

**S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)
PENUGONDA, W. G. Dist., A.P.**

P. G. DEPARTMENT OF ZOOLOGY & AQUACULTURE

M.Sc. ZOOLOGY & AQUACULTURE - SYLLABUS

(With effect from 2023-2024 admitted batch)

Objectives of the Course:

- i. To enrich the students' theoretical knowledge in basic, core and specialized papers of zoology and Aquaculture to develop competency in research in the field of zoology and aquaculture.
- ii. To train the students with hands on experience and enhance their critical thinking, constructive planning and analytical skills.
- iii. To train the students to acquire advanced laboratory skills required for placements.

Proposed Regulations:

1. The duration of the course is for two academic years with total four semesters. The nature of the course is full-time.

Candidates for the degree of Master of Science in Zoology & Aquaculture, shall be required to have passed the B.Sc. with zoology as one of the Subjects.

2. Intake for M.Sc. Zoology & Aquaculture each course is 36 (30 Counseling seats + 6 Management seats).
3. Mode of admission is through (APPGCET) common entrance examination and admissions through Counseling.
4. The course and scope of instruction shall be as defined in the syllabus prescribed. (Annexure-III).
5. The course will be conducted on credit system and evaluation will be on Ten point grading system (Annexure-II).
6. Candidate shall be required to take examinations at the end of each semester as specified in Annexure-I.
8. The course will be evaluated and the students will be graded on ten point scale with seven letter grades i.e., **O, A⁺, A, B⁺, B, C, P,** and **F**. A candidate shall be declared to have passed in any paper if he /she secures not less than 'P' grade in theory and not less than 'C' grade in the practicals provided the result otherwise is withheld .There is no minimum pass marks for internal assessment marks both in theory and practicals.

9. The minimum pass marks for Semester end examination is 28 (40%) and there is no minimum marks for internal examination. Candidate should get a total of 28 marks (40%) in both internal and external examinations put together. Further a candidate has to secure a minimum of 5.0 SGPA for a pass in each Semester.
10. A candidate shall be deemed to have satisfied the minimum requirement for the Award of the M.Sc. Zoology Degree.

i) If he/she is declared to have passed all the papers included in the scheme of examination

ii) If he/she secures 5.0 CGPA by the end of the fourth semester.

Further, a candidate will be permitted to choose any paper(s) to appear for improvement in case the candidate fails to secure the minimum prescribed SGPA/CGPA to enable the candidate to pass at the end of any semester examinations.

There shall not be any provision for the improvement of internal assessment marks in any theory or practical subjects in any year /semester of study.

11. The successful candidates in the M.Sc. degree examination shall be arranged in the order in which they are registered for the examination in two classes on the basis of the CGPA

Distinction – CGPA 7.0 or more

I Class – CGPA 6.0 or more but less than 7.0

II Class/Pass – CGPA 5.0 or more but less than 6.0

12. The Question paper will be set by external paper setters of other Universities and the valuation of the answer scripts will be done by External examiners at the end of each semester.
13. The practical examinations will be conducted and valued by both internal and external examiners at the end of each semester. The Project viva- voce examination will be conducted by both internal and external examiners at the end of the IV semester
14. Each practical paper carries 50 marks for external evaluation process in which both the internal and external examiners conduct the examination.
15. The Minimum attendance of 75% in theory and completion of 90% of the practical prescribed for the course is necessary for a student to qualify to attend the Semester End Examination. The Principal is authorized to condone the shortage of attendance in theory papers in deserving cases on recommendation of the Head of the Department, by collecting prescribed fee. However, the student should have to put in a minimum attendance of 65% in aggregate of the total number of instructional days in theory classes.

Annexure-I

M.Sc. ZOOLOGY & AQUACULTURE

SCHEME OF INSTRUCTION AND EXAMINATION

Semester – I

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23ZAQT11	Tools and Techniques for Biology	4	--	--	4	30	70	3 hours	100
Paper-II 23ZAQT12	Biosystematics, Biodiversity and Evolution	4	--	--	4	30	70	3 hours	100
Paper-III 23ZAQT13	Biomolecules	4	--	--	4	30	70	3 hours	100
Paper-IV 23ZAQT14	Molecular Cell Biology	4	--	--	4	30	70	3 hours	100
Practical-I 23ZAQP15	Tools and Techniques for Biology Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23ZAQP16	Biosystematics, Biodiversity and Evolution Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23ZAQP17	Biomolecules Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23ZAQP18	Molecular Cell Biology Lab	--	--	3	2	15	35	3 hours	50

CIA – Continuous Internal Assessment, **SEE** – Semester End Examination

Semester – II

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23ZAQT21	Biostatistics & Bio-informatics	4	--	--	4	30	70	3 hours	100
Paper-II 23ZAQT22	Animal Physiology	4	--	--	4	30	70	3 hours	100
Paper-III 23ZAQT23	Immunology	4	--	--	4	30	70	3 hours	100
Paper-IV 23ZAQT24	Molecular Biology	4	--	--	4	30	70	3 hours	100
Practical-I 23ZAQP25	Biostatistics & Bio-informatics Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23ZAQP26	Animal Physiology Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23ZAQP27	Immunology Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23ZAQP28	Molecular Biology Lab	--	--	3	2	15	35	3 hours	50

Semester – III

ZOOLOGY

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23ZOOT31	Applied Zoology	4	--	--	4	30	70	3 hours	100
Paper-II 23ZOOT32	Developmental Biology	4	--	--	4	30	70	3 hours	100
Paper-III 23ZOOT33	Principles of Ecology	4	--	--	4	30	70	3 hours	100
Paper-IV 23ZOOT34	Metabolic Cell Function & Regulation	4	--	--	4	30	70	3 hours	100
Practical-I 23ZOOP35	Applied Zoology Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23ZOOP36	Developmental Biology Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23ZOOP37	Principles of Ecology Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23ZOOP38	Metabolic Cell Function & Regulation Lab	--	--	3	2	15	35	3 hours	50

CIA – Continuous Internal Assessment, **SEE** – Semester End Examination

Semester – IV**ZOOLOGY**

Paper / Paper Code	Title of the Paper	Instruction Hours Per Week			Credits	Evaluation			Total Marks
		L	T	P		CIA Marks	SEE		
							Marks	Duration	
Paper-I 23ZOOT41	Neurobiology & Animal Behavior	4	--	--	4	30	70	3 hours	100
Paper-II 23ZOOT42	Animal Cell Culture & Stem Cell Technology	4	--	--	4	30	70	3 hours	100
Paper-III 23ZOOT43	Aquaculture	4	--	--	4	30	70	3 hours	100
Paper-IV 23ZOOT44	Animal Biotechnology & Bio-ethics	4	--	--	4	30	70	3 hours	100
Practical-I 23ZOOP45	Neurobiology & Animal Behavior Lab	--	--	3	2	15	35	3 hours	50
Practical-II 23ZOOP46	Animal Cell Culture & Stem Cell Technology Lab	--	--	3	2	15	35	3 hours	50
Practical-III 23ZOOP47	Aquaculture Lab	--	--	3	2	15	35	3 hours	50
Practical-IV 23ZOOP48	Animal Biotechnology & Bio-ethics Lab	--	--	3	2	15	35	3 hours	50
Project 23ZOOP49	Project work & Viva				4				100

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23ZAQT11 TOOLS AND TECHNIQUES FOR BIOLOGY

UNIT – I

Assays- Chemical and Biological assay, Centrifugation, Working Principle and applications of Centrifugation; differential and density gradient centrifugation, Ultrafiltration. Electrophoresis – Electrophoresis, Agarose Gel electrophoresis, 2- D Electrophoresis working Principle, structural components and applications of electrophoresis. pH meter: Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes.

UNIT-II

Chromatography-Working Principle and applications of chromatography, Chromatography Planar chromatography (paper & TLC), Gas Chromatography (GC-MS), High Performance Liquid Chromatography (HPLC), and LC-MS. Spectrophotometer - UV-visible, fluorescence, circular dichroism, absorption spectrophotometry principles and applications, NMR and ESR spectroscopy.

