

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous),

Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of Syllabus For T.Y.B.Sc. Zoology (NEP 2023 Pattern)

(Based on NEP 2020 framework 2023 pattern)

(To be implemented from the Academic Year 2025-26)

Semester- V

Sem- V (Third Year)

C o u r s e T y p e	Course Code	Course	Course / Paper Title	Hou rs / W ee k	Cre dit	CI A	E S E	Tot al
Maj or Manda tory (4 + 4 + 2)	23ScZooU5101	Major Core Paper 9 (Theory) Section 1	Developmental Biology & Evolution	2	4	40	6 0	100
		Major Core Paper 9 (Theory) Section 2		2				
	23ScZooU5102	Major Paper 10 (Theory) Section 1	Biochemistry & Human Physiology	2	4	40	6 0	100
		Major Paper 10 (Theory) Section 2		2				
	23ScZooU5103	Major Paper 11 (Practical)	Zoology Major Practical-5	4	2	20	3 0	50
Maj or Elect ives	23ScZooU5201	Elective I (Theory)	Microbiology, Parasitology & Immunology	2	4	40	6 0	100
	23ScZooU5202	Elective I (Practical)	Zoology Elective Practical-1	4				
	23ScZooU5203	ElectiveII (Theory)	Wildlife Conservation & Management	2	4	40	6 0	100
	23ScZooU5204	Elective II (Practical)	Zoology Elective Practical-2	4				
Min or (4)	23ScZooU5301	Minor Paper IV (Theory) Section 1	Parasitology	2	4	40	6 0	100
		Minor Paper IV (Practical) Section 2	Zoology Minor Practical-4	4				
OE (2)		--	--	--	--	--	--	--

VSC (2)	23ScZooU5501	Major Specific Practical IV	Lab Course on Environmental Biotechnology	4	2	20	30	50
SEC (2)		--	--	--	--	--	--	--
AEC(2) ,		--	--	--	--	--	--	--
VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--
FP / CEP(2)		FP –II	Field Project II (Zoology)	4	2	20	30	50
Total				38	22	220	330	550

OE : Open Elective

AEC: Ability Enhancement Course

VEC: value Education Courses

CC : Co-Curricular Courses

IKS : Indian Knowledge System

OJT : On Job Training

FP : Field Project

VSC : Vocational Skill Courses

CEP : Community Engagement Project

Subject: Zoology Semester- V

TYBSC NEP (2023) syllabus

Major Paper-9 Section- I (T)

Credits: 4C (Theory)

Course Code: 23ScZooU5101

Course Name: Developmental Biology & Evolution

Course outcomes

After successfully completing the course, the students will be able to

- 1) Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
- 2) Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
- 3) Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- 4) Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
- 5) Examine the evolutionary history of the taxa based on developmental affinities.
- 6) Understand the relevance of developmental biology in medicine or its role in development of diseases.

Theory

Unit-I	How does reproduction start, commence and modify in living system	Lectures
	• Reproduction: a basis of species sustenance. Asexual and sexual reproduction and their relevance in corresponding environments. How are germ cells “special”? • Gamete formation, types, their diversity and competence, • fertilization-external and internal; causes of Infertility. Structural and biochemical changes in gametes during and after fertilization, block to polyspermy. • Establishment of the major embryonic axes, polarity, morphogen gradients and their interpretation. Fate maps, their relevance. • <i>In vitro</i> fertilization; Amniocentesis; Artificial insemination	16

	(AI); Gamete intra-fallopian transfer (GIFT). Intra-cytoplasmic sperm injection (ICSI); Test tube baby.	
Unit-II	How does development affect organization of phenotypes and their variation? (with reference to development of chick up to 48 hr.)	Lectures
	• Developmental commitment. Mosaic and regulative development. Direct and indirect development. • Cleavage: types and patterns. Body plan and symmetries. Germ layer differentiation. Tubulation. • Blastula- types, Mid-blastula transition. • Morphogenesis: Epiboly, emboly/ invagination, involution and ingression. • Gastrulation • Cell-cell interactions (cell signaling, cell adhesion etc.) during tissue organization, lateral inhibition, induction, and recruitment. Organisers • Organogenesis: formation of gut, heart, kidney and muscles. Concept of competence, determination and differentiation and growth, molecular mechanism involved. Pluripotency. Stem cell biology and tissue repair	14
Unit-III	Tracing the evolutionary biology of development	Lectures
	• Role of extra embryonic membranes in development, Placenta: types, structure and functions. • Metamorphosis in insect and frog. • Regeneration: epimorphosis, morphallaxis and compensatory regeneration. • Development, ageing and apoptosis. Developmental mechanisms of evolutionary change (Evo-devo). • Ecological Developmental Biology. Developmental biology in understanding of disorders. • Teratogenesis; wound healing, birth defects, developmental brain disorders. Neurodegeneration. Endocrine Disruptors & Cancer.	14
Unit-IV	Understanding evolution through natural selection, adaptation and optimal modelstradeoffs	Lectures
	• Early life on Earth and its indirect evidences, direct evidence of early life; great oxygenation and its relationship with life. • Evolution and radiation of metazoans, major evolutionary transitions • Mass extinctions, Anthropocene and its uniqueness. • Evidences of evolution: Hardy-Weinberg Equilibrium, Selection, Migration. Nonrandom mating • Cost/ benefit of sex, Sexual conflict	16

	• Evolution in asexual systems Life-history adaptations • Trade-offs, Number and size of offspring; • Parent-offspring conflict. Genetic drift, Neutral evolution; • Theories of evolution. Linkage disequilibrium; Epistasis. Heritability; Breeding value. • Sources of variation: mutation, recombination, epigenetic variation. Evolution of mutation rates. • Phenotypic plasticity • Genome evolution: Mobile genetic elements; gene duplication. • Evolution and Health: Evolution of antibiotic Resistance, Virulence, Evolutionary medicine.	
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References

1. Gerhart, J. *et al.* (1997) Cells, Embryos and Evolution. Blackwell Science
2. Gilbert, S.F. (2010) Developmental Biology (9th edition). Sinauer
3. Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press
4. Campbell, N. and Reece, J. (2014) Biology (10th edition). Benjamin Cummings
5. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing.
6. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
7. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers

Subject: Zoology Semester- V

TYBSC NEP (2023) syllabus

Major Paper-10 (T)

Credits: 4C (Theory)

Course Code: 23ScZooU5102

Course Name: Biochemistry and Human Physiology

Course Outcomes:

1. The student will be able to use the knowledge of structures and functions of biomolecules in understanding the metabolism.
2. Interrelationship between the biomolecules will be understood. Carbohydrates its structure, classification and clinical significance will be understood.
3. Proteins with their unique chemistry can be understood from the structures. Role of lipids in biological and clinical stages will be made clear. Vitamins, micronutrients their chemistry, classification and deficiency disorders will be understood by the students
4. Enzymes biological catalysts will be understood with its chemistry, enzyme substrate reactions, various factors affecting enzyme substrate reaction and mathematical equations
Understand the process of digestion and excretion and its control
5. Develop understanding in muscle structure and contraction mechanism, Learn the process of respiration and transport of gases. Understand heart structure and functioning.
6. Understand function of endocrine glands and formation of gametes.
7. Understand kidney structure and regulation of urine formation

