FATIMA COLLEGE (AUTONOMOUS)



Re-Accredited with "A" Grade by NAAC (3rd Cycle) 74th Rank in India Ranking 2019 (NIRF) by MHRD Maryland, Madurai- 625 018, Tamil Nadu, India

NAME OF THE DEPARTMENT: ZOOLOGY

NAME OF THE PROGRAMME : M.SC

PROGRAMME CODE : PSZO

ACADEMIC YEAR : 2020-21

FATIMA COLLEGE (AUTONOMOUS), MADURAI-18 DEPARTMENT OF ZOOLOGY

For those who joined in June 2019 onwards

PROGRAMME CODE: PSZO

COURSE CODE	COURSE TITLE	HRS / WK	CREDIT	CIA Mks	ESE Mks	TOT. MKs			
SEMESTER - I									
19PG1Z1	Animal Diversity	6	4	40	60	100			
19PG1Z2	Microbiology	6	4	40	60	100			
19PG1Z3	Cell & Molecular biology	6	4	40	60	100			
19PG1Z4	Lab in Animal Diversity& Microbiology	4	2	40	60	100			
19PG1Z5	Lab in Cell & Molecular Biology	4	2	40	60	100			
19PGZEDC1	Herbal Medicine	3	3	40	60	100			
	Library	1	-	-	-	-			
Total		30	19						
	SEMESTER	- II							
19PG2Z6	Genetics	6	4	40	60	100			
19PG2Z7	Evolution	6	4	40	60	100			
19PG2Z8	Biochemistry	6	4	40	60	100			
19PG2Z9	Lab in Genetics & Evolution	4	2	40	60	100			
19PG2Z10	Lab in Biochemistry	4	2	40	60	100			
19PGZEDC2	Herbal Medicine	3	3	40	60	100			
	Library	1		-	-	-			
Total		30	19						

COURSE CODE	COURSE TITLE	HRS / WK	CREDIT	CIA Mks	ESE Mks	TOT. MKs
	SEMESTER	- III				
19PG3SIZ1	Internship/Summer Project*	-	3	50	50	100
19PG3Z11	Biophysics	6	5	40	60	100
19PG3Z12	Immunology	6	5	40	60	100
19PG3Z13	Biostatistics & Research Methodology	6	5	40	60	100
19PG3ZE1/ 19PG3ZE2	Fisheries & Aquaculture / Bioinformatics	4	4	40	60	100
19PG3Z14	Lab in Biophysics & Biostatistics	4	2	40	60	100
19PG3Z15	Lab in Immunology, Fisheries & Aquaculture and Bioinformatics	4	2	40	60	100
Total		30	26			
	SEMESTER	- IV	·	·		
19PG4Z16	Environmental Biology	6	5	40	60	100
19PG4Z17	Biotechnology	6	5	40	60	100
19PG4Z18	Developmental Biology	6	5	40	60	100
19PG4ZE3/ 19PG4ZE4	Economic Zoology/ Ethology	4	4	40	60	100
19PG4Z19	Lab in Environmental Biology & Developmental Biology	4	2	40	60	100
19PG4Z20	Lab in Biotechnology, Economic Zoology& Ethology	4	2	40	60	100
19PG4Z21	Project*& Viva Voce		3	50	50	100
Total		30	26			
	Total	120	90			

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OFF-CLASS PROGRAMME

ADD-ON COURSES

Course Code	Courses	Hrs.	Credits	Semeste r in which the course is offered	CIA Mk s	ES E Mk s	Total Mark s
	SOFT SKILLS	40	4	Ι	40	60	100
	 COMPUTER APPLICATIONS Computer Application for Biologists 	40	4	Ш	40	60	100
	• SPSS MOOC COURSES (Department Specific Courses) * Students can opt other than the listed course from UGC- SWAYAM /UGC /CEC	_	Minimum 2 Credits	-	_	_	
	COMPREHENSI VE VIVA (Question bank to be prepared for all the papers by the respective course teachers)	-	2	IV	-	_	100
	READING CULTURE	15/ Semeste r	1	I-IV	-	_	_
	TOTAL		13 +				

EXTRA CREDIT COURSE

Course Code	Courses	Hrs.	Credits	Semester in which the course is offered	CIA Mks	ESE Mks	Total Marks
19PGSLZ1	Vector Borne Diseases (Offered for II PG)	-	-	III & IV	40	60	100

• Lab Courses :

• A range of 10-15 experiments per semester

• Summer Internship:

 Duration-1 month (2nd Week of May to 2nd week of June-before college reopens)

• Project:

- \circ Off class
- Evaluation components-Report writing + Viva Voce (Internal marks-50) + External marks 50

• EDC:

Syllabus should be offered for two different batches of students from other than the parent department in Sem-I & Sem-II

I M.Sc.,(Zoology) SEMESTER –I

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG1Z1	Animal Diversity	PG Core.	6	4

COURSE DESCRIPTION

This course provides an overview of the Invertebrate and Vertebrate animals by focussing on the General characters, Classification, Special features and Biology of some selected Invertebrates and Vertebrates.

COURSE OBJECTIVES

- Acquire knowledge on general characters and classification of Invertebrates.
- Understand the levels of organization of symmetry and coelom of the Invertebrates.
- Gain knowledge on the taxonomic status of Invertebrates.
- Compare the organization and functional aspects of different systems of Vertebrates

UNITS

UNIT –I PROTOZOA& PORIFERA

(18 HRS.)

Outline Classification of Animal Kingdom - Levels of Organization: Grades of Animal architecture- Symmetry - Coelom. General characters and Classification of Phyla: Protozoa and Porifera.General topics: Modes of Locomotion in Protozoa, Reproduction in Protozoa, Canal system in Sponges, Skeleton in Sponges and Origin of Metazoa.

Self-study –Outline Classification of Animal Kingdom - Levels of Organization: Grades of Animal architecture- Symmetry - Coelom.

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UNIT –II COELENTERATA, HELMINTHES & ANNELIDA (18 HRS.)

Classification General characters and of Phyla: Coelenterata, Platyhelminthes, Aschelminthes and Annelida. General topics: Polymorphism in Hydrozoa, Corals and Coral Reefs, Helminthes and Human Diseases: Nematodiasis (Ascariasis, Ancylostomiasis, Trichurosis, Trichinosis, Strongyloidiasis, Filariasis, Loiasis, **Onchocerciasis**) Ophisthorchiasis, Trematodiasis (Schistosomiasis, Paragonimiasis, Fasciolopsiasis and Fascioliasis) Cestodiasis (Taeniasis _ and Echinococcosis) and Adaptive Radiation in Annelids.

Self-study –Corals and Coral Reefs

UNIT -III ARTHROPODA, MOLLUSCA& ECHINODERMATA(18 HRS.)

General characters and Classification of Phyla: Arthropoda, Mollusca and Echinodermata up to class level. General topics: Larval forms of Crustaceans, Cephalopods are highly evolved Molluscs, Torsion in Mollusca, Water vascular system in Echinoderms and Larval forms of Echinoderms.

Self-study –Cephalopods are highly evolved Molluscs UNIT –IV PROCHORDATA& CHORDATA (18 HRS.)

General characters and Classification of Phylum – Chordata& Superclass Agnatha and Pisces, Class – Amphibia, Reptilia, Aves and Mammalia; Scales of Fishes; Economic Importance of Fishes; Neoteny and Paedogenesis; Adaptive radiation in Reptiles; Birds as Glorified Reptiles; Feet in Birds; Dentition in Mammals; Placentation in Mammals; Adaptive Convergence in Mammals.

Self-study – Economic Importance of Fishes

UNIT -V TYPE STUDY

(18 HRS.)

Type Studies from the following: Phylum- Protozoa: *Paramecium*, Phylum-Porifera: *Leucosolenia*, Phylum- Coelenterata: *Obelia*, Phylum- Arthropoda-Prawn (*Penaeus*) and Phylum- Mollusca- *Lamellidens* (Freshwater Mussel). Class- Reptilia- *Calotes* and Class- Mammalia- Rabbit (*Oryctolaguscuniculus*).

REFERENCES:

- Jordan E.L., and Verma P.S. (2001). *Invertebrate Zoology*, S.Chand& Co, New Delhi, 2001.
- Kotpal R.L. (1998). Modern Text Book of Zoology Invertebrates, Rastogi Publications, Meerut, 1998.
- 3. Prasad S.N.(1989). *Invertebrate Zoology*, Vikas publishing House Pvt Ltd, India, 1989.
- Ekambaranatha Ayyar M. and Ananthakrishnan T.N. (1981). A manual of Zoology, Part-II (Chordate), Viswanathan (Printers and Publishers) Pvt. Ltd, Chennai
- Jordan E.L and Verma P.S (2006). ChordateZoology, S.Chand & Co Ltd, NewDelhi.
- Prasad S.N. (2005). Vertebrate Zoology, KitabMahal Private Ltd , Allahabad-3.
- Vishwanath (1967). A Text Book of Zoology, Volume II [Chordates]
 S.Chand& Co. Madras.
- Newman. H.H (1987). The Phylum Chordata, Satish Book Enterprise, Motikala.
- Young J.Z. (1962). The Life of Vertebrates. Oxford University Press, New York, ed. 2, 1962

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Recall the levels of organization among Invertebrates and Chordates
CO 2	Bring out the General characters of Invertebrates.
CO 3	Classify the Phyla of Invertebrates and Chordates up to class level.
CO 4	Distinguish between Invertebrates and Chordates.
CO 5	Predict the systematic Position of Animals.

I M.Sc., ZOOLOGY

SEMESTER – I

For those who joined in 2019 onwards

PROGRAMM	COURSE	COURSE	CATEGOR	HRS/WEE	CREDIT
E CODE	CODE	TITLE	Y	K	S
PSZO	19PG1Z2	Microbiology	PG Core	6 Hrs.	4

COURSE DESCRIPTION

To understand the fundamentals of microbial diversity and applications of microbes in Industry and Environment

COURSE OBJECTIVES

- To gain knowledge of microorganisms with particular emphasis on the nomenclature, classification and biology of bacteria, viruses, viriods and prions.
- To understand the microbial genetics and metabolism
- To provide an overview on the utilization and application of microbes in Industry.

UNITS

UNIT –I INTRODUCTION

History and Scope of Microbiology - Whittaker's Five Kingdom Concept -Protist, Fungi , Helminthes - Classification according to Bergey's manual-Microscopy - Principle, Components and applications of Phase contrast microscope, Fluorescence microscope, Dark field Microscope and Electron microscope- SEM & TEM.

Self-study –History and Scope of Microbiology

UNIT –II BACTERIA

(18 HRS.)

(18 HRS.)

Morphological types - Cell shapes and arrangements - External cell structures - Pili, Flagella and Glycocalyx - Cell envelope - cell walls of Gram negative, Gram positive & Archaebacteria - Nuclear material – bacterial

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chromosomes and plasmids. Sterilization methods – Physical and chemical -Classification of Culture media (Simple, complex and special media with examples) - Growth measurements- Influence of Environmental factors on Growth.

Self-study- Classification of Culture media (Simple, complex and special media with examples)

UNIT –III VIRUSES, VIRIODS & PRIONS

Brief outline on discovery of viruses, origin of viruses, Nomenclature and classification of viruses - ICTV system of classification, properties of viruses. Morphology and ultrastructure of viruses - capsids and their arrangements; types of envelopes and their composition - viral genome (RNA, DNA) - Structure and importance - Viriods, Prions, Cultivation and assay of viruses.

Self-study- Nomenclature and classification of viruses

UNIT –IV MICROBIAL GENETICS AND METABOLISM

Genetic Recombination in Bacteria – Conjugation, Transformation and Transduction- Anaerobic Respiration – Photosynthesis: in Cyanobacteria: cyclic and noncyclic photophosphorylation ; fixation of CO₂ - Calvin cycle; Assimilation of inorganic phosphorus and sulfur – Nitrogen fixation. – Symbiotic and asymbiotic relationship.

Self-study - Nitrogen fixation

UNIT -V APPLIED MICROBIOLOGY

Food Microbiology - Food spoilage - Preservation - Fermented foods -Microorganisms as source of food - Industrial Microbiolgy - Fermentation: lactic acid fermentation, alcoholic fermentation - Production of Antibiotics -Penicillin and organic acids – citric acid ; Bioinsecticides – *Bacillus thuringiensis* - Brief note on Biopolymers, Biosurfactants, bioremediation and Biosensors.

Self-study- Food Microbiology - Food spoilage - Preservation -Bioinsecticides - Bacillus thuringiensis - bioremediation

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only)

(18HRS.)

(18 HRS.)

(18HRS.)

(HRS.)

REFERENCES:

- Presscott L.M, Harley J. P and Klein D. A., (1999) *Microbiology*, 4th ed., Mc-Graw Hill, United States.
- Pommerville J. C., (2010). Alcamo's Fundamentals of Microbiology, 8th ed., Jones and Bartlett Publishers.
- Ingraham J.L and Ingraham C.A., (2005) Microbiology- An Introduction, India Binding House.
- Ananthanarayanan R and Panicker C.K.J., (2005) Textbook of Microbiology, 7th ed., Orient Longman.
- Tortora G.J., Funke B.R., Case C. L., (2005) Microbiology: An Introduction, 8th Edition, Benjamin Cummings.
- Dubey R. C., and Maheswari D.K., (2004). A Textbook of Microbiology, 6th ed., Chand and company Ltd.
- Pelczar M.J., Chan E.C.S., and Kreig N.R., (2001). *Microbiology*, 5th ed., Tata Mc Graw Hill, New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Describe the scope of microbiology, taxonomical classification, principle and components of different types of microscopes
CO 2	Classify bacteria based on morphology, biochemical characteristics and growth parameters
CO 3	Discuss the morphology, classification and cultivation of viruses.
CO 4	Explain the microbial genetics and metabolism of bacteria
CO 5	Appraise the role of bacteria in food, industry, medicine, environment and agricultural microbiology

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I M.Sc., ZOOLOGY SEMESTER – I

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG1Z3	CELL & MOLECULAR BIOLOGY	PG Core	6	4

COURSE DESCRIPTION

This course deals with the central dogma of molecular biology and to understand the basis of heredity.