UNIT – III

Microscopy - Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells. Principle and applications of different types of microscopes - Light, Phase Contrast, Fluorescence microscopy. Electron microscopy: SEM, TEM and Atomic force microscopy (AFM). Image processing methods in microscopy: Image acquisition- 2D image techniques- 3D image techniques- Analysis.

UNIT – IV

Microtomy- Working principle and different types of Microtomes. Knives and Blades. Tissue embedding (paraffin wax), Section cutting, Flootation (water bath), slide mounting, drying (oven or hot plate) and section adhesives. Applications of microtomy in biological studies: Traditional Histology Technique-Frozen section procedure- Electron Microscopy Technique- Spectroscopy Technique. Cryotechniques- History and applications of Cryotechniques for light and electron microscopy. Different fixation and staining techniques for EM, freeze-etch and freeze fracture methods for EM.

UNIT-V:

Media preparation & Sterilization, Inoculation and growth monitoring. Biochemical Mutants and their use, Microbial assays.

Suggested Readings

1. Principles and Techniques of Biochemistry and Molecular Biology, Wilson K and Walker J.M. Cambridge University Press
2. Biophysical & Biochemical Techniques, Wilson K and Walker J.M.,
3. Laboratory Exercises and techniques in Cellular Biology, Anthony Contan to Wiley Publ.2012
4. Histological & Histochemical methods: Theory and Practice, Kiernan J.A. Scion Publ.
5. Histochemistry: Pearse A.G.E, Garfield.
6. Animal cell culture - A practical approach, Ed. John R.W. Masters, IRI Press.
7. Introduction to Instrumental Analysis. Robert Braun. McGraw Hill International Edition.
8. A Biologist Guide to Principles and Techniques of Practical Biochemistry. KWilson & K.H. Goulding, ELBS Edition. Student Learning Outcomes: LO1. Student will learn about the basics of most often used tools, techniques, methodologies and methods of analysis used in biological research.

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23ZAQT12 BIOSYSTEMATICS, BIODIVERSITY AND EVOLUTION

UNIT – I

Definition & basic concepts of biosystematics & taxonomy, Importance and applications of biosystematics in biology, Material basis of biosystematics. Theories of biological classification (Essentialism, Nominalism, Empirism, Cladism). Chemotaxonomy; Cytotaxonomy; Molecular taxonomy; Eco - taxonomy and Behavioral taxonomy

UNIT-II

Taxonomic procedures – taxonomic collections, preservation, curation of animals and Process of identification. Preservation of specimens. Taxonomic Keys - Procedure keys in taxonomy, Types, merits & demerits. Systematic publications – different kinds of publications, Process of typification and different Zoological types. International code of Zoological Nomenclature (ICZN) - Operative principles, Interpretation and application of important rules, Zoological nomenclature, formation of scientific names of various taxa. Interpretation of rules of nomenclature.

UNIT – III

Sustainable utilization of Biodiversity - Origin of biodiversity, Types of biodiversity & ecosystem, Threats of biodiversity. Equitable sharing & conservation of Biodiversity (in-situ & ex-situ & gene banks). Genetic Variations & Non genetic Variations - Molecular perspectives on conservation of Biodiversity, Hierarchy of categories.

UNIT – IV

Species Concept - Different species concepts - Typological, Nominalistic, Biological & evolutionary species concept. Sub-species and other infra specific categories, Polytypic species. Speciation – Allopatric, Sympatric & Parapatric speciation, and factors affecting speciation. Concept of Oparin and Haldane. Experiment of Miller. Evolutionary time scale – Eras, Periods and epochs.

UNIT – V

Concepts of evolution – An overview of evolutionary biology, & theories of organic evolution. Concepts of Neutral Evolution, Population genetics- Populations, gene pool, Gene frequency; Hardy Weinberg law. Concepts and rate of change in gene frequency through Natural selection, mutation, migration and random genetic drift. Phylogenetic gradualism, punctuated equilibrium and origin of higher categories.

Suggested Readings

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. G.G. Simpson, Principle of Animal taxonomy, Oxford IBM Publishing Company.
4. E.O. Wilson. The diversity of Life (The College Edition), W.W. Northern & Co.
5. B.K. Tikadhar, Threatened Animals of India, ZSI Publication Calcutta.
6. Mayr, E. 1969. Principles of Systematic Zoology. McGraw-Hill, N.Y.
7. Mayr, E. 1970. Populations, species and evolution, Cambridge Mass, Harvard Univ. Press.
8. Ferguson, A., 1976. Biochemical systematics and evolution, John Wiley and Sons, N.Y., Toronto.
9. Gote, H.E. 1982. Animal Taxonomy.
10. Mayr, E. & E. Aschok. 1991. Principles of systematic, McGraw Hill Book Co. London.
11. Minell, A. 1983. Priological systematics, The state of Art champan of Hill, London.
12. Quicke, D.L.J. 1996. Principles and Techniques of contemporary Taxonomy. Blacky Academic and Professional, London, New York.
13. Sebu, R.T. 2000. Biological systematics: Principles & Application, Cornell University Press.

Learning Outcomes: After completion of this course, students are able to

LO1. Classify animals on the basis of their relation to other animals by body structure, external characters,

development and DNA

LO2. Apply the International rules of nomenclature to give a scientific name to animals which are found

during research.

LO3. Understand the gradual development and evolutionary history of different kinds of living organisms

from earlier forms over several generations

LO4. Understand and demonstrate various animals, biodiversity and relate

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23ZAQT13 BIOMOLECULES

UNIT- I

Biomolecules- chemical composition and bonding , chemical reactivity , ionization of water. Weak acids and weak bases (pH) , buffers: buffering in biological systems, Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of bioenergetics – Principles and Laws of thermodynamics, reaction kinetics, colligative properties and their applications in biological system : entropy and enthalpy.

UNIT - II

Chemical foundations of biology, Amino acids – classification, Peptide bond, Proteins – classification, structural organization of proteins, primary structure, secondary structure, tertiary structure, quaternary structure, Conformation of proteins (Ramachandran plot) - domains, motifs and folds. Denaturation & renaturation of proteins.

UNIT - III

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Mono-saccharides, Acid derivatives of Mono-saccharides, amino-sugars, Oligo-saccharides, structure and properties, Chemistry and biological roles of homo and hetero-polysaccharides, peptidoglycan, glycosaminoglycans, glycoproteins and other glycoconjugates.

UNIT - IV

Classification of Lipids & Fatty acids and their physicochemical properties, characterization of fats and oil; Structure, properties and biological roles of triacylglycerol, phospholipids, sphingolipids, Gangliosides, Prostaglandins, Thromboxanes, Leukotrienes and steroids.

UNIT - V

Nucleic acids – nitrogen bases, nucleosides, nucleotides, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic and non-enzymatic methods, chemical synthesis of DNA; Nucleic acid sequencing, chromatin structure, Three dimensional structure of DNA; Types of RNA, Structure of RNAs – Secondary and Tertiary structure; DNA denaturation and renaturation.

Suggested Reading Material:1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. Freeman.

2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry, McGraw Hill.

3. Fundamentals of Biochemistry by Donald Voet.

4. Textbook of Biochemistry West, E.S., Todd, Mason & Vanbruggen, Macmillian&Co.

5. Biochemistry, Lubert Stryer.

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23ZAQT14 MOLECULAR CELL BIOLOGY

UNIT - I

Biomembranes

Molecular composition and arrangement, functional consequences Transport across cell membrane: diffusion, active transport, pumps, uniports, symports and antiports Membrane potential Co-transport by symporters or antiporters Transport across epithelia: Transport of macromolecules

UNIT - II

Cytoskeleton

Microfilaments and microtubules – structure and dynamics, Microtubules and mitosis Cilia and flagella. Cell movements – intracellular transport, role of kinesin and dynein, signal transduction mechanisms.

UNIT - III

Cell-Cell Signaling

Cell surface receptors, Second messenger system, MAP kinase pathways

Apoptosis: Definition, mechanism and significance

UNIT – IV

Cell-Cell adhesion and communication

Ca⁺⁺ dependent homophillic cell-cell adhesion, Ca⁺⁺ independent homophillic adhesion, Gap junctions and connections, Integrins, Collagen.