	Section I – Biochemistry	Number of Lectures
Unit I	Introduction to Biochemistry	5
	1.1 Introduction and scope of biochemistry 1.2 Principle of bimolecular organisation 1.3 Water, Structure (liquid, ice, colloid), ionic product of water, physicochemical properties, water as an ideal biological solvent. 1.4 Concept of Acid, Bases – pH, Henderson Hasselbach equation 1.5 Bonds – Types: Ionic, Covalent, Non-Covalent (hydrogen, hydrophobic, Van der Waals forces) and their significance in biomolecules.	
Unit II	Carbohydrates	5
	1.1 Carbohydrates: Structure and biological importance. 1.2 Classification Reducing and non-reducing sugars, monosaccharides, Oligosaccharides (Disaccharides), polysaccharides (peptidoglycans and glycosaminoglycans) 1.3 Catabolism of carbohydrates and ATP production, Glycolysis, Krebs cycle, Electron Transport Chain, ATP Synthesis, 1.4 Clinical significance – Diabetes mellitus, Hyper and hypoglycemia	
Unit III	Amino acids and proteins	5
	7.1 Proteins: Composition and Biological significance. 7.2 Amino acids –Structure, classification and properties, 7.3 Ionization, titration curve, pK and pI. 7.4 Physiological importance of essential and non-essential amino acids 7.5 Catabolism of amino acids: Transamination, Deamination, Urea cycle. 3.6 Ramachandran Plot	
Unit IV	Enzymes	7
	4.1 Enzymes: Nomenclature and classification, general properties, specificity, cofactors, isozymes. 4.2 Mechanism of enzyme action (ES complex and lowering of activation energy, chemical catalysis). 4.3 Kinetics (determination of Km and Vmax using Michaelis-Menten and Lineweaver-Burk plots). 4.4 Regulation of enzyme activity, inhibition, allosteric regulation, role of covalent modifications, ribozymes and concept of abzymes 4.5 Clinical significance of proteins and enzymes – AKU, PKU	
Unit V	Lipids	5
	5.1 Lipids: Structure and Biological significance. 5.2 Fatty acids- Types and nomenclature (saturated and unsaturated). Classification- Triglycerides, Phospholipids, Sphingolipids, Cholesterol 5.3 β -oxidation of saturated fatty acids with even and odd number of carbon atoms. 5.4 Clinical significance of lipids – Obesity, Atherosclerosis, Myocardial infarction	

Unit VI	Vitamins	3
	6.1 Definition and classification of Vitamins 6.2 Fat soluble vitamins – chemistry, biochemical functions and related deficiency disorders. 6.3 Water soluble vitamins – chemistry, biochemical functions and related deficiency disorders	
	Section II - Human Physiology	
Unit 1	How are processes of digestion and excretion accomplished in man?	6
	1.1. Digestive glands: Structure and function. Digestion and absorption of nutrients: carbohydrates, fats and proteins. 1.2. Nutrition: Concept of nutrition and energy requirements 1.3. Neural and hormonal control of digestion.	
Unit 2	An overview of muscular function and respiration in man	7 L
	2.1. Structure of smooth, skeletal and cardiac muscles. Neuromuscular junction. Mechanism of muscle contraction. 2.2 muscle twitch, tetanus and fatigue, muscle fatigue, rigor mortis, isotonic and isometric contractions. 2.3. Respiration: Ventilation, External and internal respiration. Transport of carbon dioxide and oxygen in blood and tissues. Factors affecting gaseous transport. 2.4. Respiratory Quotient and BMR 2.5. Definitions of acidosis, alkalosis, asphyxia, hypoxia, anoxia & cyanosis.	
Unit 3	Cardiovascular functions in man	6 L
	3.1. Structure of heart. Coordination of heartbeat; control of heart beat (neural and hormonal) 3.2. Blood cells and blood vessels. Cardiac cycle. ECG. Lymph and lymph vessels. 3.3. Definitions and significance of pacemakers, electrocardiogram, Echocardiograph, colour Doppler, angioplasty, angiography, angina pectoris, Heart attacks and coronary bypass.	
Unit 4	Endocrine and reproductive physiology	6 L

	4.1. Structure and function of endocrine glands viz., pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries and testes. 4.2. Processes of spermatogenesis and oogenesis. Fertilization and implantation. Menstrual cycle. Pregnancy and Parturition. 4.3. Hormonal control of pregnancy, parturition and lactation.	
Unit 5	Excretory system	5 L
	5.1. Functional anatomy of kidney. Mechanism of excretion and regulation of urine formation. 5.2. Definitions and clinical significance of- renal failure, renal calculi, dialysis	

References:

I) Biochemistry

1. Lehninger's Principles of Biochemistry, fifth edition (2008) Nelson D.L and Cox M.M, W.H. Freeman and Co. N.Y.
2. Biochemistry, Third edition (2008) Dr. U. Satyanarayana, Dr. U. Chakrapani
3. Biochemistry, Third edition (2005) Voet Donald and Voet Judith G. John, Wiley and sons publishers, N.Y.U.S.A
4. Biochemistry, Fourth edition (1999) Geoffrey Zubay
5. Instant notes of Biochemistry, Tywmann Medical Biochemistry, Eighth edition (2011) M. N. Chatterjee, Rana Shinde Sc

II) Human Physiology.

1. Tortora, G.J. and Derrickson, B.H. (2009) Principles of Anatomy and Physiology (12th edition) John Wiley and Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology (9th edition) McGraw Hill.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology (12th edition) Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Marieb, E. (1998) Human Anatomy and Physiology (4th edition) Addison-Wesley.
5. Kesar, S. and Vashisht, N. (2007) Experimental Physiology, Heritage Publishers.
6. Barret, K.; Brooks, H.; Boitano, S. and Barman, S. (2010) Ganong's Review of Medical Physiology (23rd edition) Lange Medical.
7. Guyton, A.C. and Hall, J.E. (2006) A text book of Medical Physiology (11th edition) Saunders.
8. Keele, C.A. & Neil, E. (1989) Samson Wright's Applied Physiology (13th edition) Oxford.
9. A Text book of General Physiology- P. H. Mistecheil.
10. Introduction of Physiology-Davson (I & II).
11. A Text book of Animal Physiology- M. Arora.
12. General Endocrinology- Turner & Bungera.
13. A Text book of Physiology- Chaterjee.
14. A Text book of Physiology- Nagabhushnum.
15. A Text book of Physiology & Biochemistry- G. H. Bell; C. R. Paterson & E. Smith.

Major Paper-11 (Practical) 2C
Course Code 23ScZooU5103

**Zoology Major Practical 5 – Practicals in Developmental Biology & Evolution,
 Biochemistry & Physiology**

Practicals (any-15)

Sr. No	Title	No. of Practical
Section-I Developmental Biology		
1	Types of eggs based on quantity and distribution of yolk: Amphioxus, insect, frog, Chick.	1P
2	To study the types of blastulae and gastrulae (amphioxus, frog and hen)	1P
3	Study of whole mount and TS slides of chick embryology – 24h, 33hr and 48hr	1P
4	Temporary preparation of chick embryo	1P
Section-II Evolution		
5	Study of types of fossils. And analogy and homology (wings of birds and insects, forelimbs of bat and rabbit).	1P
6	Zoogeography of animals.	1P
7	Island biogeography by simulation.	1P
8	Successive stages of human evolution (Models/charts)	1P
Section III – Biochemistry		
1.	To study the effect of pH, temperature and inhibition on salivary amylase	1P
2.	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests.	1P
3.	Isolation of Casein by adjusting the isoelectric point.	1P
4.	Study of preparation of standard acid, alkali and its standardization.	1P
5.	Quantitative tests for analysis of lipids	1P
6.	Determination of activity of Urea and Urease.	1P
Section IV – Human Physiology		
7.	To study the Body Mass Index (BMI)	1P
8.	Study of permanent histological sections of mammalian oesophagus, stomach, duodenum and rectum,	1P
9.	Study of permanent histological sections of mammalian lung, adrenal, kidney, thyroid, pancreas, testis, and ovary.	1P
10.	Study of family planning devices and pregnancy diagnosis test.	1P
11.	Study of principle and working of dialysis machine.	1P
12.	To study erythrocyte sedimentation rate (ESR) & Pathological report	1P