COURSE OBJECTIVES

- To provide an overview of cell structure and functions.
- To understand the cell structure and function at the molecular level , including the flow of information from genes to proteins and its regulation
- To gain knowledge in cancer biology, cell cycle and signaling pathways

UNIT –I :OVERVIEW OF CELL BIOLOGY (18 HRS.)

Structure of animal cell - Cytoskeleton: Structure and organization of actin filaments, intermediate filaments – plasma membrane: structure (review), transport of small molecules, receptor mediated phagocytosis – Cell-cell interactions: Adhesion junctions, tight junctions, gap junctions, plasmodesmata.

Self-study-Structure of animal cell - Cytoskeleton: Structure and organization of actin filaments, intermediate filaments – plasma membrane: structure (review), transport of small molecules, receptor mediated phagocytosis

UNIT -II EUKARYOTIC GENOME & REPLICATION (18 HRS.)

The complexity of Eukaryotic Genomes: Introns, exons, repetitive DNA sequences C₀t curve – C value paradox – Chromosomes & Chromatin – organization of chromatin in nucleosomes. Genome replication: Topological problems – Process – detailed mechanism - *E.coli* and Eukaryotes – Telomere synthesis . DNA repair -Types and mechanism

Self-study- DNA repair -Types and mechanism

UNIT –III TRANSCRIPTION

Eukaryotic transcription and its regulation: RNA polymerases and their promoters, Class I, II, and III Transcription factors, Activators, silencers; post transcriptional modifications – capping, polyadenylation and splicing; other RNA processing – rRNA, tRNA; transplicing and RNA editing.

UNIT -IV TRANSCRIPTION REGULATION & TRANSLATION (18 HRS.)

Transcription regulation – Process and control – *lac, trp, ara* operons. MicroRNA - Protein Synthesis: rRNA, tRNA, Ribosome, process and regulation of translation: Protein folding and processing – Protein Sorting and Transport – Endoplasmic reticulum and Lysosomes - Protein degradation

Self-study- *lac* operon

UNIT -V CELL SIGNALING, CELL CYCLE, CELL DEATH & CANCER

(18 HRS.)

Signaling molecules and receptors: pathways of intracellular signal transduction: cAMP, GTP, MAP kinase – Cell cycle: phases, regulation, events of M phase – Cell death: events of apoptosis; Cancer: development, types and causes of cancer – Oncovirus hepatitis B & C virus, retrovirus – Oncogenes – tumor suppressor genes.

(18 HRS.)

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only) (HRS. REFERENCES:

- 1. Lewin B., (2008) Genes IX, Jones and Bartlett publishers, Canada.
- Cooper G.M., (2007) The Cell A Molecular Approach, 2nd ed., ASM Press, Washington D.C.
- Brown T.A., (2002) Genomes, 2nd ed., Wiley Liss publications, New York.
- 4. Weaver R., (1999) Molecular Biology, WCB / Mc Graw-Hill, London.
- Watson J.D., Baker T.A., Stephen B.P., Gann A., Levine M and Losick R., (2004) *Molecular Biology of the Gene*, 5th ed., Pearson Education.
- Lodish D.J and Baltimore D., (2004) Molecular Cell Biology, 5th ed., Sci. American Books, W.H. Freeman and Company, New York.
- 7. Wolfe S.L., (1995) An Introduction to Cell and Molecular Biology, Wadsworth Publishing Company, New York.
- 8. De Robertis, E.D.P and De Robertis E.M.F., (1988) *Cell and Molecular Biology, 8thed.*,International ed., Infomed, HonKong.
- Geoffery M. Cooper and Hausman Robert E., (2009) The Cell: A Molecular Approach, 5th ed., ASM Press, Washington, D.C., and Sinauer Associates, Inc., Sunderland, Massachusetts.
- Malacinski G.M., (2008) Freifelder's Essentials of Molecular Biology, 4th ed., Narosa Publishing House, New Delhi.
- Rastogi S.C., (2003) Cell and Molecular Biology 2nd ed., New Age International (P) Limited Publishers, Daryaganj, New Delhi.
- Verma P.S. and Agarwal V.K., (2008) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company, New Delhi.
- Plopper G., Sharp D., and Sikorski E., (2015) Lewin's Cells, 3rd
 ed., 1st Indian ed., Jones and Bartlett India Pvt. Ltd., New Delhi.
- Tropp B.E., (2012) Molecular Biology- Genes to Proteins, 4th ed.,
 1st Indian ed., Jones and Bartlett India Pvt. Ltd., New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Explain the ultrastructure and functions of Cytoskeletons and Plasma membrane
CO 2	Discuss the complexicity of eukaryotic genome organization and its replication in Prokaryotes & Eukaryotes
CO 3	Describe the process of transcription and post transcriptional modification in Eukaryotes
CO 4	Evaluate the regulation of transcription and translation in Prokaryotes & Eukaryotes
CO 5	Assess the events of cell cycle, cell signalling pathways, cell death and cancer

I M.Sc., ZOOLOGY

SEMESTER -I

For those who joined in 2019 onwards

PROGRAMM E CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19PG1Z4	Lab in Animal Diversity & Microbiology	PG Core	4 Hrs.	2

COURSE DESCRIPTION

This course deals with the learning skills of microbial techniques and fundamentals of diversity of species.

COURSE OBJECTIVE

- Understand the fundamental organization of animals.
- Develop the practical skills in microscopy, handling microbial cultures and staining techniques of microbes.
- Acquire specialized microbiological laboratory skills applicable to microbiological research and reporting the observations.

ANIMAL DIVERSITY

- 1. Mounting of Body setae of earthworm (Spotters)
- 2. Mounting of mouth parts of Honey bee and mosquito
- 3. Mounting of Ctenoid / Placoid scale (Spotters)

4. Dissection of Frog Viscera using virtual dissection software (Spotters/Chart)

5. Visit to Coastal area

SPOTTERS

Amoeba, Ascon Sponge, Obelia Colony, Taenia solium, Ascaris (Male & Female), Nereis, Limulus, Octopus, Starfish (Oral & Aboral view)

SPOTTERS

Prochordata – Amphioxus (entire); Chordata – Anguilla (Eel), Toad (Bufo), Hyla, Ichthyophis, Cobra, Viper, Enhydrina, Chamaeleon, Draco, Chelone, Echidna, Manis

MICROBIOLOGY

- 1.Laboratory biosafety guidelines
- 2. Sterilization techniques
- 3. Media preparation

4. Isolation and enumeration of microbes from different sources – soil, air, water, food.

5. Pure culture techniques, preparation and maintenance of stock culture

6.Measurement of growth of microorganisms – growth curve (turbidity method) and Hemocytometer count, Colony counter.

- 7. Effect of Temperature and UV on bacterial growth.
- 8. Staining Techniques Simple, Gram's, endospore, negative.
- 9. Motility test Hanging drop method
- 10. Biochemical characterization of unknown isolates Carbohydrate fermentation, IMViC test, Urease test, Oxidase test, TSI test, H2S test, catalase test,
- 11. Extracellular enzymatic activities Starch, casein and gelatin hydrolysis
- 12. Enumeration of coliforms in water-potability analysis MPN method.
- 13. Antibiotic sensitivity testing: a. Kirby-Bauer disc diffusion method

REFERENCE BOOKS:

- 1. Rajan S., Christy, S.R., (2011). *Experimental procedures in Life Sciences*. Anjana Book House, Chennai.
- 2. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) *Advanced Practical Zoology*, Books and Allied (P) Ltd., Calcutta.
- 3. Tembhare D.B., (2008). *Techniques in Life Sciences*, 1st ed., Himalaya Publishing House Pvt. Ltd., Mumbai.
- 4. Dutta A., (2009). *Experimental Biology Lab manual*, Narosa Publishing House, New Delhi.
- 5. Cappucino J. G. and Sherman N., (2008). *Microbiology A Laboratory manual*, Pearson Education (Singapore).
- 6. Sharma K., (2005) Manual of Microbiology Tools and Techniques, Bababarkha Nath printers, Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Identify the diversity of animals.	K3	PSO1& PSO2
CO 2	Explain the fundamental organization of cells.	K2	PSO2
CO 3	Prepare different types of media.	К3	PSO5
CO 4	Demonstrate bacterial isolation technique and maintain pure culture.	К2	PSO8 & PSO9
CO 5	Identify unknown bacteria by biochemical testing.	К3	PSO2, PSO7 & PSO9

I M.Sc., ZOOLOGY SEMESTER –I

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG1Z5	Lab in Cell & Molecular Biology	Major Practical	4 Hrs.	2

COURSE DESCRIPTION

It includes cell biology experiments such as observation of mitotic stages in onion root tip and visualizing giant chromosome in *Chironomus* larva and isolation and estimation of DNA and RNA.

COURSE OBJECTIVES

To acquire skills to cells at different stages of mitosis and isolating and estimating various biomolecules

EXPERIMENTS:

- 1. Laboratory biosafety guidelines Preparation and identification of mitotic stages using onion root tip
- 2. Preparation and identification of meiotic stages in grasshopper testis
- 3. Observation of giant chromosomes in Chironomus larva
- 4. Yeast Cell Budding
- 5. Cell fractionation technique
- 6. General routine for preparation of tissues
- 7. Isolation of total DNA from liver/ spleen & estimation of DNA by spectrophotometric method.
- 8. Estimation of DNA by Diphenylamine method using calf thymus DNA
- 9. Determination of Tm value of isolated DNA
- 10. Isolation of total RNA from mammalian tissue /Yeast

- 11. Estimation of RNA by Orcinol method
- 12. Electrophoretic separation of DNA
- 13. Spotters: Microscopy: Inverted microscope, Flow cytometry, Phase contrast microscope, DNA double helix, A DNA, B DNA & Z DNA

REFERENCES:

- 1. Rajan S., Christy, S.R., (2011). *Experimental procedures in Life Sciences*, Anjana Book House, Chennai.
- 2. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015). Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.
- Sambrook and Russel, (2001). Molecular Cloning Laboratory Manual, 3rd ed., Cold Spring Harbor Laboratory Press, New York.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Identify and sketch the various microscopy
CO 2	Recall the preparation of tissues
CO 3	Estimate the quantity of DNA and RNA
CO 4	Infer the qualitative estimation of DNA and RNA
CO 5	Compute the mitotic index
CO 6	Demonstrate the isolation of genomic DNA
CO 7	Interpret the mitotic stages of onion root tip

I M.Sc., ZOOLOGY

SEMESTER -I

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19PGZEDC1	Herbal Medicine	PG Core	3 Hrs.	3

COURSE DESCRIPTION

This course deals with the study of medicinal plants and therapeutic values of herbs.

COURSE OBJECTIVES

- To understand the ethnobotanical importance of indigenous medicinal plants and their implications for common ailments.
- To know the key active constituents of the herbal products that are responsible for biological activity.
- Define the importance of nutraceuticals in healthcare.
- To discuss the functional food, herbal supplements and their effects on health.

UNITS

UNIT I: INTRODUCTION

HRS.)History of Herbal medicine - Traditional systems of Medicine – Siddha, Ayurveda, Homeopathy, Unani & Acupuncture - Classification of medicinal plants based on Useful part - Wood, Root, Bark, Leaf & Seed; Usage – Medicinal & Culinary; Active constituents- Aromatic, Astringent - Bitter &Mucilagenous herbs - Doctrines of signature.

UNIT II: COMMON MEDICINAL PLANTS

Morphology, Chemical constituents and Medicinal uses of *Aloe vera* (Kumari), *Acalypha indica* (Indian Nettle), *Trigonella foenum-graecum*(Fenugeek), *Cyanodon dactylon* (Bermuda grass), *Vitex negundo* (Chinese chaste tree), *Adathoda vasica* (Malabar Nut), *Piper betel*(Betel leaf),

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(9 HRS.)

Curcuma longa (Turmeric), Azadirachta indica (Neem), Andrographis paniculata (Green chireta), Emblica officinalis (Amla), Piper nigrum (Pepper).

UNIT III: HERBAL MEDICATION

(9 HRS.)

Herbal remedies for common cold – Ocimum basilicum(Holy Basil), Renal implication of herbal remedies - Musa paradisiaca(Plantain), Tribulus terrestris(Puncture vine) - Herbal medicines for Gastro intestinal problems – Allium sativum (Garlic), Zingiber officinale (Ginger) & Trachyspermum ammi (Caraway)- Herbal remedies for Hepatic disorders – Phyllanthus niruri(Stonebreaker), Eclipta alba (False daisy)- Herbal remedies for skin diseases – Holarrhena antidysenterica (Tellicherry Bark).

UNIT IV: NUTRACEUTICALS AND LIFE STYLE DISORDERS(9 HRS.)

Definition – Nutraceutical and therapeutic value of Medicinal Plants – Nutritional value and uses of *Amarathus dubius*(Greens), *Moringa olerifera* (Drumstick), *Macrotyloma uniflorum*(Horse gram) - Role of Nutraceuticals in Diabetic cure, Management of Obesity, Constipation, Blood pressure.

UNIT V: PREPARATION OF HERBAL PRODUCTS (9 HRS.)

Herbal Face Powder- Bath powder – Herbal hair care: hair conditioner & hair oil - Cough choornam- Anti-diabetic Powder- Triphala choornam – Asthavargha Choornam – Prasava Lehiyam- Health Mix powder -Preparation of Amla candy, Ginger candy, Gulkand & Sherbath.

&Cardiovascular diseases – Female health disorders- Menstrual problems.

REFERENCE BOOKS:

- 1. Schulz V, Haensel R and Tyler V.E., Rational Phytotherapy, A Physicians Guide to Herbal Medicine, Springer Publishers, Berlin.
- 2. McKenna D.J., Jones K. and Hughes K., Botanical Medicines, The Desk Reference for Major Herbal Supplements, The Haworth Herbal Press, New York.
- 3. Natural Medicines Comprehensive Database.
- 4. Maeilanandhan, S.K.M., (2010). Siddha and Ayuveda -Therapeutic Index-Siddha, Sri Lakshmi chirtaprinters,.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Make use of alternative medicinal methods.
CO 2	Infer the importance of herbs used in day today life.
CO 3	Categorize the usage of herbs for different ailments.
CO 4	Solve the life style disorders with food supplements.
CO 5	Prepare various herbal products.

