SHREE GOVIND GURU UNIVERSITY
NAVJIVAN SCIENCE COLLEGE
Program: M. Sc ZOOLOGY

No.	Course Code	Name of the Course	Hours	Credits
Semester I				
1		**Animal systematics and functional anatomy**	3+1	4
2		**Cell Biology**	3+1	4
3		**Bioanalytical Techniques**	3+1	4
4		**Ecological Science**	3+1	4
5		**Lab I**	6	4
6		**Lab II**	6	4
			Total	**24**
Semester II				
1		**Fundamentals of Biochemistry**	3+1	4
2		**Evolution and Animal Behaviour**	3+1	4
3		**Mammalian Physiology**	3+1	4
4		**Entomology and Economic Zoology**	3+1	4
5		**Lab I**	6	4
6		**Lab II**	6	4
			Total	**24**
Semester III				
1		**Genetics and Molecular Biology**	3+1	4
2		**Developmental Biology**	3+1	4
3		**Advance Techniques in Zoology**	3+1	4
4	Elective A	**Wildlife and Conservation Biology- I**	3+1	4
	Elective B	**Fisheries and Aquaculture-I**	3+1	4
5		**Lab I**	6	4
6		**Lab II**	6	4
			Total	**24**
Semester IV				
1		**Immunology**	3+1	4
2		**Toxicology and Histological Techniques**	3+1	4
3		**Biostatistics and Research methodology**	3+1	4
4	Elective A	**Wildlife and conservation Biology- II**	3+1	4
	Elective B	**Fisheries and Aquaculture-II**	3+1	4
5		**Lab I**	6	4
6		**Lab II**	6	4
				1
			Total	**24**

Shri Govind Guru University, Godhara

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – I

COURSE CODE:

NAME OF COURSE: ANIMAL SYSTEMATICS AND FUNCTIONAL ANATOMY

UNIT I: ANIMAL SYSTEMATICS:

- Introduction – Systematics; Taxonomy; Identification; Classification; Nomenclature and Phylogenetics; Classification systems introduced by Carl Linnaeus, Ernst Haeckel, Robert Whittekar, Carl Woese and Thomas Cavallier-Smith; Aims, tasks, stages and importance of taxonomy; Taxonomic characters and character states. Concepts of conventional and newer aspects of taxonomy – Ecotaxonomy, Behavioral taxonomy, Cytotaxonomy Numerical taxonomy, Cladistics, Evolutionary taxonomy, Chemotaxonomy and Molecular phylogeny; Recent developments in taxonomy – DNA barcode and Phylocode.

UNIT II: FUNCTIONAL ANATOMY OF INVERTEBRATES:

- Metamerism, Coelom and Symmetry; Feeding and digestion in Protozoa and lower metazoa; filter feeding; Amoeboid, flagellary and ciliary movement, Hydrostatic skeleton and movement; Respiratory organs and pigments; Osmoregulation; Neuro-endocrine mechanisms; Patterns of reproduction, larval forms and metamorphosis.

UNIT III: FUNCTIONAL ANATOMY OF VERTEBRATES:

- Comparative functional anatomy of Digestive, Circulatory, Excretory, Nervous, Endocrine and Reproductive Systems of Vertebrates; Respiratory organs of vertebrates.

UNIT IV: ZOOGEOGRAPHY

- History of zoogeography and zoogeography regions; Distribution of animals in respect of the regions; Factors affecting animal distribution; Extinction of species; Exotic animals and their introduction and its effects; Endemic species; Anthropological pressure on zoogeography.

References:

1. Systematic Zoology- Ernst Mayr and Peter D Ashlock.
2. Principles of Animal Taxonomy- George Gayloard Simpson.
3. Invertebrate Structure and Function- Barrington E J W.
4. Functional anatomy of the vertebrates an evolutionary perspective- Warren Walker,
5. Karel Liem- William Bemis and Lance Grande.
6. A Functional Anatomy of Invertebrates- Vera Fretter and Alistair Graham.

Shri Govind Guru University, Godhara

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – I

COURSE CODE:

NAME OF COURSE: CELL BIOLOGY

Unit I Biomembranes and Cytoskeleton:

- Biomembrane: The Structure of cell membrane: The fluid Mosaic Model, Membrane lipids and Proteins, Transport across plasma membrane.
- Cytoskeleton: Microfilaments, Intermediate filaments, Microtubules: Organization of tubules, assembly and organization within the cells, microtubule motors and movements, cilia, and flagella: structure and function.

Unit II Cell organelles:

- Organization of Mitochondria, Chloroplast, Ultrastructure and Functions of Nucleus
- Organization and functions of Endoplasmic reticulum, Golgi complex, Lysosomes (Protein sorting and transport, Types of vesicular transport and their functions), Microbodies: Peroxisomes, Ribosomes.

Unit III Cell Junctions, Cell Cycle, Cell Death, Cancer and Stem Cells:

- Cell adhesions, tight junction, gap junctions and plasmodesmata; Extracellular matrix and its association with cells.
- Cell cycle and its regulation; Cell death, apoptosis, necrosis
- Cancer, metastasis and angiogenesis.
- Stem cells, its types and application.