Subject: Zoology Semester- V

Elective-1

Course Code: 23ScZooU5201

Immunology

TYBSC NEP (2023) syllabus

Credits: 4C (Theory)

Course Name: Microbiology, Parasitology and

Course Outcomes:

1. Carry out common procedures for culturing, purifying and diagnostics of micro-organisms understand the disease-causing potential of bacteria and viruses, and the responses of the immune system.
2. Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
3. Diagnose the causative agents, describe pathogenesis and treatment for important diseases like malaria, leishmaniasis, toxoplasmosis, schistosomiasis, cysticercosis, filariasis etc. trypanosomiasis,
4. Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities. Know how resistance development and resistance transfer occur.
5. Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
6. Understand how immune responses are initiated and regulated. Understand how the immune system distinguishes self from non

Course Contents:

UNIT: 1	Microbiology: A brief account of pathogenic bacteria and viruses.	7 L
	I. Brief history of microbiology- germ theory of disease, discovery of penicillin. II. Diversity of microbes- viruses and bacteria. Host pathogen interaction: invasion, antigenic heterogeneity, toxins and enzymes secretions. III. Viral diseases: polio, rabies, hepatitis, influenza, with emphasis on their causative agents, pathogenesis, diagnosis, prophylaxis and chemotherapy. IV. Bacterial diseases caused by <i>Bacillus anthracis</i>, <i>Streptococcus pyogenes</i>, <i>Streptococcus pneumoniae</i>, <i>Salmonella typhi</i>, <i>Escherichia coli</i>, <i>Helicobacter pylori</i>, <i>Mycobacterium tuberculosis</i>, <i>Vibrio cholerae</i>. V. Fungal diseases: Ringworm infection, aspergillosis, candidiasis.	
UNIT: 2	Parasitology: an overview of common parasitic infections.	7 L
	I. Introduction to parasites and parasitic diseases. Mode of	

	transmission, portal of entry and implications of parasitism. Parasitic adaptations. II. Concept of zoonotic diseases. Protozoan and diseases of medical importance: amoebiasis, giardiasis, malaria, trypanosomiasis, leishmaniasis, toxoplasmosis. III. Helminthic diseases of medical importance: Schistosomiasis, taeniasis, echinococcosis, ascariasis, enterobiasis, dracunculiasis and filariasis.	
Unit 3	Immunology: An overview of Immune mechanism and related pathways.	8 L
	I. Definition and classification. II. Cells and organs of immune system- primary and secondary lymphoid organs. III. Innate immunity: First and second lines of defense. IV. Characteristics of antigen- antigenicity and immunogenicity, epitopes, haptens, adjuvant. V. Factors influencing immunogenicity. VI. Structure of immunoglobulin: Classification, properties and functions of immunoglobulins. VII. Antigenic determinants: isotype, allotype and idio type. VIII. Antigen and antibody interactions, affinity, avidity. Complement system (Classical, alternative and lectin pathways).	
Unit 4	Acquired immunity, Hypersensitivity and autoimmune disorders	8 L
	I. Acquired immunity: Humoral and cell mediated immune response. II. Role of B and T cell in immunity. Receptors, activation and differentiation of B and T cells. III. Cytokines: Properties and function. IV. MHC complex and molecules with classification and function. V. Antigen processing and their presentation. VI. Hypersensitivity: Gell and Coomb's classification with examples. VII. Autoimmune disorders.	

References:

1. Jawetz, M. and Adelberg (2015) Medical Microbiology (27th edition)
2. Chatterjee, K.D (2015) Parasitology (13th edition)
3. Goldsby, R.A.; Kindt, T.J. and Kuby, J. (2006) Immunology (6th edition).
4. Roitt, I.; Brostoff, J. and Male, D. (2012) Immunology (8th edition).

Elective-1 (Practical) 2C
Course Code 23ScZooU5202

Zoology Elective Practical 1 – Practicals in Microbiology, Parasitology and Immunology

Practical (Any 15)

Sr. No.	Title	No. of Practical
1.	Preparation and sterilization of equipment and culture media	1P
2.	Types of culture media and preparation.	1P
3.	Different staining techniques in microbiology.	1P
4.	Staining and identification of Gram positive and Gram negative bacteria.	1P
5.	Kinetics of bacterial growth	1P
6.	Streak Plate Method for culturing and isolation of bacteria	1P
7.	The Spread Plate Technique for culturing and isolation of bacteria	1P
8.	Study of permanent slides and specimens of parasitic protozoans.	1P
9.	Study of permanent slides and specimens of parasitic helminthes.	1P
10.	Stages of life cycle tapeworm: <i>Taenia solium</i>	1P
11.	Study of ectoparasites of animals: lice, tick, flea, mite, bedbugs	1P
12.	Vectors of different parasitic diseases: Mosquito, House fly etc.	1P
13.	Preparation of temporary slides of gut matter by saline preparation techniques to identify parasitic protozoans and helminthes. (Cockroach)	1P
14.	ABO blood group testing principle and procedure	1P
15.	Blood: Erythrocyte Sedimentation Rate (ESR).	1P
16.	Demonstration of antigen-antibody interaction in gel.	1P

Subject: Zoology Semester- V

TYBSC NEP (2023) syllabus

Elective-II

Credits: 2C (Theory)

Course Code: 23ScZooU5203

Course Name: Wildlife Conservation and Management

Course outcomes

After successfully completing this course, the students will be able to:

1. Develop an understanding of how animals interact with each other and their natural environment
2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues
3. Develop the ability to work collaboratively on team-based projects
4. Demonstrate proficiency in the writing, speaking, and critical thinking skills needed to become a wildlife technician
5. Gain an appreciation for the modern's code of scientific inquiry in the field of wildlife conservation management
6. Develop an ability to analyze, present and interpret wildlife conservation management information.

Unit	Content	No. of Lectures
I	Value of wildlife and need for its conservation	9L
	1.1 Definition, value and importance of wildlife 1.2 Inventory and classification of wetland and animal inhabitants 1.3 Population vulnerability analysis and its components 1.4 Factors responsible for the extinction of animals 1.5 Types of protected areas and the concept of zoning within the protected areas 1.5.1 Wildlife Sanctuaries and National Parks in India 1.6 Theories of population dispersal, Animal movement, Concept of home range and territory 1.7 Tracking movement by camera, drone, remote sensing and GIS	
II	Population and prey-predator dynamics	8L
	2.1 Wildlife conservation, ethics and importance of conservation 2.2 Impact of topography, geology, soil and water on wildlife 2.3 Causes of depletion of wildlife 2.3.1 Impact of habitat destruction on wildlife 2.3.2 Impact of fragmentation on wildlife 2.4 Biological parameters such as food, cover, forage and their impact on wild life 2.5 Density dependent and independent population regulation 2.6 Impact of alien, invasive species on preexisting flora and fauna of wildlife; 2.7 Predator-prey models and impact of predation	