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I M.Sc., ZOOLOGY

SEMESTER – II

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG2Z6	Genetics	Major Core	6	4

COURSE DESCRIPTION

This course provides the knowledge of Mendelian inheritance and understanding the molecular basis of mutation which leads to genetic defects in human.

COURSE OBJECTIVES

- To understand the mechanism of sex determination in different organisms
- To enable the students to draw pedigree chart for their family
- To understand the consequence of chromosomal aberrations in human
- To know the effects of somatic and germinal mutation

UNITS

UNIT -I BASIC GENETICS

(18HRS.)

Monohybrid crosses - Dominance, recessiveness - Co dominance, Semi dominance, Lethals – Principle of Independent assortment- Dihybrid ratios, Trihybrid ratio, gene interactions, epistasis, pleiotropy, penetrance and expressivity. Multiple alleles: ABO blood types, Rh factor, Probability of mendelian inheritance.

Self - study-Monohybrid crosses - Dominance, recessiveness - Co dominance, Semi dominance.Multiple alleles: ABO blood types, Rh factor

UNIT –II SEX DETERMINATION AND SEX LINKAGE (18 HRS.)

Mechanisms of Sex determination: Simple mechanisms, XX-XY mechanism of Sex determination, Y chromosome and sex determination in mammals, Genic Balance theory, Haplodiploidy, mosaics and Gynandromorphs. Sex differentiations- sex chromatin, dosage compensation, Fragile X chromosome and mental retardation – Sex influenced Dominance – Sex limited gene expression – Sex linked inheritance: Patterns of inheritance of Sex –linked genes, X-linked traits in humans, deleterious recessive Sexlinked genes in humans, pedigree analysis.

UNIT -III LINKAGE, CROSSING OVER, CHROMOSOME MAPPING(18 HRS.)

Linkage; types, factor affecting linkage, molecular mechanism- Crossing over – Molecular mechanism - Chromosome Mapping: Two factor crosses, three factor crosses, interference, QTL mapping and FISH. Transposable genetic elements in Prokaryotes: IS elements, Eukaryotes: Yeast TY element.

UNIT -IV MUTATION AND CHROMOSOMAL ABERRATION(18 HRS.)

Chromosome structural variations - Positional effects – Human Chromosome techniques – Cri du chat syndrome. Variations in chromosome number: Trisomy in humans- Down's Syndrome, Trisomy-13, Trisomy-18, Klinefelter's syndrome, Turner syndrome – Genetic counselling. Phenotypic effects of mutation: Somatic and germinal mutations, mutant Haemoglobins, Pleiotropy, Back mutations and suppressor mutations – molecular basis of mutation - Radiation induced mutation: Ionizing radiation, Ultraviolet radiation – Chemically induced mutation: Base analogs, Nitrous acid, Actidines, Alkylating and hydroxylating agents.

Self-Study -Variations in chromosome number: Trisomy in humans-Down's Syndrome, Trisomy-13, Trisomy-18

UNIT -V MICROBIAL GENETICS

(18 HRS.)

Transformation: Detection of transformation, competence, DNA uptake, molecular mechanism, mapping – Transduction: Generalized transduction, Specialized transduction – Conjugation: F-Mediated sexduction, Hfr transfer, linkage mapping, isolation of Hfr strains – Plasmids and Episomes.

Self - Study-Transformation: Detection of transformation, competence, DNA uptake

REFERENCES

 Gardner S and Snustad, (2006) *Principles of Genetics*, John Wiley and Sons, 8th ed.,

New York.

2. David F., (1987) *Microbial Genetics*, Jones and Bartlett Publishers, Inc., USA.

3. Snyder L., (2007) *Molecular Genetics of Bacteria*, 3rd ed., Blackwell Publishing Company, Oxford, UK.

 Johnston J. R., (1994) Molecular Genetics of Yeast - A Practical Approach, 1st ed., Oxford University Press, UK.

5. Fred B (2008) "Principles of cancer genetics", Springer science.

 Primrose S.B. and Twyman R.M., (2003) Principles of Genome Analysis and Genomics, 3rd ed., Blackwell Publishing Company, Oxford, UK.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Find the pattern of inheritance of traits by various crosses.
CO 2	Compare the patterns of sex determination in various organisms.
CO 3	Discuss the mechanism of crossing over and linkage
CO 4	Analyse uniqueness of chromosome mapping.
CO 5	Identify the types of variation in chromosome.
	Assess the process of bacterial transformation, transduction and
CO 6	conjugation.

I M.Sc., ZOOLOGY

SEMESTER – II

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG2Z7	Evolution	PG Core	6	4

COURSE DESCRIPTION

To understand the origin of life on the earth through the process of evolution

COURSE OBJECTIVES

- To understand the evidences, theories and the mechanism of evolution.
- To understand natural selection and speciation.
- To compare the human evolution with primates

UNITS

UNIT –I ORIGIN AND EVOLUTION OF LIFE (18 HRS.)

Molecular and biological evolution - Introduction to evolutionary biology -Origin of basic biological molecules, Theories of the origin of life – Spontaneous generation, Biochemical evolution: Oparin – Haldane Concept, Urey- Miller Experiment. - Evolution of Prokaryotes - origin of eukaryotic cells - evolution of unicellular eukaryotes - Origin of photosynthesis and aerobic metabolism – Geological time scale

Self-study - Biochemical evolution: Oparin - Haldane Concept, Urey-Miller Experiment

UNIT -II EVIDENCES AND THEORIES OF EVOLUTION (18 HRS.)

Single celled organisms to kingdoms - Evidences for organic evolution structural and functional analogy - Comparative morphological and

anatomical, embryological, physiological, biochemical and palaeontological evidence. The theories of Lamarckism, Neo Lamarckism, Darwinism, Neo Darwinism, Darwin – Wallace theory and mutation theory of De Vries.

Self-study - The theories of Lamarckism, Neo Lamarckism, Wallace theory and mutation theory of De Vries

UNIT -III MECHANISM OF EVOLUTION (18 HRS.)

Nature and types of variation – Mutation – classification of mutation – Chromosomal aberration – Genetic drift, Mutation, Recombination and Gene flow. Gene frequency and Hardy-Weinberg principle – Bottle neck effect.

Self-study - Mutation – classification of mutation

UNIT -IV NATURAL SELECTION AND SPECIATION (18 HRS.)

Natural selection in action - types of selection - Directional, Disruptive and Stabilizing. Nature and origin of species - Species and similarity, species concept and origin of species – microevolution – macroevolution and mega evolution – punctuated equilibrium – coordinate theory – Spemann experiment - Speciation: geographic, allopatric, sympatric, peripatric, parapatric - Isolating mechanisms - mass extinctions and adaptive radiation - Mimicry and colouration - co-evolution.

Self-study - Mass extinctions and adaptive radiation - Mimicry and colouration - co-evolution.

UNIT -V MOLECUALR AND HUMAN EVOLUTION (18 HRS.)

Molecular evolution: evolution of haemoglobin and Cytochrome c – History of human evolution – Biological evolution of human - The earliest hominins – bipedalism and brain size of the early human evolution - paleontological, culture and social evolution – types of cultural evolution . Fossil records and dating methods.

Self-study - History of human evolution – Biological evolution of human

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only)

(HRS.)

REFERENCES:

- Hall B.K, and Hallgrimsson B., (2015) Strickberger's Evolution, 5th ed., Jones and Bartlett Student Ed.,
- Rastogi V.B., (2017) Organic Evolution (Evolutionary Biology) 13th ed., Kedar Nath Ram Nath publications, Meerut.
- Rastogi V.B., (2015) Organic Evolution (Evolutionary Biology) 13th ed., Kedar Nath Ram Nath publications, Meerut.
- Chattopadhyay S., (2008). Evolution adaption and Ethology, 2nd Edition. Books and Allied (P) Ltd.
- 5. Moody P.A., (1992) *Introduction to Evolution 3rd ed.*, Kalyani publishers, New Delhi.
- Renganathan T.K., (1980) Evolution, 3rd revised ed., Sri Raman Press, Tuticorin.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Recall the origin and evolution of life
CO 2	Categorize the evidences and theories of organic evolution
CO 3	Describe the mechanism of evolution
CO 4	Write about the natural selection and speciation
CO 5	Explain the molecular and human evolution

I M.Sc., ZOOLOGY SEMESTER –II

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG2Z8	Biochemistry	PG Core	90 Hrs.	6

COURSE DESCRIPTION

The course is designed to provide firm foundation in the principles of Biochemistry by providing knowledge on structure, biochemical properties of biomolecules and the role of these biomolecules in the major metabolic pathways of a living system.

COURSE OBJECTIVES

- Gain comprehensive knowledge on the structure and functioning of Biomolecules.
- Understand the role of biomolecules, enzymes and hormones in the organization and regulation of Human Metabolic Pathways.
- Apply this knowledge to carry out the biochemical experiments.

UNITS

UNIT -I CARBOHYDRATES

Outline classification of Carbohydrates- Structure and biological significance of Glucose -Fructose- Lactose - Sucrose- Starch - Glycogen. Carbohydrate Metabolism: Metabolism and regulation of Glycolysis, Kreb's Cycle, Electron Transport System and Energetics; Glycogenesis, Glycogenolysis, Outline Classification Gluconeogenesis, HMP Shunt pathway and Uronic acid pathway.

UNIT -II PROTEINS

(18 HRS.)

(18 HRS.)

Structure of amino Acids based on the composition of R group, General properties of Amino Acids; Organization of Protein structure: Primary structure - Secondary structure - Tertiary - Quaternary structure, Ramachandran plot.Biosynthesis of Amino Acids, Catabolic reactions of Amino acids –Transamination- Deamination- Decarboxylation, Biosynthesis of Urea.

UNIT -III LIPIDS

Structure, Properties and classification of lipids; Oxidation of Odd and even chain fatty acids; Ketone bodies: Synthesis and utilization- Biosynthesis of Saturated and Unsaturated Fatty Acids, synthesis of triglycerides – metabolism of Phospholipids and Cholesterol.

UNIT -IV NUCLEIC ACIDS & INTEGRATION OF METABOLISM(18 HRS.)

Nucleic acid structure –Biosynthesis of Purines and Pyrimidines; Biosynthesis of Deoxyribonucleotides – *de novo* and salvage pathways; Degradation of Purine and Pyrimidines; Disorders of Purine metabolism;Integration of Metabolism, Metabolism in Starvation.

UNIT -V ENZYMES AND HORMONE

(18 HRS.)

Enzymes – Mechanism of Action – Michaelis - Menton Hypothesis; Factors affecting the Enzyme Action; Enzyme Inhibition; Coenzymes and Isoenzymes. Hormones- Chemical Nature of Hormones – Mechanism of Action; Structure, function and deficiency symptoms of Hormones of Thyroid Gland, Parathyroid Gland, Pancreas, Adrenal Gland and Pituitary Gland(**Self Study**).

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only) (18 HRS.)

REFERENCES:

- Satyanarayana U., and Chakrapani U.(2014)*Biochemistry, 4th Revised* ed, Reprinted. Elsevier, Reed Elsevier India Private Limited, New Delhi and Books and Allied (P) Ltd., Kolkata.
- Rastogi S.C. (2006) *Biochemistry, 2nded, 5th Reprint.* Tata McGraw-Hill Publishing Company Limited, New Delhi).

(18 HRS.)

- 3. Lehninger L.A., Nelson D.L and Cox M.M.(2005)*Principles of Biochemistry, 5th ed.*, W.H.Freeman and Company, New York.
- 4. Conn E.E., Stumpf P.K., Bruening G and Doi R.H. (2004). *Outlines of Biochemistry, 5th ed.*, John-Wiley and Sons, Singapore.
- 5. Stryer L.(2003) *Biochemistry, 5th ed.*, W.H.Freeman Publishers, New York.
- 6. Murray K.R., Granner D.K., Mayer A.P and Rodwell V.W.(2000)*Harper's Biochemistry*, 25th ed., Appleton and Lange.
- Devlin M.T.(1997) Textbook of Biochemistry with Clinical Correlations, Wiley-Liss Pub, New York.
- Montgomery R., Conway T.W., Spector A.A and Chapell D. (1996) Biochemistry – A case oriented approach, 6th ed., Mosby Inc., London.

COURSE OUTCOMES

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Summarize the structure, classification and- metabolic pathways of carbohydrates	K2	PSO1
CO 2	Organize the Structure, Classification and Metabolism of Proteins.	КЗ	PSO1
CO 3	Explain the structure, classification, synthesis and metabolism of Lipids	K2	PSO1
CO 4	Assess the metabolic pathway of nucleic acid.	К5	PSO1& PSO2
CO 5	Describe the structure, function and mechanism of enzyme and hormone action.	K2	PSO1 & PSO2

I M.Sc., ZOOLOGY

SEMESTER -II

For those who joined in 2019 onwards

PROGRAMM E CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19PG2Z9	Lab in Genetics & Evolution	PG Core	4 Hrs.	2

COURSE DESCRIPTION

This course deals with the laboratory experiments that teach the concepts of inheritance of genes and to explore evolutionary dynamics.

COURSE OBJECTIVE

- Examine the mendelian traits and interpret it.
- Investigates causes and consequences of natural genetic variation within species.
- Interpret the evolutionary changes in allelic frequencies within a population by Hardy-Weinberg law.

GENETICS

- 1. Study of sex ratio in insects.
- 2. Preparation of barr bodies from buccal smear.
- 3. Preparation of giant chromosome in Chironomus larva.
- 4. Simple mendelian traits.

5. Drosophila culture and observation of phenotypic variations in eye and wing.

- 6. Pedigree analysis.
- 7. Shell coiling in Limnaea (spotters).
- 8. Analysis of dominant and recessive traits through beads.
- 9. Analysis of monohybrid and dihybrid ratio by beads.
- 10. Assessment of Independent assortment trait through beads.
- 11. Analysis of Drosophila mutant.