Cell cycle : Cyclins and cyclin dependent kinases, Regulation of CDK-cycline activity

UNIT-V

Genome organization, . Hierarchy in organization, Chromosomal organization of genes and non-coding DNA, , Mobile DNA, Morphological and functional elements of eukaryotic chromosomes, Intracellular protein traffic. Protein synthesis on free and bound polysomes, Uptake into ER,

Membrane proteins, Golgi sorting, post-translational modifications, Biogenesis of mitochondria and nuclei, Trafficking mechanisms

Suggested Reading Material:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore, Scientific American Book INC, USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson Garland Publishing INC, New York.

I SEMESTER PRACTICALS

23ZAQP15 Tools and Techniques for Biology lab:

1. Spectrophotometer – Estimation of biomolecules
2. Centrifugation – Demonstration and working
3. Separation Techniques - Paper chromatography
4. Electrophoresis – Demonstration and usage
5. PH Meter – Preparation of Phosphate buffer Preparation
6. Microscope –
 - a) Demonstration of oil immersion – WBC & RBC
 - b) Preparation of tissue for SEM & TEM procedure

23ZAQ16 Biosystematics, Biodiversity and Evolution Lab:

1. Invertebrate and Vertebrate Phyla
2. Types of Speciation-Models/Charts
3. Problems on Hardy-Weinberg law
4. Random genetic drift causing change in gene frequency-Practical demonstration.
5. Recent studies in Evolution- Examples

23ZAQP17 Biomolecules lab:

1. Estimation of glycine by formal titration
2. Estimation of proteins by Lowry and Biuret methods
3. Analysis and identification of monosaccharides
4. Estimation of maltose by DNS method
5. Determination of Iodine value of oils
6. Estimation of Cholesterol
7. TLC of Amino acids

23ZAQ18 Molecular cell Biology lab:

1. Light microscopic examination of tissues
2. Preparation of different cell – types Hepatic parenchymal cells, adipocytes, macrophages, neuronal cells, epithelial cells
3. Stages of Mitosis and Meiosis
4. Squash preparation
5. Sub-cellular fractionation – separation of macromolecules

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23ZAQT21 BIOSTATISTICS & BIOINFORMATICS

UNIT - I

Biostatistics- Introduction and Scope of biostatistics, Sampling. Primary and Secondary data, Frequency distribution, Graphic representation of data- bar diagram, histograms, pie diagram, frequency polygon and Ogive.

UNIT-II

Measures of central tendency- mean, median, mode. Measures of Dispersion- variance, standard deviation, coefficient of variation

UNIT - III

Probability and probability distributions-definition of probability - Bernoulli, binomial, Poisson and normal distributions; Correlation and regression Tests of Significance - hypothesis, critical region and error probabilities, t- test, chi-square test for independence, one way and two- way analysis of variance.

UNIT - IV

Basic components of computers– hardware (CPU, input, output, storage devices), Software (operating systems), Application software; Introduction to MS-EXCEL. Use of bar diagram, histogram, scatter plots, Graphical tools in EXCEL for presentation of data; Introduction to MS- WORD, word processor- editing, copying, moving, formatting, table insertion, drawing flow charts etc; Introduction to Power Point, image and data handling.

UNIT - V

Bio-informatics –Introduction, History, Internet, Knowledge. Review of relevant definitions in molecular biology. Biological Databases –introduction. Examples of databases together with steps involved in use and interpretation of results). Sequence alignment. Phylogenetic analysis with the program PHYLIP, Introduction to computational genomics and proteomics

Suggested Reading Material:

1. Batschelet, E., Introduction to Mathematics for Life Scientists. Springer- Verlag, Berlin.
2. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA
3. Murray, J.D. Mathematical Biology. Springer – Verlag, Berlin.
4. T.K. Attwood & D.J. Parry-Smith 1999. Introduction to Bioinformatics. Pearson Education Asia.

5. Stephen Misener & S.A. Krawez 2000. *Bioinformatics: Methods and Protocol*.
6. *Bioinformatics: Sequence and Genome Analysis*, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA
7. *Bioinformatics for Dummies*, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, USA
8. Sokal, R.R. & F.J. Rohlf. *Biometry*. Freeman, San Francisco.
9. Snedecor, G.W. and W.G. Cochran, *Statistical methods for environmental biologists*. John Wiley Sons, New York

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23ZAQT22 ANIMAL PHYSIOLOGY

UNIT - I

Muscle: Molecular Structure and properties of Muscle and muscle contraction , Sliding filament theory

Blood and Circulation – Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, Blood groups, Haemoglobin, immunity, haemostasis , factors affecting blood coagulation.

UNIT-II

Nerve impulses , Synaptic transmission & Neurotransmitters, Nervous system : Neurons, action potential, gross neuro anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture

Sensory physiology: Photoreceptors, Auditory, Chemoreceptor, Mechanoreceptors

UNIT - III

Thermoregulation: Comfort zone, body temperature- Physical, chemical, neural regulation, acclimatization.

Osmoregulation in aquatic and terrestrial Environments mechanism of ionic regulation

Stress Physiology: Responses to biotic and abiotic factors: Light, temperature, salts

UNIT – IV

Digestion: absorption, energy balance of BMR

Respiratory system - comparison of respiration in different species, anatomical considerations, transport of gasses, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Excretory System : Comparative physiology of excretion, Kidney, Urine formation, Urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue ECG - its principle and significance, heart as a pump, blood pressure.

UNIT - V

Physiological Adaptation: Marine environment, shores, Estuaries Fresh water and Terrestrial environment

Role of Yoga and meditation on Health.

Suggested Reading Material:

- 1) Eckert, R .Animal Physiology: Mechanisms and adaptation, W .H.Freeman and Company, New York
- 2) Hochackka,P.W. and Somero, G.N.Biochemical adaptation,Princeton,N.J.
- 3) Hoar,W.S.General and comparative Animal physiology prentice Hall of India.
- 4) Schimdt Neisen,Animalphysiology ,Adaptation and Environment,Cambridge.
- 5) Stamd,F.L.Physiology: A regulatory systems approach,Macmillan publishing Co., NewYork.
- 6) Punmer, L.Practical Biochemistry,Tata McGraw-Hill.
- 7) Prosser,C.L. and Brown .Comparative Animal physiology.
- 8) Wilson,K.and Walker, j.Practical Biochemistry.
- 9) Willmer, PIG Sone and I.Johnson, Environmental physiology,BlackWell Science,Oxford, U.K .944p
- 10) Newell,R.C.(ed)1976.Adaptation to environment, Essays on the physiology of marine animals.
Butterworths,London,UK539pp
- 11) Townsend ,C.R and P.Callow, physiological Ecology An evolutionary approach resource use,
Blackwell Sci.publication, Oxford, UK

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23ZAQT23 IMMUNOLOGY

UNIT - I

Immunity-innate and acquired, innate immune mechanisms, acute phase reactants, properties of acquired immunity, Immunogens and antigens- Properties, factors governing immunogenicity, haptens, epitopes size and identification. Adjuvants- properties and mechanism of action.

Immunoglobulins- structure, isotypes, allotypes and idiotypes. Functions of antibody in relation to structure

UNIT - II

Antigen-antibody interactions- affinity of antibody, avidity, bonus effect, classical precipitin reaction, antigen-binding site of antibody, forces involved in antigen - antibody complex formation. Lymphoid tissue- primary and secondary lymphoid organs, structure and cellular organization. Lymphocyte traffic. Cells involved in the immune response- T cells, B cells, CD antigens, neutrophils, eosinophils and natural killer cells.

UNIT-III

Antigen presentation - pathways of antigen processing and presentation of intracellular and extracellular antigens.

Antibody response - Primary and secondary antibody response, antibody response to haptens, enumeration of antibody-forming cells, T- dependent and T- independent antigens. Macrophage- role in immune response and activation.

UNIT-IV

Cell mediated immunity- helper, cytotoxic, suppressor T cells. In vivo and in vitro assays for assessment of cell mediated immunity

Complement- classical and alternative pathways of activation. Regulation of complement activation and functions.