III	Wildlife Conservation	7L
	3.1 Inviolable area and critical habitats and their impact on wildlife 3.2 Different terrestrial habitats of wildlife in India 3.3 Restoration of degraded habitat 3.4 Damage caused by wildlife in India and its mitigation 3.5 Wildlife conservation in India: Project Tiger, Fireflies, turtle festival	
IV	Rehabilitation and management	6L
	4.1 Sick animal refuges In protected areas 4.2 Type of wildlife management-manipulative, custodial 4.3 Management of over abundant wild animal populations causing damages to nearby inhabitants and their crops and animals 4.4 Man wildlife conflict resolution and mitigation 4.5 Management of exotic and invasive wetland species in India 4.6 Habitat manipulation– control and regulation of grazing 4.7 Weed eradication- chemical, mechanical, biological, integrated weed management 4.8 Major diseases of domestic and wild animals and their control and impact of wild life tourism 4.9 IUCN Red list of threatened species 4.10 Wildlife conservation acts	

References:

1. Caughley, G., and Sinclair, A.R.E. (1994) Wildlife Ecology and Management. Blackwell Science.
2. Woodroffe, R., Thirgood, S. and Rabinowitz, A. (2005) People and Wildlife, Conflict or Co-existence? Cambridge University.
3. Bookhout, T.A. (1996) Research and Management Techniques for Wildlife and Habitats (5th edition) The Wildlife Society, Allen Press.
4. Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
5. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008) Problem solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

Elective -II (Practical) 2C
Course Code 23ScZooU5204

Zoology Elective Practical 2 – Practicals in Wildlife Conservation and Management

Practicals (Any 15)

	Title	No. of Practical
1	Identification of any five terrestrial flora	1P
2	Identification of any five mammalian fauna	1P
3	Identification of any five avian fauna	1P
4	Identification of any five herpeto-fauna	1P
5	Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)	1P
6	Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc	1P
7	Demonstration of different field techniques for flora and fauna	1P
8	Trail/transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)	1P
9	Study of animal community structure by quadrat method	1P
10	Study of Eutrophication and its effects on freshwater ecosystem	1P
11	Study of some endangered fauna and their conservation strategies	1P
12	Tools and techniques to control the menace of wild animals	1P
13	Wildlife conservation objectives-strategies and issues; Captive breeding techniques and translocation and reintroduction	1P
14	Study tour/ visit to the national park/ sanctuaries	1P
15	Study tour/ visit to any one terrestrial/ aquatic ecosystem	1P
16	Camera trap distance sampling (CTDS) method for wildlife monitoring in natural resources management	1P
17	Group discussion or Seminar presentation on one or two related topics	1P

Subject: Zoology Semester- V
Minor Paper- IV
Course Code: 23ScZooU5301

TYBSC NEP (2023) syllabus
Credits: 4C (2T+2P)
Course Name: Parasitology

Course outcomes

After successfully completing this course, the students will be able to:

1. Aware about the portal of entry of disease in human body.
2. Diagnose the causative agents, describe pathogenesis and treatment for important diseases caused due to various protozoan parasites.
3. Diagnose the causative agents, describe pathogenesis and treatment for important diseases caused due to various helminth parasites.
4. Assess the medically important arthropods.
5. Assess the importance of incidence, prevalence and epidemiology in diagnostic activities.
6. Aware of veterinary emergent parasites.
7. Gain experience at reading and evaluating the scientific literature in the area.

Unit	Content	No. of Lectures
I	Basic concept and overview	3L
	2.4 Overview of Host: Parasite relationship 2.5 Importance of parasitology to man 2.6 Parasitic adaptations 2.7 Interrelationships between host and parasite	
II	An overview of common parasites	8L
	2.8 Concept of zoonotic diseases 2.9 Introduction to parasites and parasitic diseases 2.10 Mode of transmission, portal of entry and implications of parasitism: Protozoan parasites 2.3.1 <i>Entamoeba histolytica</i> 2.3.2 <i>Plasmodium</i> 2.3.3 <i>Trypanosoma</i> 2.3.4 <i>Leishmania</i>	
III	Helminthic parasites	8L
	Habit, habitat, Lifecycle, Mode of Infection, pathogenicity and control measures of the following: 3.1 <i>Schistosoma</i> 3.2 <i>Taenia</i> 3.3 <i>Echinococcus</i> 3.4 <i>Ascaris</i> 3.5 <i>Enterobius</i> 3.6 <i>Dracunculus</i> 3.7 <i>Wuchereria</i>	

	3.8 Fasciola	
IV	Medically important Arthropods	7L
	4.11 Fleas 4.12 Bugs 4.13 Tick 4.14 Mite 4.15 Flies 4.16 <i>Pediculus</i>	
V	Human clinical and veterinary parasitology	3L
	5.1 Detection, diagnosis, prophylaxis, treatment, and pharmacology (emergent parasites) 5.2 Community medicine	

References:

1. General Parasitology-Cheng, T.C. Academic Press.
2. Medical Parasitology-Dey and Dey, Allied Agency, Kolkata.
3. Parasitology-K.D. Chatterjee, Chatterjee Medical Publication, Kolkata.
4. Parasitology-Chandler, Allied Agency, Kolkata.
5. Essentials of Parasitology-Gerald D. Smith.
6. Economic Zoology-Shukla and Upadhyay.
7. Medical Zoology-R.C. Soti, Shoban Lal & Co.
8. Parasitology- E. J. L. Soulsby
9. Handbook for Integrated vector management-World health organization.
10. Park's textbook of preventive and social medicine: 23rd Edition
K. Park, Chatterjee, K.D (2015) Parasitology (13th edition)
11. H.S. Singh, P. Rastogi (2015) Parasitology (1st edition)

Minor Paper-V (Practical) 2C
Course Code 23ScZooU5301

Zoology Minor Practical 4 – Practicals in Parasitology

Sr. no	Title	No. of Practical
1	Study of lifecycle of malarial parasite and entamoeba (whole mounts of lifestages)	1P
2	Study of lifecycle of Leishmania, Trypanosoma	1P
3	Study of lifecycle of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i> (whole mounts of life stages)	1P
4	Study of lifecycle of <i>Taenia solium</i> and <i>Fasciola hepatica</i>	1P
5	Study of intestinal and urogenital protozoa: <i>Entamoeba coli</i> , <i>Blastocystis hominis</i> , <i>Balantidium coli</i> , <i>Trichomonas vaginalis</i> , <i>Giardia intestinalis</i> , <i>Cryptosporidium</i>	1P
6	Study of epidemic parasites; <i>Vibrio cholera</i> , Variola virus, <i>Salmonella typhi</i> .	1P
7	Study of types of vector, host and parasites with example.	1P
8	Study of medically important arthropods as vector: Fleas, Bugs, <i>Pediculus</i> , Tick, Mite, Housefly, Mosquito	1P
9	Preparation of whole mounts and mouthparts of female Anopheles, female Culex and female Aedes	1P
10	Study of rectal parasites of the cockroach	1P
11	Permanent slide observation of thin and thick bloodfilms to diagnose Plasmodium infections.	1P
12	Group discussion or Seminar presentation on one or two related topics.	1P
13	Field collection of immature stages of mosquitoes	1P
14	Fecal analysis by density gradient centrifugation	1P
15	Extraction of soil/ fecal nematode by Baermann method	1P
16	Project report submission on any one of the insect vectors and the disease transmitted	1P

VSC Major Specific Practical- V Credit 2C (15 P)**Course Code 23ScZooU5501****Zoology Major Practical 5 – Lab Course on Environmental Biotechnology****List of Practicals**

