Organic Evolution ,Eleventh revised edition; Kedarnath Ramnath Delhi.

PRACTICAL COMPONENT OF ZOO-IV.E-8: EVOLUTIONARY BIOLOGY
DURATION -02 HRS/WEEK

Sr.No.	Practical	No.of Practicals
1.	Study of homology and analogy from suitable specimens	**01**
2.	Serial homology	**01**
3.	Variations are basis for evolution	**01**
4.	To demonstrate the role of Natural Selection in Fixing Favoured Adaptation and Eliminating Maladaptation.	**02**
5.	Problems based on Population Genetics (PTC /blood group)	**04**
6.	An exercise to illustrate the concepts of Genetic drift	**02**
7.	Vestigial organs or Vestiges in animals and humans.	**01**

REFERENCE BOOKS FOR PRACTICALS:

1. Pranab K. Banerjee (2011) Problems on Genetics,Molecular Genetics and Evolutionary Genetics, New Central Book Agency (P) Ltd. Delhi.

ANNEXURE XII

Question paper pattern of the college

Q1	Q2	Q3	Q4	Max Marks	Total Marks
Any 3 OF 4 **(3 marks each)**	**Any 2 OF 3** **(6 marks each)**	**Any 2 OF 3** **(6 marks each)**	**Any 1 OF 2** **(12 marks each)**	**45**	**72**