Antigen receptors -On T and B cells. Generation of receptor diversity.

UNIT - V

Development of immune system- T cell ontogeny in thymus, thymic hormones, cell development. Immunological tolerance - pathways of tolerance and mechanisms of tolerance in T and B cells. Immunological tests- Immunodiffusion, immunoelectrophoresis, immunofluorescence, radioimmunoassay and enzyme-linked immunosorbent assay.

Suggested Reading Material:

1. Immunology and Immunopathology by Stewart.
2. Cellular and Molecular Immunology by Abul K. Abbas et. al.
3. Textbook of Immunology by Barret.
4. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company (5th Ed),
Mosby (6th Ed).
5. Immunology by Kuby, Richard A. Goldsby, Thomas, J. Kindl, Barbara A. Osborne,
Freeman & Company, Mosby publishers.
6. Immunobiology – The immune system in Health disease by Janeway and Travers.
7. Immunology – An introduction by Tizard.
8. Text book of Immunology by Unani and Benacerraf.
9. Fundamentals of Immunology by Paul.
10. Immunology – A short course by Benjaini, Sunshine and Lesrowitz.

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23ZAQT24 MOLECULAR BIOLOGY

UNIT - I

History and scope of Molecular Biology DNA Structure and Replication Prokaryotic and Eukaryotic DNA Replication Mechanics of DNA Replication Enzymes and accessory proteins involved in DNA Replication

UNIT - II

Transcription Prokaryotic Transcription Eukaryotic Transcription RNA Polymerases Post-transcriptional modifications in RNA Cap formation Transcription Nuclear Export of m-RNA

UNIT - III

Translation Genetic Code Prokaryotic and eukaryotic Translation Mechanisms of initiation, elongation and termination Regulation of translation Antisense and Ribozyme technology Molecular mechanisms of antisense molecules Inhibition of splicing, polyadenylation and translation

UNIT – IV

DNA damage - DNA damaging agents, Physical, chemical and biological mutagens; types of damage caused by endogenous and exogenous agents, Molecular mechanisms of mutagenesis – Transition, Transversion, Frame Shift, mis-sense and non-sense mutations

Recombination and Repair Holiday junction, gene targeting and gene disruption RecA and other Recombinases DNA repair mechanisms

UNIT-V

Molecular mapping of genome Genetic and physical maps Physical mapping and map-based cloning

Southern fluorescence insitu hybridization (FISH) for genome analysis

Suggested Reading Material:

1. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular biology of Gene. The Benjamin/Cummings Pub. Co. Inc., California.

2. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular

Biology of the Cell. Garland Publishing Inc., New York.

3. Benjamin Lewin, Gene IV, Oxford University Press, U.K.

4. Meyers, R.A. (Eds.) Molecular Biology and Biotechnology : A comprehensive desk reference. VCH Publishers Inc., New York.

5. Sambrook, J., E.F. Fritch and T. Maniatis. Molecular cloning : A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.

6. Daber, P.D. Introduction to practical Molecular Biology. John Wiley & Sons Ltd., New York.

7. Brown, T.a. (Eds.). Molecular Biology Lab Fax. Bios Scientific Publishers Ltd., Oxford

II SEMESTER PRACTICALS

23ZAQP25 Biostatistics & Bioinformatics lab:

1. Sampling and Frequency distribution
2. Graphical presentation of the data
3. Measures of Central Tendency – Mean, median and mode
4. Measures of Dispersion – Standard deviation and Coefficient of variation
5. Correlation and Regression
6. Nucleic acid and protein databases.
7. Retrieval and analysis of DNA or protein sequence from NCBI
8. Sequence Alignment in excel sheet for data processing.

23ZAQP26 Animal Physiology lab:

1. Digestive enzymes
2. Effect of body size vs oxygen consumption
3. oxygen consumption vs temperature
4. Osmotic regulation
5. Ion concentration measurements
6. Spotters
7. Dissection- Pituitary gland of fish
8. Dissection- Nervous system of prawn.

23ZAQP27 Immunology lab:

1. Blood grouping
2. Widal test for detection of typhoid bacteria
3. VDRL Test
4. SRID
5. Ouchterlony DID
6. Immunoelectrophoresis
7. Blood clotting time and bleeding time.
8. RIA -Demonstration
9. ELISA - Demonstration

23ZAQP28 Molecular Biology Lab:

1. Estimation of DNA (Colorimetric method)
2. Estimation of RNA in tissue (Colorimetric method)
3. Fulgen reaction method for DNA localization
4. Localization of RNA by methyl green pyronin – ‘Y’
5. SDS PAGE of serum proteins.
6. Testing purity of DNA 19

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THIRD SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT31 APPLIED ZOOLOGY

UNIT - I

Microbial fermentations: Batch, continuous culture techniques, Design, operation, principle and types of fermenters and biosensors. Industrial production of chemicals - solvents (alcohol), acids (citric, lactic), antibiotics (penicillin and streptomycin), Vitamins (Riboflavin and Vitamin B12), amino acids (lysine and glutamic acid), Single Cell Protein (SCP).

UNIT - II

Animal Breeding: Principles, Structure of livestock breeding – poultry, sheep and cattle. Marker - assisted selection. Artificial insemination (AI) techniques, *in vitro* fertilization. Preservation of endangered species. Germplasm bank.

UNIT - III

Production of transgenic animals and their applications: mice, sheep and fish. Molecular farming and animal cloning. Somatic cell nuclear transfer in humans – Legal and ethical aspects. Potential applications of transgenic animals – Animal models for diseases and disorders.

UNIT - IV

Bioremediation - solid and liquid waste treatment. Biomass and energy production from waste. Bioleaching – Microbial recovery of metals and acid mine drainage. Water pollution and its control. Microbiological approach of waste water treatment.

UNIT - V

Biofertilizers – Blue green algal fertilizers – Azolla, Anabaena, symbiotic association. Sea weed fertilizers. Mycorrhizal biofertilizers, bacterial fertilizers. Biopesticides in agricultural production.

Suggested Reading Material:

1. Fermentation Technology, Standury (Pergman press)
2. Industrial Microbiology, L.E.Casida, JR. New Age International.
3. Industrial Microbiology by Presscot and Dunn.
4. Biotechnology by BD Singh (Kalyani).
5. Plant Biotechnology by A. Slater, N.W. Scott and M.R. Fowler (Oxford University press).
Biotechnology in Agriculture by Swaminathan, M.S (Mc. Millan India Ltd).
6. Biotechnology and its applications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).

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THIRD SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT32 DEVELOPMENTAL BIOLOGY

UNIT - I

Gametogenesis, Fertilization and Cleavage:

Introduction to animal development, pattern of embryonic development, Fertilization (species specific recognition of egg and sperm, acrosome reactions, fast and slow block to polyspermy); oogenesis & gameto genesis. Cleavage (patterns, molecular mechanism of cleavage)

UNIT - II

Early embryonic Development:

Gastrulation (frog, chick) Neurulation (Establishment of neural tube, Tissue architecture of CNS, cerebral organization, differentiation of neural tube, neurons and neural crest cells); Specification of cell fate and cellular basis of morphogenesis, Autonomous development, Regulative development, Syncytial development.

UNIT - III

Organogenesis:

Mechanism of cellular differentiation – Ectoderm (CNS and Epidermis), Mesoderm (Chorda Mesoderm, paraxial, intermediate and lateral plate mesoderm) and Endoderm (digestive tube and its derivatives).

UNIT -IV

Cell-cell communication, Development during organ formation: introduction and competence, paracrine and other factors (the inducer molecules), Signal transduction cascades. Birth defects -Malformations & Disruptions. Regeneration of organs.

UNIT - V

Collection and cryopreservation of gametes and embryos.

Multiple ovulation and embryotransfer technology (MOETT) (Superovulation, In vitro oocyte maturation, In vitro fertilization, embryo transfer).

Transgenic animals and knockouts: Production & Applications.

Embryonic stem cells.