Sr. No	Title	No. of Practical
1	Estimation of turbidity/penetration of light, pH, salinity, TDS of wastewater. (E)	1P
2	To estimate Dissolved Oxygen content by Winkler's method.(E)	1P
3	To determine the Chemical Oxygen Demand or free CO ₂ of water.(E)	1P
4	Determination of dissolved substances viz., nitrate, calcium, magnesium and phosphorus of water (Any one).(E)	1P
5	Determination of nitrate, calcium and phosphorus of soil.(E)	1P
6	To determine water holding capacity of Physical analysis of soil.(E)	1P
7	Gravimetric estimation of total solids, dissolved solids and suspended solid in an effluent.(D/E)	1P
8	Microbial study of air (open plate air sample) (D/E)	1P
9	Biochemical <i>tests</i> for contamination of bacteria from water by IMVIC test.(D/E)	1P
10	Detection of effect of heavy metals on bacterial growth.(E)	1P
12	Study of emerging contaminants.(E)	1P
13	Demonstration of Bioremediation (By phytoremediation method) (D)	1P
14	Problem solving based on biomagnification. (E)	1P
15	Group discussion or Seminar presentation on one or two related topics from the list	1P

Semester- VI

Sem-VI (Third Year)

Course Type	Course Code	Course	Course / Paper Title	Hours / Week	Credit	CI A	ES E	Total
Major Mandatory (4 + 4 + 2)	23ScZooU6101	Major Core Paper 12 (Theory) Section 1	Ecology & Entomology	2	4	40	60	100
		Major Core Paper 12 (Theory) Section 2		2				
	23ScZooU6102	Major Paper 13 (Theory) Section 1	Molecular Biology & Biological Techniques	2	4	40	60	100
		Major Paper 13 (Theory) Section 2		2				
	23ScZooU6103	Major Paper 14 (Practical)	Zoology Major Practical-6	4	2	20	30	50
Major Electives	23ScZooU6201	Elective III (Theory)	Biostatistics & Bioinformatics	2	4	40	60	100
	23ScZooU6202	Elective III (Practical)	Zoology Elective Practical-3	4				
	23ScZooU6203	Elective IV (Theory)	Vectors, Diseases and Control	2	4	40	60	100
	23ScZooU6204	Elective IV (Practical)	Zoology Elective Practical-4	4				
Minor (4)	23ScZooU6301	Minor Paper V (Theory) Section 1	Advanced Techniques in Biology (T+P)	2	4	40	60	100
		Minor Paper V (Practical) Section 2	Zoology Minor Practical-5	4				
OE (2)		--	--	--	--	--	--	--
VSC (2)		--	--	--	--	--	--	--
SEC (2)		--	--	--	--	--	--	--
AEC(2),		--	--	--	--	--	--	--
VEC (2)		--	--	--	--	--	--	--
IKS (2)		--	--	--	--	--	--	--
FP / CEP(2)		--	--	--	--	--	--	--
OJT(4)	23ScZooU6004	OJT	On Job Training	8	4	40	60	100
Total				38	22	220	330	550

Subject: Zoology Semester- VI

Major Core Paper-12

Course Code: 23ScZooU6101

TYBSC NEP (2023) syllabus

Credits: 4C (Theory)

Course Name: Ecology & Entomology

Course Outcomes:

1. The students will become aware of the role of insects in ecology and evolution
2. The students shall learn about interesting aspects of insect life
3. The students will be able to appreciate importance of insects in human life

Course Contents:

	Section I- Ecology	
Unit 1	An overview of Ecology, Ecosystems and Biomes	10
	• Introduction and scope of Ecology. • Multidisciplinary relevance in current perspective. Structure and function of ecosystem; • Abiotic factors affecting survival and sustenance of organisms e.g., water, temperature, light, pH and salinity. • Role of limiting factors in survival of biotic components. • Major ecosystems of the world: Ecological features, limiting factors, zonation and classification of organisms of fresh water and marine ecosystems. • Introduction to Biome: Ecological features of Tundra, Desert, Savannah and Tropical Rain Forest Biomes. • Energy flow in ecosystem, food chain and food web. Productivity. Mineralization and recycling of nutrients: C, N, P & S.	
Unit 2	Population ecology; Human population growth	10
	• Ecology of populations: Unitary and Modular populations. • Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves. • Unique and group attributes of population: mortality, age ratio, sex ratio, dispersal. • Factors regulating population dispersal and growth: Exponential and logistic growth. • Population regulation: density-dependent and independent factors; r and K strategies. • Life history strategies: reproductive effort, offspring size and cost-benefit ratio. • Ecological efficiencies.	

	Human population growth: Impacts on environment, carrying capacity, human health and welfare.	
Unit 3	Biotic community, characteristics and attributes	10
	- Community characteristics: stratification; Dominance, diversity, species richness, abundance, Evenness, Similarity. Diversity and food-web indices. - Ecotone and edge effect - Types of interaction: - Positive interactions: commensalism, proto-cooperation, and mutualism. - Negative interactions: parasitism and allelopathy; predation and predator-prey dynamics; herbivory. - Interspecific competition and coexistence, Inter and intra-specific; abundance. - Niche overlap and segregation. G - Ecological succession: Definition, Process, types, theories of succession.	
	Section II- Entomology	
Unit 1	Origin and Basic Morphology of Insects	8 L
	- Ancestry of Insects - Origin of Insects - Head: Structure and types- Appendages of head: - Antennae: Structure and types - Compound Eyes and Ocelli - Mouth parts: structure and modifications - Thorax- Thoracic appendages: - Legs: Structure and modifications - Wings; Structure and modifications - Abdomen -Abdominal appendages: - Non-genital - Genital	
Unit 2	Insect Diversity	10 L
	- General outline of classification of insects - Procedures in Taxonomy, Identification, Nomenclature - Study of following orders with respect to distribution and taxonomy, morphological characters and with minimum two examples each: - Order Collembola - Order Odonata - Order Orthoptera - Order Isoptera - Order Blattaria - Order Hemiptera - Order Coleoptera - Order Diptera - Order Lepidoptera - Order Hymenoptera - Collection and Preservation of Insects	

Unit 3	Phenomenon in Insecta	12 L
	• Insect Metamorphosis Hatching and Post-embryonic development, Hemimetabolous and Holometabolous development • Bioluminescence- Structure and distribution of Luminous organs, Mechanism of Light production, Significance of Light Production, Application of Bioluminescence • Sound Production- Mechanisms and the sounds produced, Significance of the sounds produced • Mimicry- Definition and concept of mimicry- Mullerian Mimicry, Batesian Mimicry, Cryptic Colouration and Camouflage	

References:

1. Chapman R.F.: The Insects-Structure and Function. ELBS Publication
2. Snodgrass R.E.: Principles of Insect Morphology
3. Richards O.W. and R.G. Davies: Imm's General Textbook of Entomology, Volume I
4. Richards O.W. and R.G. Davies: Imm's General Textbook of Entomology, Volume II
5. Gillott Cedric: Entomology
6. Romoser William S. and J.G. Stoffalono: The Science of Entomology
7. Evans H.E.: Insect Biology- A textbook of Entomology
8. Colinviaux, P. A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.
9. Krebs, C. J. (2001) Ecology (6th edition) Benjamin Cummings.
10. Odum, E.P., (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole.