Evolution

1. Study of museum specimens - Evolution of horse, connecting links

2. Mimicry - krait; adaptive colouration - chameleon

3. Study of the skull of vertebrates - Varanus, Crocodile, Bird, Dog, Rabbit/ Rat (Chart/pictures)

4. Calculating gene frequencies and genotype frequencies in the light of Hardy-Weinberg Law through beads.

5. Comparison of forelimbs and hind limbs of vertebrates .

6. Demonstration of natural selection by beads.

REFERENCES:

- 1. Rajan S., Christy, S.R., (2011) *Experimental procedures in Life Sciences*, Anjana Book House, Chennai.
- 2. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.
- Tembhare D.B., (2008) Techniques in Life Sciences, 1st ed., Himalaya Publishing House Pvt. Ltd., Mumbai.
- 4. Dutta A., (2009) *Experimental Biology Lab manual*, Narosa Publishing House, New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Determine the sex in man by Barr bodies.
CO 2	Experiment with the simple Mendelian traits.
CO 3	Examine the process of Sex determination in man and fruit fly.
CO 4	Construct the Pedigree charts by systematic listing of parents.
CO 5	Relate the genotypic frequencies by Hardy-Weinberg equilibrium.

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I M.Sc., ZOOLOGY

SEMESTER -II

For those who joined in 2019 onwards

PROGRAMM E CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19PG1Z10	Lab in Biochemistry	Practi cal	4 Hrs.	2

COURSE DESCRIPTION

Students gain hands-on experience and learn the theoretical basis of lab techniques common to a variety of biological disciplines such as Biochemistry and they will work in groups, learning how to collect, analyze, and present data while using the scientific method to conduct inquiry-based laboratory experiments.

COURSE OBJECTIVES

- Introductory laboratory course in current principles and techniques applicable to research problems in biochemistry and molecular biology.
- Techniques include protein purification and involve identification methods such as centrifugation, chromatography, and electrophoresis; spectrophotometric and enzymatic methods.

EXPERIMENTS

- 1. Laboratory guidelines
- 2. Measurement of concentration of solutions using different parameters
- 3. Preparation of Buffer solutions
- 4. Determination of the effect of pH on the activity of human salivary amylase
- 5. Demonstration of the presence of catalase in the given sample
- 6. Titration of Weak Acid Vs Strong Base and the determination of pKa value
- 7. Spectrophotometric estimation for verifying Beer's law
8. Spotters: Qualitative analysis of carbohydrates: Molisch's test, Iodine test, Fehling's test, Benedict test, Barfoed's test, Seliwanoff's test, Bial's test, Osazone test

9. Quantitative estimation of carbohydrate by Folin-Wu method

10. Estimation of Protein by Lowry's method

11. Separation of sugars/dyes by thin layer chromatography (TLC).

12. Qualitative analysis of proteins : Precipitation by neutral salt, heavy metals, alchohol, heat coagulation, Biuret test, Ninhydrin test, Xanthoproteic reaction, Pauly's test, Millon's test, Morner's test, Folin phenol test, Aldehyde test, Sakaguchi's test, Sodium nitroprusside test

13. Separation of proteins by SDS PAGE.

14.Protein purification -(i) Precipitation (ii) Gel filtration

15. Determination of Km & Vmax for alkaline phosphatase

16. Estimation of cholesterol by Zak's method.

REFERENCES:

- 1. Rajan S., Christy, S.R., (2011) *Experimental procedures in Life Sciences*, Anjana Book House, Chennai.
- Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.
- Tembhare D.B., (2008) Techniques in Life Sciences, 1st ed., Himalaya Publishing House Pvt. Ltd., Mumbai.
- 4. Dutta A., (2009) *Experimental Biology Lab manual*, Narosa Publishing House, New Delhi.
- Plummer T.D., (1990) An Introduction to Practical Biochemistry, 4th ed., Mc Graw Hill Book Company, Europe.
- Palanivelu P., (2004) Analytical Biochemistry and Separation Techniques A laboratory manual for B.Sc and M.Sc students, 3rd ed., Kalaimani Printers, Madurai.
- 7. Wilson K and Walker J., (2013) *Principles and Techniques of Biochemistry* and Molecular Biology, 7th ed., Cambridge University Press, New York.
- Roe S., (2001) Protein Purification Techniques A Practical Approach, 2nd ed., Oxford University Press.

- 9. Boyer R., (2000) Modern Experimental Biochemistry, 3rd ed., Pearson Education Inc.
- Wilson K and Kenneth H.G., (1992) A Biologists Guide to Principles and Techniques of Practical Biochemistry, 3rd ed., Cambridge University Press, Cambridge, UK.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Acquire skills in handling basic equipments
CO 2	Calculate the strength of unknown solutions using formula
CO 3	Estimate the various biomolecules using standard protocols
CO 4	Demonstrate experiments adopting appropriate procedures
CO 5	Critically analyze and interpret the results
C06	Design experiments to solve research problems

I M.Sc., ZOOLOGY

SEMESTER -II

For those who joined in 2019 onwards

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19PGZEDC2	Herbal Medicine	PG Core	3 Hrs.	3

COURSE DESCRIPTION

This course deals with the study of medicinal plants and therapeutic values of herbs.

COURSE OBJECTIVES

- To understand the ethnobotanical importance of indigenous medicinal plants and their implications for common ailments.
- To know the key active constituents of the herbal products that are responsible for biological activity.
- Define the importance of nutraceuticals in healthcare.
- To discuss the functional food, herbal supplements and their effects on health.

UNITS

UNIT I: INTRODUCTION

HRS.)History of Herbal medicine - Traditional systems of Medicine – Siddha, Ayurveda, Homeopathy, Unani & Acupuncture - Classification of medicinal plants based on Useful part - Wood, Root, Bark, Leaf & Seed; Usage – Medicinal & Culinary; Active constituents- Aromatic, Astringent - Bitter &Mucilagenous herbs - Doctrines of signature.

UNIT II: COMMON MEDICINAL PLANTS

(9 HRS.)

(9

Morphology, Chemical constituents and Medicinal uses of *Aloe vera* (Kumari), *Acalypha indica* (Indian Nettle), *Trigonella foenum-graecum*(Fenugeek), *Cyanodon dactylon* (Bermuda grass), *Vitex negundo* (Chinese chaste tree), *Adathoda vasica* (Malabar Nut), *Piper betel*(Betel leaf),

Curcuma longa (Turmeric), Azadirachta indica (Neem), Andrographis paniculata (Green chireta), Emblica officinalis (Amla), Piper nigrum (Pepper).

UNIT III: HERBAL MEDICATION

Herbal remedies for common cold – Ocimum basilicum(Holy Basil), Renal implication of herbal remedies - Musa paradisiaca(Plantain), Tribulus terrestris(Puncture vine) - Herbal medicines for Gastro intestinal problems – Allium sativum (Garlic), Zingiber officinale (Ginger) & Trachyspermum ammi (Caraway)- Herbal remedies for Hepatic disorders – Phyllanthus niruri(Stonebreaker), Eclipta alba (False daisy)- Herbal remedies for skin diseases – Holarrhena antidysenterica (Tellicherry Bark).

UNIT IV: NUTRACEUTICALS AND LIFE STYLE DISORDERS(9 HRS.)

Definition – Nutraceutical and therapeutic value of Medicinal Plants – Nutritional value and uses of *Amarathus dubius*(Greens), *Moringa olerifera* (Drumstick), *Macrotyloma uniflorum*(Horse gram) - Role of Nutraceuticals in Diabetic cure, Management of Obesity, Constipation, Blood pressure.

UNIT V: PREPARATION OF HERBAL PRODUCTS (9 HRS.)

Herbal Face Powder- Bath powder – Herbal hair care: hair conditioner & hair oil - Cough choornam- Anti-diabetic Powder- Triphala choornam – Asthavargha Choornam – Prasava Lehiyam- Health Mix powder -Preparation of Amla candy, Ginger candy, Gulkand & Sherbath.

&Cardiovascular diseases – Female health disorders- Menstrual problems.

REFERENCE BOOKS:

- 1. Schulz V, Haensel R and Tyler V.E., Rational Phytotherapy, A Physicians Guide to Herbal Medicine, Springer Publishers, Berlin.
- 2. McKenna D.J., Jones K. and Hughes K., Botanical Medicines, The Desk Reference for Major Herbal Supplements, The Haworth Herbal Press, New York.
- 3. Natural Medicines Comprehensive Database.
- 4. Maeilanandhan, S.K.M., (2010). Siddha and Ayuveda -Therapeutic Index-Siddha, Sri Lakshmi chirtaprinters,.

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COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Make use of alternative medicinal methods.
CO 2	Infer the importance of herbs used in day today life.
CO 3	Categorize the usage of herbs for different ailments.
CO 4	Solve the life style disorders with food supplements.
CO 5	Prepare various herbal products.

I M.Sc.,

SEMESTER -II

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	-	Computer Applications For Biologists	Add on Course	40 Hrs.	4

COURSE DESCRIPTION

It provides hands on experience on the tools and techniques of bioinformatic sequence analysis. It begins with the data storage in major biological databases, retrieval of sequences and bioinformatics tools used for pairwise and multiple sequence alignment.

COURSE OBJECTIVES

To gain skills on *in silico* data analysis and protein structure prediction

COURSE CONTENT

- 1. Statistical analysis with MS-EXCEL
- 2. Biological databases NCBI, UniProt
- 3. Sequence retrieval from biological databases
- 4. Sequence similarity analysis BLAST, FastA,
- 5. Multiple sequence alignment ClustalO
- 6. Phylogenetic analysis MEGA6
- 7. Protein Structure visualization PDB, Rasmol
- 8. Homology modeling SWISSPDB Viewer

REFERENCES:

- Khan I.A and Khanum A., (2004). Fundamentals & Biostatistics, 2nd ed., Ukaaz Publications, Hyderabad.
- Banerjee P.K., (2006). Introduction to Biostatistics, 3rd ed., S.Chand Publication, New Delhi.
- 3. Misra B.N and Misra M.K., (1983). Introduction to Practical Biostatistics, Naya Prokash, Calcutta,.
- Baxevanis D and Francis B.F., (2004). Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, 3rd ed., John Wiley & Sons Inc.
- 5. Attwood T.K and Parrysmith D.J., (2005). *Introduction to Bioinformatics*, Pearson Education.
- 6. Campbell M.A and Heyer L.J., (2004). *Discovering Genomics*, Proteomics and Bioinformatics, Pearson Education.
- Gibson G and Muse S.V., (2002). A Primer of Genomic Science, Sinauer Associates Inc. Pub., Sunderland.
- 8. Jones N.C and Pevzner P.A., (2005). An Introduction to Bioinformatics Algorithms, Ane Books, New Delhi.
- 9. Lesk M., (2004). Introduction to Bioinformatics, Oxford University Press.
- Bergeron B.M.D., (2003). Bioinformatics Computing The Complete Practical Guide to Bioinformatics for Life Scientists, Pearson Education (Singapore) Pvt. Ltd., Delhi.
- 11. Rastogi P.S.C., Namita M and Rastogi P., (2004). *Bioinformatics Concepts, Skills and Applications*, CBS Publishers, New Delhi..

WEB REFERNCES:

- 1. <u>www.ncbi.nlm.nih.gov</u>
- 2. <u>www.uniprot.org</u>
- 3. <u>www.rcsb.org</u>
- 4. <u>https://prosite.expasy.org</u>
- 5. <u>www.ncbi.nlm.nih.gov/blast/</u>
- 6. <u>www.ebi.ac.uk/Tools/msa/clustalo</u>
- 7. <u>www.megasoftware.net/</u>
- 8. <u>https://spdbv.vital-it.ch/</u>
- 9. <u>www.autodock.scripps.edu/</u>

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Apply MS-EXCEL for statistical analysis
CO 2	Retrieve nucleotide, protein sequences and protein structure
CO 3	Perform BLAST and FastA
CO 4	Interpret the results obtained through bioinformatic tools
CO 5	Model protein structure using Swisspdb viewer
CO 6	Illustrate the biological interactions of target protein and drugs

I M.Sc., ZOOLOGY SEMESTER –II

For those who joined in 2019 onwards (for Zoology, Home science students)

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	-	SPSS	Add on Course	40 Hrs.	4

COURSE DESCRIPTION

It provides hands on experience on the tools and techniques of SPSS statistical package.

COURSE OBJECTIVES

To gain skills on analysis of data and interpretation using SPSS software

COURSE CONTENT

- 1. Introduction to Research Methodology- Testing Hypothesis
- 2. Data Entry in SPSS through Questionnaire, Importing Data
- 3. Charting with SPSS- explore, PP plots and QQ Plots and Interpretations
- Descriptive analysis Measures of Central Tendency, Kurtosis, Skewness
- 5. One Sample t test Independent and Paired sample t test
- 6. Correlation Pearson Regression analysis-Simple Linear, R square
- 7. Factorial ANOVA, F- Statistics and p values
- 8. Hierarchical Clustering with SPSS -Interpretation and Report Writing

REERENCES

- Ajaj S.G and Sanjaya S. G., (2009). Statistical Methods for Practice and Research: A Guide to Data Analysis Using SPSS (Response Books) 2nd Edition, Kindle Edition. Sage Publications Pvt. Ltd; 2 edition (13 May 2009)
- 2. Kiran P., Smruti B and Sanjay S., (2011).SPSS in Simple Steps Paperback.
- George D., Mallery P., English N.A., George D and Mallery P., (2016). IBM SPSS Statistics 23 Step by Step: A Simple Guide and Reference.
- Kayyanaraman K., Hareesh N.R and Harikumar P.N., (2016). Statistical Methods for Research: A Step by Step Approach Using IBM SPSS Hardcover – Atlantic Publications.

WEBSITE REFERENCE:

- 1. <u>https://www.spss-tutorials.com/basics/</u>
- 2. <u>https://www.udemy.com/course/spss-statistics-foundation-course-from-scratch-to-advanced/</u>
- 3. <u>https://www.open.edu/openlearn/society-politics-</u> law/sociology/getting-started-spss/content-section-

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Apply the knowledge of research methodology and frame the hypothesis
CO 2	Explains the features of questionnaire
CO 3	Perform Students t test and ANOVA
CO 4	Interpret the results obtained through SPSS analysis tools
CO 5	Analyse the data SPSS
CO 6	Performs Hierarchical Clustering using SPSS software

II M.Sc., ZOOLOGY SEMESTER –III

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	PG3Z11	Biophysics	PG Core	6	5

COURSE DESCRIPTION

Biophysics which is an inter disciplinary course, deals with the discipline concerned with the application of the principles and methods of physics and the other physical sciences to the solution of biological problems.