Suggested Reading Material:

1. Scott F. Gilbert. Developmental Biology, Latest Edition, Sinauer Associates, Inc., Publishers Sunderland, Massachusetts, USA
2. L. Wolpert Rosa Beddington Thomas M. Jessell Peter Lawrence Elliot M. Meyerozitz and Jim Smith (2002) Principles of Development Lates Edition Oxford University Press.
3. JMW Slack (2005) Essential Developmental Biology Latest Edition Blackwell Publishing Australia.
4. Mac E. Hadley Endocrinology Sixth Edition Prentice hall International, Inc. Arizona (For Section 9).
5. Medical Implications of Developmental Biology 21

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THIRD SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT33 PRINCIPLES OF ECOLOGY

UNIT - I

Introduction to Ecology, Environmental concepts, Ecosystem structure and function-Biotic and Abiotic environments. Habitat and Ecological Niche. Dynamics of ecosystem- energy flow, food chain, food web, Ecological pyramids. Concepts of primary productivity. Mineral cycling.

UNIT - II

Population Ecology- Characteristics of population. Population growth. Growth models. Optimal yield. Life histories strategies(r and K Selection). Intraspecific and Interspecific interactions.

UNIT - III

Concept of metapopulation. Population Demography and life tables- mortality, natality, age structure, fecundity, net reproductive rate
Evolutionary ecology. Community ecology- Nature of communities. community structure and attributes. Community composition.

UNIT - IV

Concept of Ecological succession. Patterns of biodiversity, Latitudinal and altitudinal gradients: Theory of Island biogeography. Biogeographic realms of the world. Biogeographic zones of India and faunal diversity. Hotspots the world & in India.

UNIT - V

Environmental stress- environment pollution. Major drivers of bio-diversity change. Biodiversity status, Monitoring and documentation. Biodiversity conservation-Threats, major approaches to management. IUCN classification of wild life. Indian case studies on conservation/management strategy. Concepts of sustainable development.

Suggested Reading Material:

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford, UK.
2. Koromondy, E.J. Concepts of ecology. Prentice Hall, New Delhi.
3. Clarke, G.L. Elements of Ecology, John Wiley & Sons, New York.
4. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, Philadelphia.
5. Krebs, C.J. Ecology. Harper & Row, New York.
6. Chapman JL and Reiss MJ. 1995. Ecology Principles and Application. Cambridge University Press.
7. Trivedy RK, Goel and Trisa. 1997. Practical methods in Ecology & Environmental Science.
8. Agarwal KC. 1998. *Biodiversity*. India.
9. Peggy I. Fieldler and Perer M. Kareiva. 1997. *Conservation Biology*.
10. Prabodh K. Maiti and Paulami Maiti. 2011. *Biodiversity: Perception, Peril and Preservation*.
11. Saharia VV. 1982. *Wildlife in India*. Natraco Publishers, Dehradun.

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THIRD SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT34 METABOLIC CELL FUNCTIONS & REGULATION

UNIT - I

Thermodynamic principles and steady-state conditions of living organisms

Organization and methods to study metabolism

Degradation of glucose, palmitic acid, phenylalanine

UNIT - II

Energy metabolism and high energy compounds

Redox potentials

Mitochondrial electron transport chain

Oxidative phosphorylation

UNIT - III

Storage and utilization of biological energy

Biosynthesis of Urea, Glucose, Glycogen, Oleic acid and prostaglandins

UNIT - IV

Nature of Enzymes

Classification and nomenclature of enzymes

Kinetic analysis of enzyme catalysed reactions

Metabolic profile of adipose, neural, hepatic, and muscle tissues

UNIT - V

Metabolic Engineering

Immobilized enzymes and their applications

Suggested Reading Material:

1. Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons
2. Foster, R.L. Nature of Enzymology
3. Lodish et. al. Molecular Cell Biology
4. Annual Reviews of Biochemistry
5. Garrett and Grisham. Biochemistry.

III SEMESTER PRACTICALS

23ZOOP35 Applied Zoology lab:

1. Production of protease/amylase by batch fermentation.
2. Selective isolation of *Actinomyces* from soil samples
3. Microbial growth curve.
4. Production of alcohol by *S.cerevisiae* and its estimation.
5. Production of streptomycin by fermentation.
6. Production of citric acid by *A.niger*.
7. Production of red wine from grapes.
8. Determination of suspended solids in industrial effluents.
9. Removal of color of the industrial effluents by biological methods.
10. Reduction of pollution load in effluents by biological methods (laboratory models).

23ZOOP36 Developmental Biology Lab

1. Estimation of shell calcium during the development of chick and its role
2. Estimation of phosphorous during the development of chick
3. Observation of spermatozoa in vertebrates
4. Effect of Iodine in the metamorphosis of frog.
5. Effects of Thyroxine in the metamorphosis of frog.
6. Preparation of sperm smear from goat testis
7. Observation of slides: Cleavage, Morula, Blastula, Gastrula
8. Neurulation slides: Neural plate, Neural fold, Neural tube.

23ZOOP37 Metabolic cell function and regulations lab:

1. Enzyme kinetics
2. Dehydrogenase assay
3. Lactic acid estimation
4. Proteins, glucose and Lipid estimations
5. DNA, RNA estimation
6. Transaminases

23ZOOP38 Principles of Ecology Lab

1. Ecosystem-structure and function-demonstration.
2. Populations interactions.
3. Local fauna- Identification. Conservation activities for any
4. Enumeration of Plankton.
5. Estimation of Population-Plant/Animal sps by quadrant method
6. Diversity indices- Abundance, dominance and Diversity
7. Creation of Life tables

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FOURTH SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT41 NEUROBIOLOGY & ANIMAL BEHAVIOUR

UNIT - I

Introduction to Neurobiology: Organization of the Brain: Functional Anatomy of the brain. Systems neurobiology – Visual systems, Hearing systems. Neurons, astrocytes, oligodendroglia, Schwann cells, microglia, ependymal cells, neuroglial cell interaction.

UNIT - II

Neuron: Passive and membrane properties, information flow in neurons, compartments, spike initiation zone. Neuron – Excitability, conductivity, Membrane potentials (Resting & Action), Single neuron recording, Patch-clamp recording, Nerve Impulse, Refractory period, The Nernst equation and Goldman equation.

UNIT - III

Neural Communication: Synapses- Electrical and Chemical synapses, Nerve-muscle synapse and signaling, Neurotransmitters (synthesis, storage and function), post-synaptic action of neurotransmitters, neuro-transmitter gated ionic channels.

UNIT - IV

Cognitive Neuroscience: Nerve cells and their network, Role of limbic System in cognition, Cognitive skills, Learning and memory- Conditioning, habituation, insight learning, association learning. Imprinting – case studies of animal models.

UNIT - V

Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behaviour; Habitat selection and optimality in foraging; Migration(Fish and bird), orientation and navigation; Domestication and behavioral changes.

Suggested Reading Material:

1. Fundamental Neuroscience by Haines, Duane E., Churchill Livingstone, New York.
2. Principles of Neural Science by Kandel Eric, James H. Schwartz, and Thomas Jessel; 4th ed. Mc Graw-Hill.
3. Basic Neurochemistry: Molecular, Cellular and Medical Aspects, by George M.D. Siegel, R. Wayne Albers, Scott Brady, Donald M. D. Price; Seventh Edition; Elsevier Academic Press.
4. Foundations of Neurobiology by Fred Delcomyn, N.Y. Freeman.
5. The Neuron: Cell and Molecular Biology 3ed by Irwin B. Levitan, Leonard K. Kaczmarek, (2002), Oxford University Press.
6. Neuroscience (Book with CD-ROM) 3ed by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Lawrence C. Katz, Anthony-Samuel LaMantia, James O. McNamara, S. Mark Williams (2004) Sinauer Assoc.,

7. Fundamental Neuroscience, 2ed by Larry R. Squire, Floyd E. Bloom, Susan K. McConnell, James L. Roberts (Editor), Nicholas C. Spitzer, Michael J. Zigmond (2002) Academic Press.
8. An Introduction to Animal Behaviour, 5th Edition by Aubrey Manning and Marian Stamp Dawkins.