Subject: Zoology Semester- VI

TYBSC NEP (2023) syllabus

Major Paper-13

Credits: 4C (Theory)

Course Code: 23ScZooU6102

Course Name: Molecular Biology and Biological

Techniques

Course Outcomes:

1. Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.
2. Get well versed in recombinant DNA technology which holds application in biomedical &
3. genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.
4. Apply their knowledge in problem solving and future course of their career development in higher education and research.
5. Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.
6. Students shall come to know the use of different equipment in biology. Skills would be developed in students about instruments used in analytical laboratory

	Section I- Molecular Biology	No. of Lectures
Unit I	Understanding Nucleic acids and Central dogma	6
	1.1 Introduction to Molecular Biology 1.2 Central Dogma of Molecular Biology 1.3 Prokaryotic and Eukaryotic Genomes, Model Genomes. 1.4 Structure and Function of DNA 1.5 DNA Polymorphism - Plasmid DNA, Genomic DNA and Repetitive DNA. Conformation, Structure and Topology of DNA. 1.6 Structure and Function of RNA, Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA.	
Unit II	Chromosomes; DNA replication, recombination, repair	6
	2.1 Chromosomes, Chromatin, Histones, Histone-modifications. 2.2 DNA Replication – Prokaryotic and Eukaryotic 2.3 DNA polymerases, other regulatory proteins 2.4 Plasmid DNA replication, centromeric and telomeric DNA replication and cell cycle regulation. 2.5 Mutation, DNA-damaging agents, DNA recombination. DNA repair, mismatch repair, single strand- and double strand DNA repair	
Unit III	RNA transcription	6
	3.1 Transcription, RNA polymerase I, II, III, transcription fchromatin remodeling.	

	3.2 Regulation of gene expression in prokaryotes and eukaryotes. RNA processing 3.3 Splicing of mRNA, 5'-capping and 3'-polyadenylation of mRNA, rRNA and tRNA modifications and processing. 3.4 RNA editing, alternative splicing, trans-splicing, miRNA	
Unit IV	Ribosomes: Role in cell sustenance	6
	4.1 Ribosomes, Genetic Code, Wobble base, synonymous codons, degeneracy of codons, missense-, nonsense- and frame shift mutations. 4.2 Translation, protein synthesis in E. coli and eukaryotic cells. 4.3 Aminoacylation of tRNA, initiation, elongation, peptide bond formation, translocation, termination, recycling of ribosome, regulation of protein synthesis and codon bias. 4.4 Post-translational modifications and processing of proteins, large protein-protein complexes and protein trafficking	
Unit V	Operons	4
	5.1 Concept of Operons 5.2 Lactose Operon 5.3 Tryptophan Operon	
	Section II – Biological techniques	No. of Lectures
Unit 1	Tools and techniques in Biochemistry and Physiology	8
	1.1 Physiological Salines, Buffers 1.2 Extraction of Tissue Glycogen, Proteins, Lipids and Nucleic Acids by Graaf's Method. 1.3 Use of pH meter 1.3 Centrifugation- Subcellular Fractionation by Differential Centrifugation 1.4 Chromatography- TLC 1.5 Gel filtration chromatography 1.6 HPLC	
Unit 2	Spectrophotometry Electrophoresis	4
	2.1 Spectrophotometer Principle, Instrument of UV-Spectrophotometer, Applications 2.2 Electrophoresis: Principle and applications of PAGE and Agarose gel electrophoresis	
Unit 3	Microtechnique	7
	3.1 Definition, Uses of microtechnique 3.2 Tissue procurement 3.3 Fixation-Types of Chemical fixative -simple, compound, Merits and demerits of fixatives 3.4 Washing 3.5 Dehydration 3.6 Clearing-Types of clearing agents 3.7 Impregnation and Embedding 3.8 Microtomes and knives –Types and Advances 3.9 Section cutting- Trimming of block, cutting paraffin ribbon, problems in section cutting. 3.10 Affixing and processing of sections.	
Unit 4	Stains and staining	3

	4.1 Definition of stain 4.2 Classification of stains-a) Acidic stains b) Basic stains c) Neutral stains 4.3 Vital stain 4.4 Gram staining 4.5 Histo-chemical staining-PAS and Feulgen technique 4.6 Mounting media-characteristics and types	
Unit 5	Blotting Techniques	3
	5.1 Southern blotting, Northern blotting, Western blotting 5.2 Applications of blotting techniques	
Unit 6	Cell culture, maintenance of Laboratory animals	7
	6.1 Cell culture laboratory animals- Rats and Rabbits, Ethics 6.2 Cell culture laboratory and equipment, 6.3 Culture media-Nutrient and Non-nutrient, commonly used media for human cell lines. 6.4 Sterilization of culture wares and Media, laminar flow. 6.6 Types of animal cell culture: Primary cell line and continues cell line, cell viability testing. cryopreservation. 6.7 Hybridoma technique- MAB 6.8 Stem cells- Types and uses.	

References:

I) Molecular Biology

1. *iGenetics – A molecular approach* (2006), Peter J. Russell publishing as Benjamin Cummins Inc.
2. *Genes VIII*, 8th edition, Benjamin Lewin, John and Barlett Publishers.
3. *Molecular Biology of the Gene*, 5th edition (2004) James D. Watson, Tania Baker.
4. *Fundamentals of Molecular Biology* (2009), Pal J.K and Saroj Ghaskadbi, Oxford University Press
5. *Principles of Genetic manipulation*, 6th edition (2001), Primrose S. Tywman R, Blackwell Science Ltd.

II) Biological Techniques

- *Biophysical Chemistry: Principles And Techniques*.-Upadhyay ,Upadhyay , Nath. Himalaya Publishing House .
- *Principles And Techniques of Biochemistry And Molecular Biology*. 7th Edition. Keith Wilson , John Walker .
- *Biological Instrumentation And Methodology* . – P.K. Bajpai . S. Chand publication Delhi.
- *Handbook of basic Microtechnique*, 1958, 2nd Edn., Gray P., McGraw-Hill, USA.
- *Elementary Microtechnique*, 1973, 4th Edn., Peacock H.A., Edward Arnold Publ. Ltd.
- *Histological and Histochemical Methods, Theory and Practice*, 2008, 4th Edn., John A. Kiernan, Scion Publishing Ltd, UK.
- *Basic Separation Techniques in Biochemistry*, 1998, Okotore R. O., New Age International, New Delhi.
- *Introduction of Medical Laboratory Technique*,1998, 7 thEdn., Baker F. J., Silverton R. E., Pallister C. J., Butterworth-Heinemann, UK.
- *Hematology: Basic Principles and Practice*, 2008, 5th Edn., Ronald Hoffman , Bruce Furie, Philip McGlave, Churchill Livingstone Elsevier, USA
- *Hand book of microtechniques* . Peter Grey Mc.
- *Culture of Animal Cells- A Manual of Basic Technique And Applications* –R. Ian Freshney .
- *Text Book Of Biotechnology* –B. D.Singh .

- Animal Cell Culture Approach .- John Master.
- Animal cell culture Technology- Michael Butler .
- Animal cell and Tissue culture. – Mathur Shivangi .