COURSE OBJECTIVES

- To imbibe the principles of physics involved in the structure elucidation of biomolecules
- To understand the principles of energy transformation in living systems
- To apply the use of modern physical instruments to unravel the importance of therapeutic radiology, in which the measurement of dose is critical to treatment, and in diagnostic radiology, particularly with techniques involving isotopes

UNITS:

UNIT-I: CHEMCAL BONDS AND MOLECULAR INTERACTIONS [15 HRS.]

Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide bond, Peptide bonds- Forces between Molecules: Electrostatic force, Van der Waal's forces, hydrophobic and hydrophilic - Biological importance and domains of Physics in Biology-Electrolytic dissociation and electrolytes:- Ionisation, Basis of acidity and Basicity, Bronsted Lowry theory, strength of acids and bases, Henderson and Hasselbalch equation. Water as Dipole -Biological importance of water

Self-Study:-Water as Dipole -Biological importance of water,Electron configuration of an atom: Covalent bond, hydrogen bond, Disulphide bond, Peptide bonds- Forces between Molecules: Electrostatic force, Van der Waal's forces, hydrophobic and hydrophilic

UNIT-II: THERMODYNAMICS AND BIOLOGICAL OXIDATION [15 HRS.] [15 HRS]

Laws of Thermodynamics: Concept of free energy and entropy, Exergonic and Endergonic reactions, Rate of reactions - Effect of sunlight and temperature on reactions - Energy of Activation: Arrhenius expression, Diffusion: Fick's Laws-I & II law, constant laws, Osmotic coefficient: Gibbs Donnan equilibrium- Oxidation and reduction reactions: Redox potentials in biological system- High energy phosphate group : ATP synthesis in mitochondria, ATP synthase.

UNIT-III: INSTRUMENTATION

[15 HRS.]

[15 HRS.]

Principle, Components and Biological applications of Light microscope, Polarising microscope, Inverted microscope, Confocal and X-ray microscope, Flow cytometry - Colorimetry and Spectrophotometry: Laws of absorption, complementary colours, Chromophore concept, Absorption spectrum, Wavelength selectors, Detection devices, amplification and read out. Chromatography: Paper chromatography, TLC and Column chromatography. Centrifugation: Principle, Types & Applications, Relative Centrifugal Force, Factors affecting sedimentation and types of centrifugation

UNIT-IV: PHOTO BIOPHYSICS

Electromagnetic spectrum: Components of EMR, Quantum theory of radiation, Biological application, Effects of UV on Biological systems -Radioactive isotopes: Measurements of radiation, Dosimetry, Cerenkov radiation, Interaction of radioactivity with matter, Gas ionization methods:

Ionization chambers, proportional counters, GM tubes, Photographic methods: Autoradiography, Excitation method: Liquid Scintillation counters; Use of isotopes as tracers in Biology; Safety aspects

Self-Study:-Use of isotopes as tracers in Biology; Safety aspects, Effects of UV on Biological systems

UNIT-V: BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY [15 HRS.]

Biophysical aspects of vision: photoreceptors :simple and compound, structure and function of vertebrate eye, mechanism of conversion of light stimulation to neuronal impulse - Nerve conduction: Neurotransmitters and Synapse, Nerve impulse, membrane potential, resting potential and action potential, Action potentials in earthworm nerve fiber - Muscle contraction

Self-Study:-Neurotransmitters and Synapse

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only)

REFERENCES:

- Claycomb J.J, Tran J.Q.P., (2011) Introductory Biophysics: Perspectives on the living state, Jones and Bartlett publishers, New Delhi.
- Upadhyay A, Upadhyay K and Nath N., (2007) Biophysical chemistry Principles and Techniques, Himalaya Publishing House Pvt. Ltd., Mumbai.
- Narayanan P, (2007) Essentials of Biophysics, New Age International (P) Ltd., Publishers, New Delhi.
- 4. Nolting B., (2005) *Methods in modern Biophysics, Springer (India)* private Ltd., New Delhi.
- 5. Cotterill R., (2004) *Biophysics and Introduction, John Wiley and Sons* Ltd., printed in India by Replika press pvt. Ltd., Kundli
- Agarwal S.K., (2005) Advanced Biophysics, APH publishing corporation, New Delhi.

7. Pattabhi V and Gautham N., (2004) *Biophysics*, Narosa Publishing House, New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
	Classify the chemical bonds and forces interacting between
CO 1	molecules
CO 2	Summarize the theories involved in acidity and basicity
	Explain the principles of Thermodynamics and biological
CO 3	oxidation
	Describe the principle, procedure, components involved and
CO 4	biological applications of Instruments
	Apply the principles of Photobiology in the Perception and
CO 5	Chemical Processing of Vision
a a c	Assess the principles, properties applications and hazardous
CO 6	nature of Radioactive isotopes
	Interpret the Biophysical aspects of neurophysiology applied to
CO 7	the Animals
	Organize the Biological importance and various domain of
CO 8	physics in Biology in the form of flow chart

II M.Sc., ZOOLOGY SEMESTER –III

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	PG3Z12	Immunology	PG Core	90 Hrs.	5

COURSE DESCRIPTION

The course intends to provide the biology of immune system and mechanism of immune response, maturation of lymphocytes and major histocompatibility complex and immune system related disorders and vaccines.

COURSE OBJECTIVES

To understand the functions of immune system and to envisage the different immune response in human health.

UNITS

UNIT –I OVERVIEW OF THE IMMUNE SYSTEM (15 HRS.)

Historical perspective (Overview) - Innate (Nonspecific) and adaptive (Specific) immunity – Cells of the immune system: B-lymphcytes, T lymphocytes, mononuclear cells, granulocytic cells (Neutrophils, Eosinophils, Basophils), Mast cells, Dendritic cells – Primary lymphoid organs: Thymus, Bone marrow, Lymphatic system – Secondary lymphoid organs: Lymph nodes, spleen, MALT, Bursa of Fabricius. Primary immune response and secondary immune response.

Self-study – Secondary lymphoid organs

UNIT -II ANTIGENS AND ANTIBODIES

(15 HRS.)

Antigen-structure and properties, Haptens, Adjuvants, Epitopes: B cell epitope and T cell epitope. **Antibody**: Immunoglobulin - structure, classes

biological functions. Characteristics - Isotypes - Allotypes - Idiotypes - Immunoglobulin super family, monoclonal and polyclonal antibodies. Organization and rearrangement of light-chain genes ($\kappa \& \lambda$ chain) and Heavy chain genes - Antigen–Antibody interactions, Immunodiffusion and immunoelectrophoresis.Agglutination, Precipitation, Hybridoma Technology.

Self-study - B cell epitopes and T cell epitopes.

UNIT -III LYMPHOCYTES MATURATION AND ACTIVATION & MHC (15 HRS.)

B-cell maturation – B cell activation and proliferation - affinity maturation – class switching – generation of plasma cells and memory B cells - General organization and inheritance of MHC – MHC Genes - Structure of MHC molecules – Class I & II - Processing and presentation of exogenous and endogenous antigens - Tissue typing - T-cell maturation: Thymic selection – T cell activation – T cell differentiation.

Self-study - Structure of MHC molecules - Class I & II

UNIT -IV COMPLEMENT SYSTEM AND HYPERSENSITIVITY (15 HRS.)

Complement activation pathways: Classical, Alternate and Lectin -Regulation of complement system - Biological consequences of complement activation - Complement deficiencies. Hypersensitive reactions – IgE mediated (Type I) Hypersensitivity: components, mechanism, mediators and consequences – Antibody mediated cytotoxic hypersensitivity (Type II) – Immune complex mediated Types III hypersensitivity and T_{DTH} mediated Type IV hypersensitivity.

Self-study - Biological consequences of complement activation

UNIT -V VACCINE AND IMMUNITY IN HEALTH AND DISEASE (15 HRS.)

Vaccines: Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines. Immune response and immune evasion during bacterial (Tuberculosis), Parasitic (Malaria) and viral (HIV) infections.Congenital immunodeficiency diseases (SCID and Ataxia). Autoimmunity: Organspecific autoimmune diseases. Systemic auto-immune diseases.

Self-study - Congenital immunodeficiency diseases

REFERENCES:

- Owen J, Punt J, Stranford S.A. (2013). *Kuby Immunology*. 7th ed., Macmillan, International Ed..
- 2. Rao C.V. (2007). A text book of Immunology, 3rd ed., Narosa Publishing House, New Delhi.
- 3. Parham P. (2014). *The Immune System*, Fourth Edition, Garland Science Publisher, USA.
- 4. Chakravarthy A.K. (2003). Immunology, 2nd ed., N.L. Publishers. Siliguri.
- 5. Lydyard P.M, Whelan A, Fanger M.W. (2003). Instant notes on Immunology. Viva Books Private Limited. New Delhi.
- Clark W.R. (1991). The experimental foundations of modern Immunology, 4th ed., John Wiley and Sons, INC.
- Roitt I.M. (1988). Essential Immunology, 6th ed., English Language Book Society/ Blackwell Scientific Publications.
- Emil R. U., Benacerraf B. (1984). *Text book of Immunology*, 2nd Ed., Williams and Wilkins, Baltimore, London.
- Mc Connell, Munro A, Waldmann H. (1984). The Immune System, 2nd Ed., Blackwell Scientific Publication.
- 10. Hyde R.M. (1977). Immunology, 3rd Ed., B.I.W. Waverly Pvt Ltd New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Compare the innate and adaptive immunity
CO 2	Describe the structure and functions of immune cells and lymphoid organs
CO 3	List the properties of B and T cell epitopes
CO 4	Discuss the structure, types and properties of various Immunoglobulins
CO 5	Differentiate the gene organization and molecular structures of MHC class I and class II
CO 6	Discuss the activation and maturation of B-cells and T-cells
CO 7	Relate immunoglobulins and biological consequences of complement activation
CO 8	Summarize the methods, merits and demerits of different types of vaccines
CO 9	Explain the immune response to infectious diseases

II M.Sc., ZOOLOGY

SEMESTER -III

For those who joined in 2019 onwards

PROGRAMM E CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19PG3Z13	Biostatistics & Research Methodology	PG Core	6 Hrs.	5

COURSE DESCRIPTION

This course deals with specific procedures or techniques used to identify and process the research data.

COURSE OBJECTIVES

- Identify the research problem and generation of raw data through different methods.
- Apply the statistical tools to calculate and tabulate the data.
- Interpret the results and draw conclusion.
- Outline the steps in drafting the thesis.

UNITS

UNIT –I INTRODUCTION TO BIOSTATISTICS (18 HRS.)

Introduction, Definitions, Types of biological data, Sampling – types, samples from populations, graphical frequency distribution and graphical representation of data. Measures of central tendency - Mean, Median, and Mode. Dispersion & variability – the range and the mean deviation, the variance, standard deviation, the coefficient of variance, standard error.

Self – study - Introduction, Definitions, Types of biological data, Sampling – types, samples from populations, graphical frequency distribution and graphical representation of data.

UNIT -II DISTRIBUTION AND TESTING OF HYPOTHESIS(18 HRS.)The normal distribution- skewness & kurtosis, proportions of a normal

curve – Z scores - Testing of hypothesis - Importance & types – Chi – square

test – comparison of means of two large samples, means of two small samples, paired & unpaired t tests.

UNIT -III CORRELATION& REGRESSION

Correlation analysis-Kinds, Degree - Types of correlation- Pearson's Correlation Coefficient -Regression analysis- Simple, linear regression, testing the significance of regression. The analysis of variance - Single factor ANOVA – basic assumptions under ANOVA, One Way and Two Way ANOVA.

UNIT -IV INTRODUCTION TO RESEARCH & RESEARCH DESIGN

(18 HRS.)

Research: Definition, Importance, Meaning of research –Characteristics of research –Types of Research – Research approaches (Qualitative and Quantitative)- significance of research. Research problem: Identification, Selection and formulation of research problem –Research design: Features and concepts -Dependent and independent variables, research hypothesis – Types.

Self – study- Research report-components, tables, figures, formatting and typing

UNIT -V THESIS WRITING

(18HRS.)

Preparation and Writing of Thesis: Components of thesis – Literature collection - Literature citation- Research report-components, tables, figures, formatting and typing. Preparing of scientific papers for publication to a Journal and presenting in symposia/seminar, Plagiarism - Types.

Self – study- Research report-components, tables, figures, formatting and typing

TEXT BOOK:

Ramakrishnan P., (2010). Biostatistics, Saras publication, Nagercoil, Tamil Nadu.

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(18 HRS.)

REFERENCES:

- 1. Kothari. C.R., (2009). Research Methodology, New Age International,
- 2. Khan and Khanum., (2004).*Fundamentals & Biostatistics*, 2nd ed., Ukaaz Publications, Hyderabad.
- 3. Gurumani N., (2010). An Introduction to Biostatistics, MJP Publishers, Chennai.
- 4. Satguru Prasad., (2012). *Elements of Biostatistics*, Rastogi publications, Meerut.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Find the measures of central tendency and dispersion values
CO 2	Assess the difference between the expected and observed frequencies by Chi-Square test
CO 3	Compute degrees of relationship between two variables with reference to correlation and regression
CO 4	Test the hypothesis of mean of the variables whether significant or not through ANOVA
CO 5	Identify the research problem and generation of raw data through different methods
CO 6	Apply the statistical tools to calculate the data
CO 7	Tabulate the research data in appropriate order
CO 8	Interpret the results and draw conclusion
CO 9	Outline the steps in drafting the thesis
CO100	Formulate the research work through documentation

II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	PG3ZE1	Fisheries & Aquaculture	Elective Core	4Hrs.	4

COURSE DESCRIPTION

This Course focuses on Fisheries and Aquaculture of Finfishes, Marine

Prawn, Pearl Oyster and Disease Management.

COURSE OBJECTIVES

To impart knowledge on Fisheries and Aquaculture Practices in India.