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FOURTH SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT42 ANIMAL CELL CULTURE & STEM CELL TECHNOLOGY

UNIT - I

Introduction to cell and tissue culture, Components of cell culture: cell types and cell lines, different substrates, Preparation of cell lines: viral and chemical induction; maintenance of cell lines. Types of culture processes.

Cancer Biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNIT - II

Hybridoma technology: methods of cell fusion, hybrid selection, cloning and *in vitro* & *in vivo* methods of hybridoma propagation, production and characterization of monoclonal antibodies and their applications. Vaccines: Conventional, peptide and recombinant vaccines. Production and characterization of recombinant chimeric & multimeric antibodies, immunoadhesins & immunotoxins and their uses, Principle of diagnostic kit development.

UNIT - III

The biology of stem cells: Overview; types of stem cells-embryonic stem cells, fetal tissue stem cells, adult stem cells; human & animal cloning. Isolation and propagation of embryonic stem cells. Differentiation of adult stem cells,

UNIT - IV

Stem cell plasticity: self renewal potential; differentiation versus stem cell renewal; transdifferentiation. Yamanaka factors, Induced pluripotent stem cells, *Ex- vivo* expansion of haemopoietic cells for the production of blood cells and their products.

Stem cell assays and protocols: Isolation of defined stem cell populations; sources of progenitor cells, cytokine and chemotherapy approaches to mobilization of progenitor cells; flow cytometric techniques.

UNIT - V

Clinical applications of stem cell therapy: neurodegenerative diseases, tissue systems failures-diabetes, cardiomyopathy, kidney failure, liver failure, hemophilia, lymphoma and leukemic malignancies requiring stem cell therapy.

Suggested Reading Material:

1. Culture of animal cells; a manual of basic technique, 5th ed. Freshney, R. Ian.

Wiley-Liss.

2. Handbook of stem cells Volume 1 and 2 Eds Robert Lanza and others Elsevier

Academic Press.

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FOURTH SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT43 AQUACULTURE

UNIT - I

Aquaculture- History, General Principles. Types of culture systems and economics of different kinds of aquaculture and productivity of culture ponds. Biological characteristics of aquaculture species. Fish seed Resources and Transportation - Fish seed technology - natural collection, bundh breeding, induced breeding, cryopreservation of gametes. Transport of finfish and shellfish- transport of eggs, fry, fingerlings and adults. Induced breeding. Fish hatchery.

UNIT - II

Construction of fish fresh water & brackish water farms. Pond preparation- and management.-Pre-stocking and post stocking. Integrated fish farming. Indian Major carp culture, catfishes, murels and prawn culture. Ornamental fish culture

UNIT - III

Principles of fish nutrition - nutritional requirements of commercially important finfish and shellfish, feed types, feeding techniques and Feed management, role of probiotics in nutrition. Shell fish hatchery construction and management.,

UNIT - IV

Role of genetics in aquaculture– gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity *Chanos chanos*. *Lates calcarifer*. *Litopenaeus vannamei*.

UNIT - V

Water quantity management in aquaculture. Overview of fish diseases in fish and shell fish culture- common fish pathogens, routes of pathogen entry in fish, methods of colonization and spread of pathogens, immune - evasion mechanisms of fish pathogens.. General principles of Molluscan culture. Pearl Oyster culture. Seaweeds culture. Environmental impact of aquaculture- aquacultural wastes and future developments in waste minimization, environmental consequences of hyper-nutrication.

Suggested Reading Material:

1. Pillay, T.V.R. 1990. Aquaculture – Principles and Practices. Fishing News Books Survey, U.K.
2. Jhingran, V.G. 1993. Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi.
3. Ravishankar Piska, 1999. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
4. Santanam, R., Ramanathan, N. and Jegatheesan, G. 1990. Coastal Aquaculture in India. CBS Publishers & Distributors, Delhi.
5. Bardach, J.E., Ryther, J.H. and McLarney, W.O. 1972. Aquaculture. John Wiley & Sons Inc., USA.
6. Ghosh, S., Palanisamy, K. and Pathak, S.C. 1994. Shrimp and Freshwater Hatchery Public

Relations Division, National Bank for Agriculture and Rural Development, Bombay.

7. Fishponds in Farming Systems, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands

8. Aquaculture and Fisheries Biotechnology Genetic Approaches, Dunham, R. A., CABI Publishing, USA

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FOURTH SEMESTER M.Sc. ZOOLOGY

SYLLABUS

(With effect from 2023-24 Admitted batch)

23ZOOT44 ANIMAL BIOTECHNOLOGY & BIO-ETHICS

UNIT- I

Introduction to Animal Biotechnology, Recombinant DNA technology: Restriction endonucleases, Restriction maps, isolation of gene fragments using restriction endonucleases and mechanical shearing; Cloning vectors - Isolation and properties of plasmids, bacteriophage cosmids, Ti plasmid (binary vector), expression vectors, viral vectors, YAC, BAC, phagemids and vectors used for cloning in mammalian cells, Hosts - Prokaryotic: *E.coli*, *B.subtilis*, Eukaryotic: Yeast and mammalian cell lines; Ligation of fragments

UNIT - II

Gene transfer techniques: Biological and artificial delivery system, Cloning strategies, shot gun experiments, isolation of poly mRNA, synthesis of cDNA, cDNA cloning in bacteria; Genomic and cDNA libraries, Identification of recombinants - structural and functional analysis of recombinants;

UNIT - III

Design and preparation of DNA and RNA probes for hybridization, Southern and Northern blotting.

DNA sequencing methods: Maxam and Gilbert's chemical and Sanger's chain termination methods, automated DNA sequencing, Base calling and sequencing accuracy. Introduction to next generation sequencing (NGS).

UNIT - IV

DNA fingerprinting. PCR amplification and diagnosis - Applications in forensic medicine. Genetic diseases. Gene therapy- Types and use of rDNA constructs for gene therapy.

UNIT - V

Bioethics: Introduction – causes of unethical acts, ignorance of laws, policies and procedures, recognition, friendship, personal gains. Professional ethics – professional conduct. Ethical decision making, ethical dilemmas. Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory accreditation.

Suggested Reading Material:

1. Principles of Gene manipulation: An Introduction to genetic Engineering. R.V.Old and S.B.Primrose (Blackwell Scientific Publications).
2. Biotechnology by B.D.Singh (Kalyani).
3. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
4. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).
5. Bioethics and Biosafety in Biotechnology by V. Sree Krishna, New Age International Publishers.

IV SEMESTER PRACTICALS

23ZOOP45 Neurobiology & Animal Behaviour lab:

1. An introduction to animal behaviour – Animal Psychology – Classification of behavioural patterns
2. Perception of the environment – Examples
3. communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)
4. Ecological aspects – Food selection, optimal foraging, prey and predator, Host-Parasite relations
5. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization - insects
6. Reproductive behaviour – mating systems, sexual selection, parental care
7. Biological rhythms – examples – migration of fish, turtle and bird.

23ZOOP46 Animal Cell Culture & Stem Cell Technology lab:

1. Preparation of animal cell culture media
2. Preparation of single cell suspension from spleen and thymus
3. Viable cell counting.
4. Primary culture demonstration
5. Sub-culture preparations
6. Cell preparation for storage.
7. Cell preparation for feeding.