Major Paper-14 (Practical) 2C
Course Code 23ScZooU6103

Zoology Major Practical 6 – Practicals in Ecology & Entomology, Molecular Biology and Biological Techniques

Practical (Any 15)

Sr. No.	Name of Practicals	No. of Practical
Section I- Ecology		
1.	Determination of nitrate, calcium and phosphorus of soil. (E)	1P
2.	To determine water holding capacity and Physical analysis of soil. (E)	1P
3.	Visit to aquatic ecosystem for collection of water sample	1P
4.	Identification of Zooplanktons of a lake/ any waterbody.	1P
Section II- Entomology		
1.	Study of types of head, eyes and antennae [D]	1P
2.	Study of types of legs and wings [D]	1P
3.	Study of external characters of a generalized insect e.g. grasshopper/ Cockroach. Temporary mountings of a. Mouth parts b. Antennae c. Legs d. Wings e. Thoracic spiracles f. Abdominal spiracle g. Tympanum [D]	1P
4.	Study of insect metamorphosis: holometabolous and hemimetabolous [D]	1P
Section- III Molecular Biology		
1.	Estimation of DNA by Diphenylamine method	1P
2.	Detection of DNA and RNA by methyl green pyronin	1P
3.	Preparation of DNA paper model	1P
4.	Basic microbiology - Preparation of LB-agar plates, streaking, broth and suspension culture preparation	1P
Section IV – Biological Techniques (Any 4)		
1.	Preparation of buffer and measurement of pH using different samples	1P
2.	Separation of Amino acids by TLC	1P
3.	Tissue collection, fixation, Embedding and Block making	1P
4.	Sectioning, staining & mounting. Submission of any two permanent slides from different organs	1P
5.	Cell/ Tissue culture laboratory design, equipments and cell culture media	1P
6.	Cell counting by Haemocytometer	1P
7.	Primary cell culture of chick embryo fibroblast	1P

Subject: Zoology Semester- VI

TYBSC NEP (2023) syllabus

Elective -III

Credits: 2C (Theory)

Course Code: 23ScZooU6201

Course Name: Biostatistics and Bioinformatics

Course Outcomes:

After successfully completing this course, the students will be able to:

1. Know basic concepts of statistics. Perform and interpret statistical analyses with real biology data
2. Know the theory behind fundamental bioinformatics analysis methods.
3. Be familiar with widely used bioinformatics databases.
4. Know the applications and limitations of different bioinformatics and statistical Methods.
5. Acquire knowledge of various databases of proteins, nucleic acids. Primary, secondary and composite databases. BLAST, FASTA, DOT PLOT
6. Make phylogenetic predictions or prediction of structure of proteins and nucleic acids

Course Contents:

UNIT: 1	Data collection, distribution, presentation, authentication and analysis	8 L
	I. Collection and classification of data. II. Graphical representation of data: Pie chart, Bar diagram, Histogram, Frequency polygon. Cumulative frequency curve (Ogive), Box plot. III. Measures of central tendency: Arithmetic Mean, Median, Mode; Measures of dispersion: IV. Variance, Standard deviation and Standard error, Concept of Coefficient of variation.	
UNIT: 2	Correlation, regression analysis	7 L
	I. Correlation: Types of correlation, Calculation of correlation in continuous data and ordinal data. II. Regression: Linear regression, regression coefficient.	
Unit 3	Basics of IT; Data archiving systems etc.	5 L
	I. Introduction and scope of bioinformatics: concept of digital laboratory. II. Basics of information technology, computer, operating systems, network. III. Concept of internet protocol (TCP/IP), hypertext, home-page, web-page and uniform resource locators (URL). IV. Introduction to data archiving systems (FASTA format, Accession, and GI Number)	
Unit 4	Data base management: software, packages and tools	10 L

	• Basic features and management systems of following: I. Nucleic acid sequences databases II. Genome databases, III. Protein sequence, structures and interacting proteins databases IV. Literature databases V. Biodiversity and ecosystem based databases. VI. Introduction to data retrieval systems, Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR). VII. Introduction to molecular sequence analysis software packages and tools, Prediction of motifs, folds and domains VIII. Sequence alignments (BLAST and Clustal W) and phylogenetic trees (PHYLIP). IX. Applications of bioinformatics: Clinical informatics, Cheminformatic resources and pharmacoinformatics	
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References:

1. Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences (10th edition) John Wiley.
2. Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and Health Sciences (2nd edition) McGraw Hill.
3. Zar, J.H. (2013) Biostatistical Analysis (5th edition) Pearson.
4. Barnes, M.R. and Gray, I.C. (2003) Bioinformatics for geneticists, Wiley.
5. Mount, D.W. (2006) Bioinformatics (2nd edition) CBS.

Elective- III (Practical) 2C
Course Code 23ScZooU6202

Zoology Elective Practical 3 – Practicals in Biostatistics and Bioinformatics

Practical (Any 15)

Sr. No.	Title	No. of Practical
1	Calculation of mean, mode and median.	1P
2	Calculation of standard deviation and calculation of standard error.	1P
3	Calculation of correlation coefficient values and finding out the probability	1P
4	Calculation of 'F' value and finding out the probability value for the F value. (2P)	2P
5	Student's t-test: Independent and dependent. (2P)	2P
6	Hand calculation and calculation using MS Excel.	1P
7	ANOVA: Hand calculation (One-way)	1P
8	ANOVA: calculation using MS Excel (One-way/two-way).	1P
9	Handling and interpretation of Nucleic acid (Gen Bank)	1P
10	Handling and interpretation of protein databases (PDB).	1P
11	Sequence retrieval from databases (ENTREZ).	1P
12	Pair-wise alignment of sequences (BLAST) and interpretation of the output	1P
13	Sequence homology and Gene annotation.	1P
14	Translation of a nucleotide sequence and selection of the correct reading frame of the polypeptide from the output sequences	1P
15	Construction of phylogenetic tree.	1P
16	Comparative analysis of different databases in metabolomics (SWISSPROT, Uniprot, Prosite).	1P

Subject: Zoology Semester- VI
Elective-IV

TYBSC NEP (2023) syllabus
Credits: 2C (Theory)

Course Code: 23ScZooU6203

Course Name: Vectors, Diseases and Control

Course outcomes

After completing this course the students will be able to

1. Understand the importance of pest identification and monitoring.
2. Know the methods of sampling of the pests.
3. Understand the mode of action of nematicides and the consequences of their use.
4. Understand the effective way of insect pest management strategy.
5. Students will learn how ecological factors (e.g., climate, host plant, natural enemies) and economic factors (e.g., crop value, pest damage) contribute to pest problems
6. Understand the principles of IPM, assess management approaches.

Unit	Content	No. of Lectures
I	Conservation Background to Insect Pests and Vectors	7L
	1.1 Insect pests and vectors of plant and animal diseases 1.2 Pest status: (major, minor, occasional, migrant) 1.3 Human practices and pest occurrence. 1.4 Density dependent and independent factors affecting pest and vector population. 1.5 Sampling and monitoring methods of arthropod pests.	
II	Insect Pest and Chemical Control	6 L
	2.1 Insecticides. 2.1.1 Types of insecticides, 2.1.2 Formulation; 2.1.3 Toxicity 2.1.4 Safety 2.2 Application of insecticides: Droplet size; Application equipment, 2.3 Problems associated with using insecticides 2.3.1 Hazardous of pesticides and antidot 2.4 Environmental and cultural control (Irrigation, Fertilizer, Sanitation. Alternate hosts, Multiple and intercropping, Separation in time and space, Crop geometry). 2.5 Host resistance 2.5.1 Basis for resistance 2.5.2 Mechanisms of resistance	
III	Insect Pest and Biological Control	9L
	3.1 Biocontrol agents: Predators, Parasitoids, Parasites. 3.2 Pathogens: fungi, viruses, bacteria, microsporidia, nematodes, arthropods. 3.2.1 Transmission of pathogens. 3.3 Techniques of biocontrol 3.3.1 Constraints and reasons for failure of biocontrol.	