UNIT I - INDIAN CAPTURE FISHERIES

History of Fisheries, Indian Capture Fisheries: Riverine fisheries, Estuarine fisheries, Reservoir fisheries, Lacustrine Fisheries, Cold-water fisheries; Marine Capture fisheries: Inshore capture fisheries, Off shore and deep sea fisheries

UNIT II - AQUACULTURE PRACTICES

Preparation and Construction of Ponds; Water Quality Management; Maintenance of Fish Farms; Fish Nutrition – Live feed, Artificial feed - FCR; Induced Breeding – Eyestalk ablation and Hypophysation.

UNIT III - CULTURE SYSTEMS

Culture Systems – Based on habitat, expenses, site, climatic conditions and Composition of Organisms Culture of Indian Major Carps, Marine Prawn, Pearl Oyster and Sea Cucumber - Sewage fed fish culture, Integrated Fish Farming.

UNIT IV - FISH PATHOLOGY AND POST HARVEST TECHNOLOGY

(15 HRS)

Parasitic diseases – Protozoan, Helminth, Crustacean, Fungal, Bacterial and Viral diseases and Deficiency Diseases; Preservation of Fish; Fish Marketing

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(15 HRS)

(15 HRS)

(15 HRS)

UNIT V - INDIAN FISHERY

Indian Fish Geography, Fishing Gears and Methods, Fishing Crafts; Indian Exclusive Economic Zone – Use of Remote Sensing and GIS.Role of Government and Public Sector on Indian Fisheries, FFDAs.

REFERENCE BOOKS:

1. Pandey K. and Shukla J.P., (2012) *Fish and Fisheries*, 3rd Revised ed., Rastogi Publications, Meerut.

2. Srivastava C.B.L., (2008) A Textbook of Fishery Science and Indian Fisheries, 3rd Revised ed., Published by KitabMahal, Allahabad.

3. Kumar R., (2012) *Fish Farming Management*, 1st ed., Arise Publishers and Distributors, New Delhi.

4. Chandrasekhar Y.S., (2013) *Fish Nutrition in Aquaculture*, 1st ed., Swastik Publications, New Delhi.

5. Reddy S.M. and Sambasiva Rao K.R.S., (1999) *A Textbook of Aquaculture*, Discovery Publishing House, New Delhi.

COURSE OUTCOMES

On the successful completion of the course, students will be able to:

NO.	COURSE OUTCOMES
CO 1	Identify the economically important fishes and fishery products.
CO 2	Plans according to the recent concepts in fisheries management.
CO 3	Distinguish the various aquaculture systems.
CO 4	Organizes the type of hatchery, brood stock, larval production, feed management water quality and disease management in cultivable species, live feed production.
CO 5	Evaluates the Fisheries and Aquaculture Practices in India.

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II M.Sc., ZOOLOGY

SEMESTER –III

For those who joined in 2019 onwards

PROGRA MME CODE	COURSE CODE	COURSE TITLE	CATEGO RY	HRS/WEE K	CREDIT S
PSZO	19PG3ZE2	Bioinformatics	Elective Core	4 Hrs.	4

COURSE DESCRIPTION

The course provides an outline on various DNA sequencing methods, and principle and methods of sequence analysis with various bioinformatics tools and macromolecular structure prediction.

COURSE OBJECTIVES

To understand the fundamentals of biological sequence analysis and principle of substitution matrices, phylogenetic tree construction and protein structure prediction.

UNITS

UNIT -I DNA SEQUENCING AND BASICS OF INTERNET (12 HRS.)

Sanger's, Chemical, and Automated methods - Hierarchical sequencing and shot gun sequencing - Human Genome Project.Networking in computers: Intranet and internet - TCP/IP, file transfer protocols, web browsers, internet addresses, domain names, basic concepts of HTML, HTTP, web search engines.

Self-study - concepts of HTML, HTTP, web search engines

UNIT -II BIOLOGICAL DATABASES

(12 HRS.)

Classification of Biological Databases, Nucleic acid sequence databases: GenBank, EMBL, DDBJ - Protein sequence databases: UNIPROT, Secondary

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Databases: PROSITE, PRINTS - Genome Databases, Gene Expression database: GEO, Chemical Structure database: PubChem, and Pathway database: KEGG.

Self-study – DDBJ, PRINTS

UNIT -III PAIRWISE ALIGNMENT

(12 HRS.)

Pair-wise alignment: Types - Global and local alignment; gapped and ungapped alignment – DOTPLOT, Dynamic programming: Needleman-Wunsch algorithm - Substitution matrices: PAM, BLOSUM - Word methods– Sequence similarity tools: working principle and types of BLAST.

Self-study – DOTPLOT

UNIT –IV MULTIPLE SEQUENCE ALIGNMENT (12 HRS.)

Multiple Sequence alignment: Progressive method and iterative method applications - ClustalO – Phylogenetic analysis: Orthologs, paralogs, xenologs - Typical structure of phylogenetic tree - types: rooted and unrooted tree, phylogram and cladogram, Phylogenetic algorithm: Phenetic method (UPGMA) – Cladistic method (Maximum parsimony).

Self-study - ClustalO, Cladistic method

UNIT -V STRUCTURE PREDICTION & DRUG DESIGNING (12 HRS.)

Classification of proteins (Review) – Structure databases – Structural classification databases: SCOP, CATH - Secondary structure prediction – Chou-Fasman method, GOR method, Nearest neighbourhood method – Three dimensional structure prediction: homology modeling, threading, *ab initio* – Structure based drug design (SBDD).

Self-study – Structural classification databases

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only) (12 HRS.)

REFERENCES:

- Baxevanis D and Francis B.F., (2004). Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, 3rd ed., John Wiley & Sons Inc.
- 10. Attwood T.K and Parrysmith D.J., (2005). Introduction to Bioinformatics, Pearson Education.

- 11. Campbell M.A and Heyer L.J., (2004). *Discovering Genomics, Proteomics and Bioinformatics*, Pearson Education.
- 12. Gibson G and Muse S.V., (2002). *A Primer of Genomic Science*, Sinauer Associates Inc. Pub., Sunderland.
- 13. Jones N.C and Pevzner P.A., (2005). An Introduction to Bioinformatics Algorithms, Ane Books, New Delhi.
- 14. Lesk M., (2004). *Introduction to Bioinformatics*, Oxford University Press.
- Bergeron B.M.D., (2003). Bioinformatics Computing The Complete Practical Guide to Bioinformatics for Life Scientists, Pearson Education (Singapore) Pvt. Ltd., Delhi.
- 16. Rastogi P.S.C., Namita M and Rastogi P., (2004). *Bioinformatics Concepts, Skills and Applications*, CBS Publishers, New Delhi.

WEB REFERNCES :

- 1. <u>www.ncbi.nlm.nih.gov</u>
- 2. <u>www.uniprot.org</u>
- 3. <u>www.rcsb.org</u>
- 4. <u>https://prosite.expasy.org</u>
- 5. <u>www.ncbi.nlm.nih.gov/blast/</u>

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Recall the features of Human Genome Project
CO 2	Compare and contrast Hierarchical and shotgun sequencing
CO 3	List the different web browsers, search engines and biological databases
CO 4	Summarize the information stored in the flatfile of biological databases
CO 5	Prepare the DOTPLOT and identify matching sequence and repeat regions

NO.	COURSE OUTCOMES
CO 6	Compute dynamic programming using Needleman-Wunsch
CO 7	Explain the development and significance of substitution matrices
00.8	Relate the usage of different PAM and BLOSUM for closely and
08	distantly related sequences
	Recall the methods and applications of multiple sequence
CO 9	alignment
CO 10	Model phylogenetic tree based on the distance matrix
CO 11	Discuss the secondary structure prediction methods
CO 12	Summarize the three dimensional structure prediction methods

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II M.Sc., ZOOLOGY SEMESTER -III

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PGSZO	19PG3Z1 4	Lab in Biophysics & Biostatistics	PG Lab	4 Hrs.	2

COURSE DESCRIPTION

The course is designed to give a hand on experience in Biophysics and biostatistics

COURSE OBJECTIVES

On completion of the course, students should be able to develop skill in performing experiments, analysis and interpretation of the result.

BIOPHYSICS

- 1. pH Meter: Standardization of pH meter, Preparation of Buffers.
- 2. pH titration curve of acid-base
- 3. Osmolarity: Determination of osmotic pressure of salts.
- 4. To study the characteristics of absorption spectra of Aromatic Amino Acids.
- 5. To study the characteristics of absorption spectra of Proteins
- 6. Colorimeter: Verification of Beer's Lambert law, determination of absorption maxima of coloured compounds, and molar extinction coefficient.
- 7. Estimation of percent purities of dyes and inorganic compound
- 8. Centrifuge Principle and techniques.
- 9. Separation of aminoacid mixture using paper chromatography
- 10. Surface tension by drop weight method
- 11. Comparison of Viscosity of two liquids

BIOSTATISTICS

- 1. Collection of data and representation histogram, curves and pie diagrams.
- 2. Calculation of mean, median, mode, standard deviation, standard error, variance and coefficient of variation individual observation
- 3. Calculation of mean, median, mode, standard deviation, standard error, variance and coefficient of variation continuous series.
- 4. Calculation of correlation coefficient width/diameter of shell.
- 5. Calculation of correlation coefficient height and weight of students in the class.
- 6. Calculation of regression co-efficient using length and width of leaves.
- 7. Probability experiment with coin tossing (one coin, two coins). using chi square test
- 8. Test of significance for small samples student's t test.

REFERENCES:

- 1. Rajan S., Christy, S.R., (2011) *Experimental procedures in Life Sciences*, Anjana Book House, Chennai.
- Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.
- Tembhare D.B., (2008) Techniques in Life Sciences, 1st ed., Himalaya Publishing House Pvt. Ltd., Mumbai.
- 4. Dutta A., (2009) Experimental Biology Lab manual, Narosa Publishing House, New Delhi.
- Palanivelu P., (2004) Analytical Biochemistry and Separation Techniques A laboratory manual for B.Sc and M.Sc students, 3rd ed., Kalaimani Printers, Madurai.
- Wilson K and Walker J., (2013) Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, New York.
- Roe S., (2001) Protein Purification Techniques A Practical Approach, 2nd ed., Oxford University Press.
- Boyer R., (2000) Modern Experimental Biochemistry, 3rd ed., Pearson Education Inc.

- Wilson K and Kenneth H.G., (1992) A Biologists Guide to Principles and Techniques of Practical Biochemistry, 3rd ed., Cambridge University Press, Cambridge, UK.
- 10. Khan I.A and Khanum A., (2004) Fundamentals & Biostatistics, 2nd ed.,
 Ukaaz Publications, Hyderabad.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Recall the principle of centrifuge, pH meter, Chromatography
CO 2	Determine the maximum absorption and its molar extinction coefficient of sample
CO 3	Estimate the pH Titration curve, Surface tension and viscosity of sample
CO 4	Interpret the results for statistical analysis including mean, median, mode and Standard deviation for individual, continuous series
CO 5	Determine the correlation, regression and significance for the statistical data

II M.Sc., ZOOLOGY

SEMESTER -III

For those who joined in 2019 onwards

PROGRAM ME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDIT S
PGSZO	19PG3Z16	Lab in Immunology, Fisheries & Aquaculture and Bioinformatics	Major Practical	40 Hrs.	2

COURSE DESCRIPTION

It focuses on techniques related to the field of immunology. It includes preparation of antigens and to visualize precipitin and agglutination

COURSE OBJECTIVES

To perform hemoagglutination, single immunodiffusion, double immunodiffusion, and also to be familiarized with the principle of ELISA, immunoelectrophoresis, rocket immunoelectrophoresis.

EXPERIMENTS

- 1. Laboratory safety guidelines and Animal ethics
- 2. Lymphoid organs Thymus (Chick), Spleen (Goat)
- 3. Separation of serum & plasma
- 4. Total Leukocyte Count (TLC)
- 5. Separation of lymphocytes from peripheral blood
- 6. Isolation of splenocytes from goat
- 7. Antigen preparation and immunization
- 8. Isolation of serum immunoglobulins
- 9. Haemagglutination titration

- 10. Immunodiffusion techniques single and double immunodiffusion
- 11. Immunoelectrophoresis Demonstration
- 12. Rocket Immunoelectrophoresis Demonstration
- 13. Complement mediated hemolysis
- 14. Spotters: ELISA
- 15. Biological databases NCBI
- 16. Sequence analysis BLAST, ClustalO
- 17. Field visit to aquarium

REFERENCES:

- Sinha, J, Chatterjee, A.K, Chatoopadhya, P. (2015). Advanced practical Zoology, 4th Edition, Books and Allied, (P) Ltd.
- Dutta A. (2009). Experimental Biology A laboratory Manual, Narosa Publishing House, New Delhi.
- 3. Nigam A and Ayyagari A. (2008). Lab manual in Biochemistry, Immunology, and Biotechnology, 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Tembhare, DB. (2008). Techniques in Life Sciences, 1st Edition, Himalaya Publishing House.
- Rao, CV. (2007). A text book of Immunology, 3rd edition, Narosa Publishing House, New Delhi.
- Philopose, P.M., (2006). Experimental Biotechnology, 1st Edition, Dominant Publishers and Distributors, New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES		
CO 1	Identify and sketch the different lymphoid organs		
CO 2	Recall the properties of soluble and particulate antigen		
CO 3	Estimate the lymphocytes from peripheral blood		
CO 4	Demonstrate the various bleeding techniques		
CO 5	Demonstrate the separation of serum and plasma		
CO 6	Identify immunoelectrophoresis and rocket immunoelectrophoresis		
CO 7	Estimate the concentration of test antigen by single/double immunodiffusion		
CO 8	Experiment the complement mediated lysis		
CO 9	Infer the formation of precipitin line and button formation		

II M.Sc., ZOOLOGY

SEMESTER -IV

For those who joined in 2019 onwards

PROGRAM ME CODE	COURSE CODE	COURSE TITLE	CATE GORY	HRS/WEE K	CREDITS
PSZO	19 PG4Z16	ENVIRONMENTAL BIOLOGY	PG Core	6	6

COURSE DESCRIPTION

To understand the basic concepts of Ecology.

COURSE OBJECTIVES

To understand the key aspects of ecology, impact of pollution and biodiversity conservation for sustainable development.

UNIT –I ECOSYSTEM AND HABITAT (18 HRS.)