23ZOOP47 Aquaculture lab:

1. Spotters: cultivable species of finfish, shellfish and ornamental based on the theory
2. Analysis of water: Turbidity, pH, Dissolved oxygen, Alkalinity etc.
3. Primary productivity, Estimation by Light and Dark bottle method
4. Dissecting out the pituitary gland and preparing the extract
5. Identification of types of feeds
6. Feed analysis-Biochemical constituents
7. Visits to aquaculture farms, finfish and shellfish hatcheries

23ZOOP48 Animal Biotechnology and Bio-ethics Lab:

1. Isolation of genomic DNA
2. Agarose gel electrophoresis of genomic DNA.
3. Purification of bovine serum IgG by ammonium sulphate precipitation
4. Western Blotting of proteins.
5. Southern Blotting (Demonstration)
6. PCR diagnosis of white spot syndrome virus, *monodon* baculovirus, haemotopoetic necrosis virus - Demonstration
7. Intellectual property and India: comprehensive e-filing patents, Trademarks.
8. On line patent search.
9. Online patent register and application status.
10. WIPO online database search

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– I Semester

PAPER –I: TOOLS AND TECHNIQUES FOR BIOLOGY (23ZAQT11)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) What is an assay? Explain different types of assays.
(OR)
b) Write about pH meter: Operation of pH electrodes.
2. a) Describe various types of chromatographic techniques to separate molecules
(OR)
b) Describe the principle and applications of spectrophotometer.
3. a) Write an essay on Visualization of cells and subcellular components by light microscopy.
(OR)
b) Write the principle and types of microscopy and elaborate on dark field microscopy
4. a) Write about microtomy working principle and different types of microtomes.
(OR)
b) Write about the applications of microtomy in biological studies.
5. a) Describe the process of inoculation and growth monitoring.
(OR)
b) Explain in detail about microbial assays.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Density gradient centrifugation
7. Electrophoreses
8. TLC.
9. TEM.
10. Histology.
11. Sterilization.
12. Growth Media.
13. HPLC

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M.Sc. Zoology– I Semester

PAPER –II: BIOSYSTEMATICS, BIODIVERSITY & EVOLUTION(23ZAQT12)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) Define Biosystematics. Explain in detail the importance and applications of Biosystematics

(OR)

b) Write about chemotaxonomy

2. a) Discuss about the different taxonomic procedures.

(OR)

b) Write about ICZN in detail.

3. a) Discuss the types of Biodiversity and ecosystem.

(OR)

b) Write about Equitable sharing & conservation of Biodiversity.

4. a) Write about different species concepts.

(OR)

b) What is Speciation. Explain the mechanism involved in speciation.

5. a) Discuss in detail about the theories of Organic Evolution.

(OR)

b) What is Hardy Weinberg Law Discuss.

Answer any FIVE questions

SECTION-B

(5x4 = 20 Marks)

6. Cytotaxonomy.

7. Essentialism.

8. Taxonomic keys.

9. Gene Banks.

10. Eras.

11. Experiment of Miller.

12. Mutations.

13. Punctuated equilibrium.

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M.Sc. Zoology– I Semester

PAPER –III: BIOMOLECULES (23ZAQT13)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) Write about Biomolecules chemical composition.
(OR)
b) Discuss the principles and laws of thermodynamics.
2. a) Describe the structure, classification and properties of aminoacids.
(OR)
b) Explain about structural characterization of proteins.
3. a) Write about the classification, structure, properties and functions of monosaccharides.
(OR)
b) Explain about polysaccharides and their occurrence in nature.
4. a) Discuss about the classification, structures, properties and biological functions of fatty acids.
(OR)
b) Explain about phospholipids, sphingolipids, prostaglandins, and steroids with their biological role.
5. a) Explain about the structure, types and physicochemical properties of DNA.
(OR)
b) Write in detail about RNA and its functions.

Answer any Five questions

SECTION-B

(5x4 = 20 Marks)

6. Entropy and enthalpy
7. Ramachandranplot.
8. Peptidebond.
9. Glycoproteins.
10. fattyacids.
11. Chitin
12. Denaturation of DNA.
13. mRNA

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– I Semester

PAPER –IV: MOLECULAR CELL BIOLOGY(23ZAQT14)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Describe in detail about the transport across the cell membrane.
(OR)
b) Explain the transport of macromolecules across the epithelial layer.
2. a) Explain the role of cytoskeletal elements in defining the structure of a cell.
(OR)
b) Enumerate the role of cytoskeletal elements in mitosis.
3. a) Elaborate on the second messenger system in cell signaling
(OR)
b) Write about MAP kinase pathways
4. a) Write in detail about cell adhesion and communication mechanisms.
(OR)
b) Write an essay on cell cycle.
5. a) Write an essay on mobile DNA
(OR)
b) Describe various post-translational mechanisms in protein synthesis.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Membrane potential.
7. Surface receptor
8. Kinesin
9. Apoptosis
10. Integrins and collagen.
11. Chromosomal organization of genes.
12. Non coding DNA.
13. Symports and antiports.

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– II Semester

PAPER –I: BIOSTATISTICS & BIOINFORMATICS (23ZAQT21)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1. a) What an essay on Sampling.
(OR)
b) Write about graphical presentation of data.
2. a) Discuss in detail about the Measures of Central tendency.
(OR)
b) Write about Measures of dispersion.
3. a) Explain in detail about the bivariate analysis..
(OR)
b) What is test of significance. Discuss in detail.
4. a) Describe about the Basic components of the Computer..
(OR)
b) Explain the use of MS excel in for data presentation..
5. a) What are biological databases? Explain.
(OR)
b) Discuss in detail about sequence alignments.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Primary data and secondary data
7. Ogive.
8. Mode
9. Poisson distribution
10. Chi square test.
11. MS word.
12. Power point.
13. Phylogenetic analysis

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– II Semester

PAPER –II: ANIMAL PHYSIOLOGY (23ZAQT22)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

2. a) Write briefly molecular structure and properties of muscle, Add note on sliding filament theory.

(OR)

- b) Write about haemopoiesis, Haemoglobin, and haemostasis. Add note on factors affecting blood coagulation.

2. a) Write about the anatomy of brain.

(OR)

- b) Write about photoreceptors, Auditory, Mechanoreceptors..

3. a) Write about osmoregulation in aquatic Environments.

(OR)

- b) Write about response to biotic and abiotic factors.

4. a) Write about the comparative physiology of excretion, Urine formation, Urine concentration, and waste elimination.

(OR)

- b) Write about comparative anatomy of heart structure, myogenic heart. Add a note on blood pressure.

5. a) Explain fresh water and terrestrial environment..

(OR)

- b) Write about Yoga and Meditation

Answer any FIVE questions

SECTION-B

(5x4 = 20 Marks)

6. Cardiac muscle
7. Blood groups.
8. Synaptic transmission.
9. Chemoreceptor.
10. Acclimatization
11. BMR
12. Micturition
13. Estuaries.

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– I Semester

PAPER –III: IMMUNOLOGY (23ZAQT23)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x 10 = 50 Marks)

1.a) What is innate immunity? Describe various innate immune mechanisms.

(OR)

b) Describe the structure and functions of various types of immunoglobulins

2.a) Write an essay on antigen-antibody interactions.

(OR)

b) What are the cells involved in immune response? Describe their role.

3.a) Write about processing and presentation of intracellular and extracellular antigens

(OR)

b) Elucidate the mechanisms of antibody response to antigens.

4. a) Write about cell mediated immunity

b) Write about Classical and alternative activation of complement..

5. a) What is immune tolerance? Elucidate the mechanisms of tolerance in T and B cells.

(OR)

b) Write an essay on immunological tests used in molecular and diagnostic laboratories.

Answer any Five questions

SECTION-B

(5x4 = 20 Marks)

6. Acquired immunity.

7. Haptens

8. Primary lymphoid organs.

9. Antigen presenting cells

10. Macrophage

11. Antigen receptors.

12. ELISA.

13. Thymic hormones.

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– I Semester

PAPER –IV: MOLECULAR BIOLOGY(23ZAQT24)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Explain the prokaryotic and eukaryotic DNA replication.
(OR)
b) Explain the mechanics of DNA replication.
2. a) Explain the post transcription in prokaryote and eukaryotic transcription.
(OR)
b) Explain the post transcriptional modifications in RNA.
3. a) Explain the mechanisms of prokaryotic and eukaryotic translation.
(OR)
b) Explain the molecular mechanism of the antisense molecules and add a note on inhibition of splicing.
4. a) Write about DNA damage- DNA damage agents.
(OR)
b) Write about gene targeting and DNA repair.
5. a) Explain the types of mapping and molecular mapping of genome.
(OR)
b) Explain the Southern fluorescence in situ hybridization for genome analysis.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Structure of DNA
7. RNA polymerases.
8. mRNA
9. Genetic code.
10. Ribozyme
11. Mutagens
12. Holiday junction
13. FISH

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– III Semester

PAPER –I: APPLIED ZOOLOGY (23ZOOT31)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) What are fermenters? Write about principle and types of fermenters.
(OR)
b) Explain in detail about the industrial production of pencillin and riboflavin.
2. a) Describe about structure of live-stock breeding in poultry.
(OR)
b) Explain artificial insemination technique.
3. a) Elucidate on breeding of animals through artificial insemination.
(OR)
b) Describe the production of transgenic animals and their applications in health and disease.
4. a) Explain the mechanism of recovery of metals and acid mines from drainage using bioresources.
(OR)
b) Write about water pollution and its control?
5. a) Write about biofertilizers in detail?
(OR)
b) Discuss in detail on the need and usage of biopesticides in agricultural production

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Biosensors
7. SCP(Singl Cell Protein)Molecular cloning.
8. Germplasm bank.
9. Cloning.
10. Bioremediation Recombinant vector antigens.
11. Transgenic animal.
- 12 Anabaena.
- 13 Sea weed.