	3.3.2 Use of pheromones/ allelochemicals in pest management 3.3.3 Mating disruption/confusion 3.3.4 Alarm pheromones and oviposition deterrents; repellents. 3.3.5 Exclusion and barriers, Traps. Physical disturbance. 3.3.6 Use of Larvivorous Fish and plants in vector control	
IV	Legislation and other alternatives	7L
	4.1 Exclusion and routes of entry 4.2 Risk assessment 4.2.1 Damage thresholds Forecasting 4.2.2 Increasing agroecosystem resistance 4.3 Legislation for Pesticide use 4.4 Effects of regulation 4.5 Genetically modified organisms: New concepts and practices 4.6 Integrated vector management. 4.6.1 The integrated control/ IPM 4.6.2 Constraints towards IPM adoption 4.6.3 Eradication versus management concept	

References:

1. VanEmden, H.F. and M.W. Service. (2004) Pest and Vector Control. Cambridge University Press.
2. Cameron, M. & Lorenz, L. (2013) Biological and Environmental Control of Disease Vectors. CABI, UK
3. Chatterjee, K.D. (1981) Parasitology: Protozoology and Helminthology: Introduction to Clinical Medicine. (12th Edition) Chatterjee Medical Publishers
4. Mullen, G. and Durden, L. (2009). Medical and veterinary entomology, Academic press, London.
5. Kochhar, S.K. (2009). A Text Book of Parasitology. Wisdom Press

Elective-IV (Practical) 2C
Course Code 23ScZooU6204

Zoology Elective Practical 4 – Practicals in Vectors, Diseases and Control

Practicals (Any 15)

Sr. no	Title	No. of Practical
1	Sampling techniques for estimation of insect population and damage	1P
2	Pest surveillance through field incidence, light traps and pheromone traps	1P
3	Pest monitoring techniques	1P
4	Study of distribution pattern of insects in crop ecosystem	1P
5	Practicable IPM practices: physical and mechanical methods	1P
6	Practicable IPM practices: cultural and biological methods	1P
7	Effect of chemical insecticide on housefly	1P
8	Effect of Biopesticide (neem) on insect pest	1P
9	Preparations of doses/ concentrations of insecticides	1P
10	Study of insect pests with respect to marks of identification, nature of damage and control measures.	1P
11	Study of types of vectors with examples	1P
12	Study of vector borne diseases and their control	1P
13	Study of disease transmitting arthropod vector, molluscan vector	1P
14	Pest control devices- pheromone trap, Knapsack sprayer, hand rotary duster	1P
15	Study of LD ₅₀ , LC ₅₀ by using mosquito/cockroach	1P
16	Mounting of mouthparts of any 5 insect pest/ vector	1P
17	Submission of mouthparts of any 5 insect pest/ vector	1P
18	Field visits to crop field/ Pharmaceutical company	1P

Subject: Zoology Semester- VI

TYBSC NEP (2023) syllabus

Minor Paper-V

Credits: 4C (2T+ 2P)

Course Code: 23ScZooU6301

Course Name: Advanced Techniques in Biology

Course Outcomes:

- 1) Students shall come to know the use of different equipment in biology.
- 2) Skills would be developed in students about instruments used in analytical laboratory.
- 3) Students would learn application of equipment used in characterization of biomolecules.
- 4) Students would get knowledge of theory, operation and functions of equipment.
- 5) Students would get knowledge of tissue culture in animals.
- 6) Learn the maintenance laboratory equipments/ tools, safety hazards and precautions

Course Contents

Unit 1	Tools and techniques in Biochemistry and Physiology	8 Lectures
	1.4 Physiological Salines, Buffers 1.5 Extraction of Tissue Glycogen, Proteins, Lipids and Nucleic Acids by Graaf's Method. 1.6 Use of pH meter 1.3 Centrifugation- Subcellular Fractionation by Differential Centrifugation 1.4 Chromatography- TLC 1.5 Gel filtration chromatography 1.6 HPLC	
Unit 2	Spectrophotometry Electrophoresis	4 Lectures
	2.1 Spectrophotometer Principle, Instrument of UV-Spectrophotometer, Applications 2.2 Electrophoresis: Principle and applications of PAGE and Agarose gel electrophoresis.	
Unit 3	Microtechnique	7Lectures
	5.1. Definition, Uses of microtechnique 5.2. Tissue procurement 5.3. Fixation-Types of Chemical fixative -simple, compound, Merits and demerits of fixatives 5.4. Washing 5.5. Dehydration 5.6. Clearing-Types of clearing agents 5.7. Impregnation and Embedding 5.8. Microtomes and knives –Types and Advances 5.9. Section cutting- Trimming of block, cutting paraffin ribbon, problems in section cutting. 5.10. Affixing and processing of sections.	
Unit 4	Stains and staining	3 Lectures

	6.1. Definition of stain 6.2. Classification of stains-a) Acidic stains b) Basic stains c) Neutral stains 6.4. Vital stain 6.5. Gram staining 6.7. Histo-chemical staining-PAS and Feulgen technique 6.9. Mounting media-characteristics and types,	
Unit 5	Blotting Techniques	3 Lectures
	7.1. Southern blotting, Northern blotting, Western blotting 7.2 Applications of blotting techniques	
Unit 6	Cell culture, maintenance of Laboratory animals	7 Lectures
	8.1. Cell culture laboratory animals- Rats and Rabbits, Ethics 8.2 Cell culture laboratory and equipment, 8.3 Culture media-Nutrient and Non-nutrient, commonly used media for human cell lines. 8.4 Sterilization of culture wares and Media, laminar flow. 8.5 Types of animal cell culture: Primary cell line and continues cell line, cell viability testing. cryopreservation. 8.6 Hybridoma technique- MAB 8.7 Stem cells- Types and uses.	

References:

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- 2) Principles And Techniques of Biochemistry And Molecular Biology. 7th Edition.Keith Wilson , John Walker .
- 3) Biological Instrumentation And Methodology . – P.K. Bajpai . S. Chand publication Delhi.
- 4) Handbook of basic Microtechnique, 1958, 2nd Edn., Gray P., McGraw-Hill, USA.
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- 6) Histological and Histochemical Methods, Theory and Practice, 2008, 4th Edn., John A. Kiernan, Scion Publishing Ltd, UK.
- 7) Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
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- 9) Hematology: Basic Principles and Practice, 2008, 5th Edn., Ronald Hoffman , Bruce Furie, Philip McGlave, Churchill Livingstone Elsevier, USA
- 10) Hand book of microtechniques . Peter Grey Mc.
- 11) Culture of Animal Cells- A Manual of Basic Technique And Applications –R. Ian Freshney .
- 12) Text Book Of Biotechnology –B. D.Singh .
- 13) Animal Cell Culture Approach .- John Master.
- 14) Animal cell culture Technology- Michael Butler .
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Minor Paper-V (Practical) 2C
Course Code- 23ScZooU6301

Zoology Minor Practical 5 – Practicals in Advanced Techniques in Biology

Sr. No.	Title	No. of Practical
1	Preparation of buffer and determination of pH (E)	1P
2.	Separation of Amino acids by TLC. (E)	1P
3.	Study of principle of spectrophotometer (E)	1P
4.	Measurement of PH (Lemon juice, Pepsi, D.W. Alkali) (E)	2P
5.	Separation of proteins using Agarose Gel Electrophoresis (E)	2P
6.	Tissue collection & fixation. (E)	1P
7.	Embedding and Block making (E)	1P
8.	Sectioning, staining & mounting. Submission of any two permanent slides from different organs (D)	1P
9.	Cell/ Tissue culture laboratory design (D)	1P
10.	Equipments in cell culture laboratory. (D)	1P
11.	Study of cell culture media (D)	1P
12.	Cell counting by Haemocytometer (E)	1P
13.	Primary cell culture of chick embryo fibroblast (D)	1P
14.	Calculate the cell viability by using Tryphan blue (E)	1P
15.	Study of Southern blotting (D)	1P
16.	Visit to Tissue culture laboratory/Institute	1P