Structure – Components of ecosystems - Food chain, Food web - Ecological pyramids-Trophic levels-energy flow - productivity – Biomagnification-Classification of ecosystems- Introduction, structure and function of terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine) - Energy flow and mineral cycling (CNP)- Concept of habitat and niche ecosystem - Ecological indicators- Biomes - Tundra, Forest, Desert and mountain biomes – Biogeography: biogeographical zones of India.

Self-Study - Structure – Components of ecosystems - Food chain, Food web - Ecological pyramids

UNIT –IIPOPULATION AND COMMUNITY ECOLOGY (18 HRS.)

Concept of population - Biotic potential and Natality, Mortality, Survivorship curves, life table, Age structure, carrying capacity, Environmental resistance -Population growth forms - Life history strategies (r and K selection) –Population fluctuatuions- Population interactions-Competition, Predation, Parasitism, Mutualism -Concept of Community -Structure, Composition and Stratification- Community Function- Ecological succession – Primary and Secondary succession- Climax community - Hydrarch ,Xerarch - Ecotone and Edge effect – Ecological equivalents - Ecotypes and Ecophenes

Self-Study - Population interactions- Competition, Predation, Parasitism, Mutualism

UNIT –III NATURAL RESOURCES (18 HRS.)

Renewable & Non-renewable resources: Renewable resources-Forest Resources: Types of forests-Biomass, Biogas, Solar energy, Wind Energy, Tidal Energy, Geothermal Energy - Non Renewable resources-Fossil fuel (Coal, Petrol & Natural Gas) Nuclear Fuels

Self study - Forest Resources : Types of forests

UNIT -IV ENVIRONMENTAL POLLUTION

Impact of pollutants on general fauna, flora and ecosystems - Environmental pollution: Causes, effects and control measures of air, water, soil, noise and nuclear pollution- Greenhouse gases, Ozone layer and depletion –Waste water management – Primary secondary Global Climatic change - *El nino*and *La nina*Phenomenon- Green peace movement- Chipko movement- Nuclear disarmament - Role of Government agencies - Central and state Pollution Control Boards- - Environmental protection act, 1986 - Paris Summit- Kyoto protocol.

Self-Study - Environmental pollution: Causes, effects and control measures of air, water, soil, noise and nuclear pollution

UNIT –V BIODIVERSITY CONSERVATION

(18 HRS.)

(18 HRS.)

Concepts of Biodiversity - Need for conservation-Conservation Stratagies-In situ conservation - Protected areas, National parks, Sanctuaries, Biosphere reserves, Sacred groves – Ex situ Conservation - Seed Banks, Gene banks- Sthalvirukshas - Animal Translocation- Human animal conflicts and management - Biodiversity database - Endangered animals, endemism and Red data Book- Environmental protection act (1986)- Forest conservation Act (1980)- Biodiversity Act, 2002- Remote sensing and GIS: Methods and Applications in environmental management

Self-study - Concepts of Biodiversity- Need for conservation

REFERENCES:

- Odum, E.P. and Barrett, G.W. (2005) Fundamental of Ecology. 5th Ed., Cengage Learning India. New Delhi.
- Primark R.B., (2000) A Primer of Conservation Biology. 2nd Ed., SinauerAssociates..
- 3. Kormondy, E.J. (1996) *Concepts of Ecology. 4th Ed.*, PHI Cengage Learning India, New Delhi).
- Peter J.R., Stephan, L.W., PauleH., Ceche S. & Bevlerly, M. (2008) Ecology. Cengage learning India, New Delhi.
- Wright, R.T.(2008) Environmental Science, 10th Ed., Pearson Education, New Delhi.
- Smith T.M. & Smith R.L. (2008) *Elements of Ecology*. 6th Ed., Pearson Education, New Delhi.
- 7. Turk A. & Turk J. (1993) Environmental Science. 4th Ed., Saunders.
- Odum, E.P. & Barrett, G.W. (2005) Fundamentals of Ecology. 5th Ed., Cengage Learning India. New Delhi).

COURSE OUTCOMES

NO.	COURSE OUTCOMES	
CO 1	Develop an understanding of ecological key interactions and processes	
CO 2	Elaborate how minerals enter, used and exit an ecosystem	
CO 3	Explain the factors that affect population size, Density,Distribution and dynamics	
CO 4	Compare Ecological niche and habitat	
CO 5	Agree significance of Biodiversity, consequences on loss of Biodiversity andconservation Strategies	
CO6	CO6 Design novel mechanism for the sustainable utilization of natural resources	
C07	Criticize various kinds of pollution in the environment, their impact on the ecosystem	
CO8	Analyze causes of climatic change and its effects	
II M.Sc., ZOOLOGY SEMESTER –IV For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19 PG4Z17	Biotechnolog y	Major Core	6	5

COURSE DESCRIPTION

This course provides knowledge about genetic engineering and rDNA technology and its application in gene therapy, cell culture and GM food.

COURSE OBJECTIVES

- To familiarize the use of tools and techniques of genetic engineering for the study of living organisms, or derivatives to make or modify products for specific use for human welfare.
- Understand DNA finger printing and its application,
- Know about the application of animal cell culture for *in vitro* testing of drugs.

UNITS

UNIT -I RECOMBINANT DNA TECHNOLOGY (18HRS.)

Scope and importance of rDNA technology – Tools of rDNA technology: Enzymes involved in rDNA technology - Linkers and Adaptors – Cloning vectors: bacterial plasmid vectors – pBR322, pUC vectors – Agrobacterium based plasmids –cosmids – shuttle vectors - λ and M13 phage vectors – YAC - Simian virus 40, BAC and Transposons.

Self-study – Scope and importance of rDNA technology – Tools of rDNA technology: Enzymes involved in rDNA technology

UNIT –II TECHNIQUES OF GENETIC ENGINEERING (18 HRS.)

Gene transfer techniques: Transformation, Transduction, Biolistic, Microinjection, Liposome fusion, Electroporation, and agroinfection -Selection of recombinants: Reporter genes, Blue-white selection method preparation of cDNA- Hybridization techniques - DNA finger printing: RFLP & PCR techniques - Genomic library - Blotting techniques: Southern, Northern and Western blotting.

UNIT –III ANIMAL BIOTECHNOLOGY

Basics of animal cell, tissue and organ culture - Primary culture and established cell line culture - Basic techniques of mammalian cell culture and application -Organ culture ,whole embryo culture Embryo transfer and splitting - *In vitro* fertilization (IVF) technology - Nuclear transplantation: Dolly - Manipulation of reproduction in animals-Transgenic animalsstrategies for gene transfer, Targeted gene transfer, Artificial insemination, Animal Bioreactor and Molecular Farming, Human gene therapy, Cryobiology.

UNIT -IV PLANT BIOTECHNOLOGY

Introduction to the techniques of plant tissue culture - Historical background – Basic requirements for a tissue culture lab - Totipotency - Requirements for cell and tissue culture - Nutrient media - culture of plant materials - single cell culture, Organogenesis: Root and Shoot culture, Micropropagation- Somaclonal variation - Somatic embryogenesis and production of embryoids: Haploid and double haploid production - Protoplast isolation and culture, Somatic hybridization and Cybrid production and their applications in crop improvement - GM foods.

Self-study – GM foods

UNIT -V REGENERATIVE MEDICINE

Stem cells: Types, isolation umbilical cord blood cells, mesenchymal cells –-Current status and application in medicine, Application of animal cell culture for *in vitro* testing of drugs; Production of recombinant hemoglobin, blood substituents, Artificial blood, General account of *in vitro* regulation of blood cells production - Bioethics of stem cell research.

Self-study – Stem cells: Types, isolation umbilical cord blood cells

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(18 HRS.)

(18 HRS.)

(18 HRS.)

REFERENCES

- Bernard G.R and Jack P.J., (2002) *Molecular Biotechnology:* Principles and Applications of recombinant DNA, Indian reprint, Panima Publishing Corporation, New Delhi.
- Das H.K., (2007) Textbook of Biotechnology, 3rd ed., Wiley India (p) Ltd., New Delhi.
- 3. Selvaraj L., (2013) Stem Cells, 1st ed., MJP Publishers, Chennai.
- Dubey R.C., (2004) A Text book of Biotechnology, 3rd ed., S. Chand and company Ltd., New Delhi.
- Brown T.A., (2004) Gene cloning and DNA analysis, 6th ed., Wiley-Blackwell Science, Osney Mead, Oxford.
- Old R.W. and Primrose, S.B., (1985) Principles of Gene Manipulations, An introduction to Genetic Engineering, Oxford Blackwell Publishers, London.
- Winnacker E.L., (2003) From Genes to Clones, Panima Publishing Corporation, New Delhi.
- Sree Krishna V., (2007) Bioethics and Biosafety in Biotechnology, 1st ed., New Age International Publishers, New Delhi.
- Helen K and Adrianne M., (2001) Recombinant DNA and Biotechnology: A Guide for students, 2nd ed., American Society for Microbiology Press, Washington D.C, USA.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Find the enzymes in rDNA technology
CO 2	Compare the cloning vehicles with their specific advantages.
CO 3	Criticize the boon technology of <i>in-vitro</i> fertilization
CO 4	Analyse the technique of tissue culture
CO 5	Identify the importance of artificial blood

II M.Sc., ZOOLOGY

SEMESTER -IV

For those who joined in 2019 onwards

PROGRAM ME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
PSZO	19PG4Z18	Development al Biology	MAJOR CORE	6 Hrs.	5

COURSE DESCRIPTION

This Course focuses on the developmental process from a single egg to zygote by fertilization, into blastula by Cleavage, followed by Gastrulation into Gastrula. From Gastrula, organ forming rudiments are formed, which give rise to the Organ Systems of the Organism.

COURSE OBJECTIVES

Imparts knowledge on the developmental process from a single egg to foetus, then in an adult.

UNITS

UNIT I: INTRODUCTION TO DEVELOPMENTAL BIOLOGY (15 HRS)

Historical Review and Scope of Embryology; Reproductive Cycles – Regulation; Structure of sperms and eggs - influence of yolk - polarity symmetry - Egg membranes; Gametogenesis : Migration of Germ cells in Vertebrates, Spermatogenesis and Oogenesis

UNIT II: FERTILIZATION

Fertilization – Sea Urchin, and Mammals - Approach of the Spermatozoan to the Egg; Reaction of the Egg; Fusion of Gametic Nuclei; Egg Cytoplasm rearrangement by Fertilization; Parthenogenesis.

UNIT III: CLEAVAGE

Cleavage: Planes of Cell Divisions; Patterns of cleavage; Laws of Cleavage; Cellular Mechanism of Cleavage; Morula and Blastula; Physiology of Cleavage; Products of Cleavage;; Role of Maternal genes during the early Development.

UNIT IV: GASTRULATION

Gastrulation – Unique features – Gastrula; Morphogenetic movements; Fate maps, Fate of Germinal layers; Axis Formation in Sea Urchin, Fishes,

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(15 HRS)

(15 HRS)

(15 HRS)

Amphibians, Birds and Mammals; Concept of Spemann's Organizer; Formation of Extra embryonic membranes; Placentation in Mammals

UNIT V: ORGANOGENESIS & POSTEMBRYONIC DEVELOPMENT(15 HRS)

Development of Central Nervous System, Heart and Lungs; Metamorphosis in Insects, and Amphibians; Teratology; Types of Regeneration, Molecular basis and rôle of Genes on Teratology; Aging and Senescence.

REFERENCE BOOKS:

- 1. Browder L.N., *Developmental Biology*, Saunders College, Philadelphia (1980).
- 2. Balinsky B.L., *An Introduction to Embryology*, 5th ed., Saunders Co., Philadelphia (1981).
- 3. Berrill N.J., *Developmental Biology*, Tata McGraw Hill, New Delhi, (1986).
- 4. Carlson B.M., *Foundations of Embryology*, Tata McGraw Hill, New Delhi, (2007).
- 5. Gilbert S.F., *Developmental Biology*, Sinamer Associates Inc. Saunderland, Massachusets, U.S.A. (2003).

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Recalls the basic concepts of Developmental Biology.
CO 2	Explain how fertilization, cleavage and Gastrulation occur.
CO 3	Compares the basic concepts of organogenesis in different organisms.
CO 4	Understand the development of egg into a foetus, then into adult.
CO 5	Associate the embryo development with Phylogeny.

II M.Sc.,Zoology SEMESTER -IV

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19 PG4ZE3	ECONOMIC ZOOLOGY	PG Major Elective	4	4

COURSE DESCRIPTION

The course has great potential for creating self-employment and business opportunity

COURSE OBJECTIVES

- Enable the students to be familiarized with bee keeping, prawn culture, pearl culture, poultry and dairy farming to become an entrepreneur.
- Understand the medicinal value of honey.
- Know to manage and maintain poultry farms.

UNITS

UNIT -I APICULTURE

(12 HRS.)

Scope of Apiculture - Morphology of honey bees -species of honey bees: *Apisdorsata,Apisindica, Apisflorea, Apismellifera*- social behaviour of honey bees - Bee keeping: Newton's Bee hive -Extraction of honey - Medicinal value of honey - bee products - Importance of bee colonies in crop pollination.

Self-study – Scope of Apiculture -Social behaviour of honey bees – Bee keeping: Newton's Bee hive -Extraction of honey – Medicinal value of honey – bee products.

UNIT -II SERICULTURE

(12 HRS.)

Sericulture in India -silk route - Role of Central Silk Board - Different silkworm species and their host plants - Life cycle of Mulberry silkworm silkworm rearing: Rearing appliances and Rearing methods-cocoon marketing - raw silk testing - silk waste - economic importance of silk.

Self-study – silk route- Economic importance of silk

UNIT -III PRAWN AND PEARL CULTURE

Prawn culture: Types of prawn culture - Culture of fresh water prawn -Culture of marine prawn – Preparation of farm - Preservation and processing of prawn- Export of prawn.

Pearl culture: Types of pearl - Oysters and pearl formation - Composition, colour, size and quality of pearl - culture of pearls.

UNIT -IV POULTRY FARMING

Breeds of chick - Housing and Equipment: Deep litter System - Laying cages - Methods of brooding and Rearing -Debeaking - Management of growers, Layers, Broilers - Feed formulations for chicks, Growers and Broilers - vaccination schedule - Nutritive value of egg and meat.