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M.Sc. Zoology– III Semester

PAPER –II : DEVELOPMENTAL BIOLOGY (23ZOOT32)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Describe in detail about the process of fertilization.
(OR)
b) Write an account on molecular mechanism of cleavage and cleavage patterns.
2. a) Give a detailed account on chick gastrulation.
(OR)
b) What is neurulation .Explain the process of neurulation with an example.
3. a) Explain the mechanism of cellular differentiation of ectoderm into CNS & Epidermis.
(OR)
b) Describe the cellular differentiation in Endoderm?
4. a) How does cell to cell communication help in organ formation during development?
(OR)
b) Write about Birth defects-Malformations & Disruption.
5. a) write an assay on collection and cryopreservation of gametes and embryos?
(OR)
b) Write about Multiple ovulation embryo transfer technology(MOETT)?

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Blocking of polyspermy.
7. Structure of sperm.
8. Regulative development.
9. Mesoderm derivatives.
10. Signal transduction cascade
11. Paracrine and other factors.
12. In vitro fertilization.
13. Embryonic stem cells.

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– III Semester

PAPER –III: PRINCIPLES OF ECOLOGY (23ZOOT33)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Write in detail about the abiotic component of the ecosystem.
(OR)
b) Explain the Concept of Primary Productivity.
2. a) Discuss about the Population growth.
(OR)
b) Write about Life histories and strategies (r and k selection)?
3. a) Write about Population demography and life tables
(OR)
b) What is an Ecological Community. Explain in detail about the structure and form of the Community
4. a) Discuss about the biogeographic realms of the world.
(OR)
b) Describe the Hot spots of the World & in India
5. a) Write about Environmental stress- environment pollution?
(OR)
b) What is biodiversity conservation threats major approaches to management?

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Food chain.
7. Ecological Pyramids.
8. Optimal yield.
9. Metapopulation
10. Ecological Succession.
11. Hotspots.
12. Sustainable development.
13. IUCN.

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M.Sc. Zoology– III Semester

PAPER –IV: METABOLIC CELL FUNCTION AND REGULATION (23ZOOT34)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Describe the thermodynamic principles suitable for living organisms.
(OR)
- b) Write notes on degradation of palmitic acid.
2. a) Write about energy metabolism and high energy compounds?
(OR)
- b) Explain the electron transport chain in mitochondria?
3. a) Write about storage and utilization of biological energy?
(OR)
- b) Explain the biosynthesis of prostaglandins.
4. a) Describe the classification and nomenclature of enzymes?
(OR)
- b) Discuss on the metabolic profile of neural tissue.
5. a) Explain the process of immobilization of enzymes.
(OR)
- b) What is metabolic engineering? Elaborate.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Methods to study metabolism.
7. Degradation of glucose
8. Oxidative phosphorylation. Kinetic analysis of enzymes.
9. Biosynthesis of Urea
10. Metabolic profile of adipose.
11. Nature of enzymes .
12. Metabolic profile of tissue.
13. Applications of Engymes

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– IV Semester

PAPER –I: NEUROBIOLOGY AND ANIMAL BEHAVIOUR (23ZOOT41)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Describe in detail the flow of information in neurons.
(OR)
b) Derive Nernst equation.
2. a) What is Action potential. Explain the propagation of action potential across the neuron.
(OR)
b) Discuss the types of channels involved in signaling.
3. a) Write an account on Catecholamine synthesis, release and uptake.
(OR)
b) Write an account on organization of the brain.
4. a) Discuss the behavior in insects with examples.
(OR)
b) What are cognitive skills. Explain different types of learning with examples.
5. a) Discuss the behavior in insects with examples.
(OR)
b) What are cognitive skills. Explain different types of learning with examples.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Neuroglial cell interaction.
7. Metabotropic receptors.
8. Cerebellum.
9. Imprinting.
10. Structure of neuron.
11. Sodium channel.
12. Temporal lobe.
13. Memory.

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Penugonda-534320, W. G. Dt., A.P.

M.Sc. Zoology– IV Semester

PAPER –II: ANIMAL CELL CULTURE & STEM CELL TECHNOLOGY (23ZOOT42)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Discuss the Scope and Importance of biotechnology.
(OR)
b) Explain Recombinant DNA and gene cloning technology.
2. a) Write about polymerase chain reaction.
(OR)
b) Discuss the application of PCR in biotechnology and genetic engineering.
3. a) Explain the laboratory facilities of culture media in animal cell and tissue culture.
(OR)
b) Discuss biotechnology in Medicine.
4. a) Explain pollution control of environment and energy conservation.
(OR)
b) Explain in detail IPR and IPP.
5. a) Explain pollution control of environment and energy conservation.
(OR)
b) Explain in detail IPR and IPP.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Gene libraries.
7. Basic PCR and its modifications.
8. Cell lines.
9. Organ culture.
10. Biotechnology and biodiversity.
11. Genetic counselling.
12. Vectors.
13. Expression vectors.

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M.Sc. Zoology– IV Semester

PAPER –III: AQUACULTURE (23ZOOT43)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Explain the criteria involved for the construction of fish farms.
(OR)
b) Write about the preparation and management of different types of ponds in fish farms.
2. a) What are the different fish seed resources? Add a note on their transportation.
(OR)
b) Discuss about carp culture.
3. a) Discuss about fish nutrition.
(OR)
b) Explain crab culture.
4. a) Discuss about the shrimp hatchery construction and its management.
(OR)
b) Explain the water quality management in brackish water farms.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Biological criteria for selection of aquaculture species.
7. Integrated fish farming.
8. Milk fish culture.
9. Feed management.
10. Pearl oyster culture.
11. Preparation and management of nursery ponds.
12. Composite Fish Culture.
13. Cage culture and pen culture.

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M.Sc. Zoology– IV Semester

PAPER –IV: ANIMAL BIOTECHNOLOGY & BIO-ETHICS (23ZOOT44)

(W.e.f. 2023-24 Admitted Batch)

Time: 3 hrs.

MODEL QUESTION PAPER

Max. Marks: 70

Answer ALL questions

SECTION-A

(5 x10 = 50 Marks)

1. a) Write about the tools used in rDNA technology with examples.
(OR)
b) Describe different types of vectors used for cloning in mammalian cells.
2. a) What is gene transfer? Write the mechanism of gene delivery systems.
(OR)
b) What is hybridization? Explain the design and preparation of probes used for hybridization.
3. a) Enumerate the methods of DNA sequencing and add a note on next generation sequencing.
(OR)
b) Discuss the role of DNA finger printing in forensic science.
4. a) Define bioethics. Discuss the need to follow the policies and laws in scientific field.
(OR)
b) Write an account on good laboratory practices.
5. a) Define bioethics. Discuss the need to follow the policies and laws in scientific field.
(OR)
b) Write an account on good laboratory practices.

Answer any FIVE questions

SECTION-B

(5x 4 = 20 Marks)

6. Mechanical shearing.
7. cDNA library.
8. Automated DNA sequencing.
9. Un-ethical acts.
10. Ti plasmid.
11. Northern blotting.
12. Gene therapy.
13. Laboratory accreditation.