Self-study – Nutritive value of egg and meat

UNIT -V DAIRY FARMING

Indigenousandexotic breeds - Rearing - housing - feedandrationing-Commercialimportanceofdairyfarming- Pasteurization of milk – milk products - nutritive value of milk.

Self-study – Pasteurization of milk

REFERENCES:

- 1. Vasantharaj David, B. and Kumaraswami T., 1998. Elements of Economic Entomology Pop. Book Depot. Chennai.
- 2. GangaandSulochanaChetty J.G. (2005)An introduction to sericulture, second edition, Oxford & IBH Publishing & Co. Pvt. Ltd., New Delhi.
- 3. Reddy, S. G., (1994) Silkworm Breeding, Oxford & INH Publishing Co Pvt. Ltd., New Delhi.
- 4. Boraiah, G. (1994) Lectures on Sericulture, SBS Publishers distributors, Bangalore.

(12 HRS.)

(12 HRS.)

(12 HRS.)

- 5. Krishnaswamy S., (1988)*Sericulture Manual* 1, 2 &3, FAO Publications, New Delhi.
- 6. Jhingran, V.G., (1975) *Fish and Fisheries of India*, Hindustan publishing corporation, India.
- 7. Rath, A.K., (2011) Freshwater Aquaculture, Scientific publishers, Jodhpr, India.
- 8. Uma Shankar Singh, (2008) *DairyFarming*, Anmol Publications, New Delhi.
- 9. ICAR, Hand book of Animal Husbandry, The Indian Council for Agricultural Research, New Delhi.
- N. Nagaraja and D.Rajagopal, (2009). Honey Bees- Diseases, Parasites, Pests, Predators & their management, MJP Publishers, Chennai.

11.R. C. Mishra, (1998) *Perspectives in Indian Apiculture*, Agro Botanica, New Delhi.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Compare the morphological adaptation in bees in relation to their social behaviour.
CO 2	Plan for a sericulture unit as a cottage industry.
CO 3	Analyse the rearing methods of prawn and pearl oysters.
CO 4	Discuss the rearing methods of chick.
CO 5	Find the feed formulations for chick.
CO 6	Assess the commercial importance of dairy farm

II M.Sc., ZOOLOGY

SEMESTER -IV

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19PG4ZE 4	Ethology	PG Major Elective	4 Hrs.	4

COURSE DESCRIPTION

Students gain knowledge on learning, behaviour and biorhythm in animal.

COURSE OBJECTIVES

- Acquire fundamental knowledge on the behavioural concept in animals
- Understand the environment, social and reproductive behaviour in animals
- Summarize the phenomenon behind the molecular basis of biological rhythm including circadian.

UNIT –I INTRODUCTION TO ETHOLOGY

Introduction -Ethology and Animal psychology. Classification of behavioral patterns: Analysis of behaviour (ethogram) - Reflexes and complex behaviour. Perception of the Environment: Mechanical, Electrical, Chemical, Olfactory, Auditory and Visual. Neural and Hormonal Control of behaviour; Role of nervous system in mergence of behavioural patterns; Role of endocrine secretions in behavioural expressions. Genetic and environmental components in the development of behaviour.

Self - study - Introduction to Ethology and Animal psychology. Perception of the Environment: Mechanical, Electrical, Chemical, Olfactory, Auditory and Visual.

UNIT -II COMMUNICATION AND LEARNING

(12 HRS.)

(12 HRS.)

Communication: Importance – types - components and evolution of communication. Role of Visual & auditory systems, hormones & pheromones in communication.Language of communication - invertebrates and vertebrates. Learning and instincts: conditioning, habituation, sensitization, reasoning. Innate releasing mechanisms: key stimuli, stimulus filtering, supernormal stimuli, open and closed IRM, mimetic releaser, code breakers.

Self - study - Communication: Importance

UNIT -III REPRODUCTION AND SOCIAL BEHAVIOUR (12 HRS.)

Reproductive Behavior: Evolution of sex and reproductive strategies, Mating systems, courtship. Sexual selection: intra sexual selection (male rivalry), inter-sexual selection (female choice), infanticide, sperm competition, mate guarding, sexual selection in human, consequences of mate choice for female fitness, monogamous verses polygamous sexual conflict. Social Behavior: Aggregations – Schooling in fishes, flocking in birds, herding in mammals - group selection, kin selection. Altruism – reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call. Social organization in insects.Parental Care in Primates.

Self - study - Primates - Parental care.

UNIT -IV ECOLOGICAL BEHAVIOUR

(12 HRS.)

Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression, homing, territoriality, dispersal, host parasite relations.

Homeostasis and behaviour: motivational system, physiological basis of motivation, control of hunger drive in blow fly and thirst drive in goat, role of hormone, motivational conflict and decision making, displacement activity, models of motivation, measuring motivation. Hormones and pheromones influence on behaviour of animals.

UNIT -V CIRCADIUM RHYTHM

(12 HRS.)

Biological Rhythms: Circadian and Circannual rhythms, Orientation and navigation: Migration of fish and birds. Molecular Genetics of Circadian Rhythms- the regulation of biological clock-sleep and awake in

man.Sleeping disorders - medical diagnosis and therapy. Chronopharmacology, Chronomedicine, Chronotherapy.

Self study – Migration of fish and birds

UNIT -VI DYNAMISM (Evaluation Pattern-CIA only) (HRS.)

REFERENCES:

- 1. Agarwal V.K. (2010). Animal Behaviour (Ethology). S. Chand Publishers.
- Insect Clocks D.S., Saunders C.G.H., Steel X., Afopoulou (ed.) R.D. Lewis. (3rd Ed) 2002 Barens and Noble Inc. New York, USA.
- 3. Vinod Kumar (2002). *Biological Rhythms* .Narosa Publishing House, Delhi/ Springer-Verlag, Germany
- Jay C. D., Jennifer J., Loros, Patricia J. DeCoursey (ed). (2004). *ChronobiologyBiological Timekeeping*: Sinauer Associates, Inc.Publishers, Sunderland, MA, USA
- 5. Saunders D.S., Steel C.G.H. (2002). *Insect Clocks* Afopoulou (ed.)R.D. Lewis. (3rdEd) Barens and Noble Inc. New York, USA
- 6. Manning A. and Dawkins M.S, (2012). *An Introduction to Animal Behaviour*, Cambridge, University Press, UK.
- 7. John A. (2001). Animal Behaviour, Sinauer Associate Inc., USA. 7th Ed.
- 8. Paul W. S and John A. (2013). *Exploring Animal Behaviour*, Sinauer Associate Inc., Massachusetts, USA. 6th Ed.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Classify different patterns of genetic, environmental, neural and
	normonal animal behaviour
<u> </u>	Explains the role of visual, auditory communication with respect
CO 2	to learning and instincts mechanism
CO 3	Discuss the various reproductive and social behaviours in context to pair selection.
CO 4	Summarizes the ecological condition such as hunger, thirst, territories etc., in influencing the animal behaviour.
CO 5	Compare the circadium and cirannual behaviour
CO 6	Elaborate the molecular regulation of circadian rhythm

II M.Sc., ZOOLOGY SEMESTER -IV

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE	CATEGO	HRS/WEE	CREDIT
ME CODE	CODE	TITLE	RY	K	S
PSZO	19 PG4Z19	Lab In Environment al Biology & Development al Biology	PG Lab	4	2

COURSE DESCRIPTION

This course provides knowledge about the relationship between organisms and their environment. It also helps to learn about development of organisms.

COURSE OBJECTIVES

- Enable the students to estimate the physico-chemical parameters of soil and water.
- Observe the different developmental stages of chick embryo and record it.
- Understand the life cycle of *Drosophila melanogaster* by rearing them and record the observation.

UNITS

Ecology

- 1. Study of Pond/ River ecosystem Food web and food chain
- 2. Determination of chlorides in soil
- 3. Estimation of Primary Productivity
- 4. Estimation of pH of soil
- 5. Estimation of soil organic carbon
- 6. Estimation of alkalinity of soil
- 7. Estimation of alkalinity of water
- 8. Quantitative estimation of salinity, phosphates and nitrates in water samples

- 9. Estimation of Biological Oxygen Demand (BOD).
- 10. Identification of Planktonic organisms.
- 11. Observation of species using quadrat method

Field Study Report

• Visit to Pollution Control Board

Developmental Biology

- Identification of chick embryo developmental stages 24hrs, 48hrs, 72hrs, &96hrs.
- 2. Study of life cycle of Drosophila melanogaster.
- 3. Contraceptive devices.
- 4. Placenta of goat.

REFERENCES:

- 1. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.
- 2. Rajan S., Christy, S.R., (2011) Experimental procedures in Life Sciences, Anjana Book House, Chennai.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Find the primary productivity
CO 2	Demonstrate the estimation of various components of soil and water.
CO 3	Identify the zoo planktons in water sample.
CO 4	Analyse the various developmental stages of chick embryo.
CO 5	Compare the diversity of species by quadrat method.

II M.Sc., ZOOLOGY

SEMESTER -IV

For those who joined in 2019 onwards

PROGRAM	COURSE	COURSE TITLE	CATEGOR	HRS/WE	CREDIT
ME CODE	CODE		Y	EK	S
PSZO	19PG4Z20	Lab In Biotechnology, Economic Zoology & Ethology	PG Lab	4	2

COURSE DESCRIPTION

This course provides rich knowledge in isolating DNA from different sources. It also helps to observe the behavioural pattern of selected animals.

COURSE OBJECTIVES

- Students acquire hands on experience in using lab equipment.
- Gain knowledge in tissue culture and micropropagation techniques.
- Enable the students to know about chasing behaviour in fish.

UNITS

Biotechnology

- 1. Biosafety guidelines
- 2. Plant tissue culture techniques: Preparation of MS media, callus formation.
- 3. Micropropagation techniques
- 4. Isolation of genomic DNA from goat liver
- 5. Isolation of plasmid DNA from bacteria
- 6. DNA estimation using diphenylamine method
- 7. Restriction enzymes digestion of DNA.
- 8. Separation of DNA using Agarose gel electrophoresis.
- 9. Demonstration of PCR techniques
- 10. Elution of DNA from Gel

Economic zoology

11. Visit of silk farms and silk reeling weaving units in nearby areas and submission of the report.

12.Observation of larval stages of Prawn.

13.Newton's Bee hive.

14.Feeder

Ethology

15.A field study of foraging or trail making behaviour in ant species.

16.Study of nest building behaviour in birds.

17.Study of habitat selection in spiders.

18. Chasing behaviour in fish.

REFERENCES:

- 1. Sinha J., Chatterjee A.K., Chattopadhyay P., (2015) Advanced Practical Zoology, Books and Allied (P) Ltd., Calcutta.
- 2. Rajan S., Christy, S.R., (2011) Experimental procedures in Life Sciences, Anjana Book House, Chennai.

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Demonstrate the plant tissue culture technique.
CO 2	Experiment with DNA isolation
CO 3	Estimate DNA quantitatively
CO 4	Analyse Newton's bee hive
CO 5	Relate nest building in different birds

II M.Sc., ZOOLOGY

SEMESTER – III & IV

SELF-LEARNING PAPER

(For those who joined in 2019 onwards)

PROGRAM	COURSE	COURSE	CATEGORY	HRS/	CREDIT
ME CODE	CODE	TITLE		WEEK	S
PSZO	19PGSLZ1	VECTOR BORNE DISEASES	Self Learning	-	2

COURSE DESCRIPTION

The course intends to provide the epidemiology, causes, symptoms, lifecycle of causative agent and prevention of various vector-borne diseases.

COURSE OBJECTIVE/S

- To understand the biology of vectors and host-vector interactions
- To envisage the environmental factors associated with disease prevalence.

UNITS

UNIT I – AEDES MOSQUITOES

Identification of *Aedes aegypti* and *Aedes albopictus* – epidemiology, Causes, transmission cycle - clinical symptoms, prevention and control measures of Chikungunya, Dengue fever, Yellow fever, Zika virus.

UNIT II – ANOPHELES AND CULEX MOSQUITOES

Epidemiology, Causes, clinical symptoms, life cycle of causative agent, prevention and control measures of Malaria, Japanese encephalitis, Lymphatic filariasis, West Nile fever.

UNIT III – OTHER VECTORS

Biology of Sandflies – Leishmaniasis – Biology of Ticks – Crimean-Congo haemorrhagic fever – Biology of Tsetse fly – African trypanosomiasis - Scrub Typhus.

UNIT IV - PREVENTION AND CONTROL

Long-lasting insecticidal nets – indoor residual spraying – outdoor spraying – Environmental management: Reduce breeding habitats – biological control, genetic control – Waste management – Housing modifications – personal protection – medication – prophylaxis and preventive therapies

UNIT V – ENVIRONMENTAL FACTORS

Deforestation - Agriculture and animal husbandry - Water control projects -Urbanization - Loss of biodiversity -. Introduction of alien species - Climate change - Anthropogenic factors driving climate change – Direct climate change effects – indirect climate change effects.

REFERENCES

- A global brief on Vector-borne diseases (2014), WHO, WHO Press, World Health Organization, Geneva, Switzerland.
- 2. Vector Borne Diseases: Prevention, Treatment and control, Disease Prevention and Outbreak Response Cell (DPORC), Centre for Community Medicine, All India Institute of Medical Sciences, New Delhi
- **3.** Benelli, G. and Mehlhorn H. (2018) *Mosquito-borne Diseases Implications for Public Health*, Springer Nature Publications, USA.
- 4. Tyagi BK. (2019) Vector-Borne Diseases: Epidemiology and Control Scientific Publishers, India.
- Institute of Medicine. 2008. Vector-Borne Diseases: Understanding the Environmental, Human Health, and Ecological Connections: Workshop Summary. Washington, DC: The National Academies Press.

WEB REFERENCES

1. <u>https://www.who.int/news-room/fact-sheets/detail/vector-borne-</u> <u>diseases</u>

COURSE OUTCOMES

NO.	COURSE OUTCOMES
CO 1	Describe the biology and lifecycle of various vectors
CO 2	Discuss the genome and proteins of virus transmitted by vectors
CO 3	Relate the environmental factors that increase the prevalence of vector borne diseases
CO 4	Summarize the various vector control methods and prevention of the disease
CO 5	Examine the anthropogenic factors that cause high incidence of vector-borne disease