Unit IV Animal cell culture:

- Basics requirements of cell culture laboratory;
- Sterilization techniques
- Tissue culture Media: Serum and serum-free media
- Primary and secondary cultures; Cell lines
- Histotypic and organotypic cultures; 3-D cell culture.
- Scaling-up of Monolayer cultures; Suspension cultures
- Contamination and its remedies
- Cryopreservation

References:

1. The cell: A molecular approach-Geoffrey M Cooper and Robert E. Hausman
2. Cell Biology-Karp
3. Molecular Biology of the cell- Alberts
4. Molecular Cell Biology-Lodish et al.

5. Culture of animal cells: A manual of basic technique- R. Ian Freshney, Wiley Publication.
6. Animal biotechnology – P. Ramadass, MJP Publishers
7. Biotechnology- U.Styanarayan, Books and Allied (P) Ltd.
8. Animal Tissue culture- Sudha Gangal

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – I

COURSE CODE:

NAME OF COURSE: BIOANALYTICAL TECHNIQUES

Unit I Microscopy and Histochemical Techniques:

- Tissue fixation; Embedding; Staining; Basic and Acid Dyes; Mordants; Amphophillic and Neutrophilic tissues.
- Metachromatic histochemical and immunohistochemical techniques.
- Principles of Transmission and Scanning Electron microscopy
- Principles of Phase Contrast and Fluorescence Microscopy

Unit II Spectroscopy:

- Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD
- CD and structure of proteins using NMR and ESR
- Neutron and X-Ray diffraction for elucidation of 3D structure
- Molecular modelling, Mass Spectrometry

Unit III Chromatographic techniques:

- Basic Principle and types of Chromatography
- Gas Chromatography & GC-MS
- Ion Exchange Chromatography, gel permeation, Affinity chromatography
- High Performance Liquid Chromatography and FPLC

Unit IV Centrifugation and Electrophoretic Techniques:

- Principle and applications of Centrifugation techniques
- Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
- Isoelectric focusing, 2D-PAGE and their uses in protein research
- Fractionation and Blotting Techniques

Reference Books:

1. Instrumental method of chemical analysis: Sharma B K
2. Instrumental methods of analysis: D A Skoog
3. An introduction to practical Biochemistry: Plummer
4. Instrumentation: Chatwal and Anand
5. Modern experimental Biology: Boyer
6. Freifelder D. M. Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd ed., W.H. Freeman, 1982.
7. Wilson & Walker. Principles and Techniques in Practical Biochemistry. 5th ed. Cambridge Univ. Press, 2000.
8. West & Todd. Biochemistry. 4th ed. Oxford and IBH.
9. Horst Friebolin. Basic One and Two-dimensional spectroscopy. VCH Publ, 1991.
10. Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st ed. Wiley-Liss, 2001.
11. R. Marimuthu – Microscopy and Microtechnique, MJP Publishers, 2015.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – I

COURSE CODE:

NAME OF COURSE:ECOLOGICAL SCIENCE

Unit-1 Ecological Principles:

- Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
- Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection)
- Concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.
- Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit-2 Community Ecology

- Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
- Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.
- Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition
- Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

Unit-3 Environmental Science

- Definition and Scope of Environmental science. The Environment: Physical environment; biotic environment; biotic and abiotic interactions.
- Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.
- Biomes of the world,Parasitism, prey-predator relationships
- Overview of Sanctuaries, National Park and Botanical garden.

Unit-4 Pollution and Environmental Impact Assessment

- Air: Natural and anthropogenic sources of pollution, primary and secondary pollutants, Methods of monitoring and control of air pollution, Effects of pollutants on human beings, plants, animals, materials and on climate, Acid rain, Air Quality Standards
- Water: Types and Sources of water pollution, Standards, sewage and waste water treatment. Water quality standard, Soil pollution and Soil pollution control
- Global Environmental problems: Ozone depletion, global warming and climatic change, clean development mechanism.
- Introduction to environment impact analysis, Environmental Impact Assessment methodologies, Procedure for reviewing environmental impact analysis,
- Principles of Remote sensing and its applications of environmental sciences, Application of GIS in Environmental management.

REFERENC BOOKS:

1. Ecology - Principles and Applications by J.L. Chapman & M.J. Reiss. (2008) (2nd Ed.) Cambridge University Press, U.K. (ISBN: 978-0-521-68920-5)
2. Ecology and Environment by P.D. Sharma. (2010). (10th Ed.) Rastogi Publications, Meerut (India). (ISBN: 978-81-7133-905-1)
3. Economic Zoology by G.S. Shukla & V.B. Upadhyay. (2000). (4th Ed.) Rastogi Publications, Meerut (India). (ISBN: 81-7133-434-2)
4. Elements of Ecology by Thomas Smith & Robert Smith. (2007) (6th Ed.) Dorling Kindersley Press. (South Asia). (ISBN: 81-317-1557-4)
5. Environmental Science: Practical and Field Manual by Jitendra Pandey and Madhu Sudan Sharma. (2003). Yash Publishing House, Bikaner (India). (ISBN: 81-8688209-X)
6. Fundamentals of Ecology by Eugene Odum& Gray Barrett. (2009) (5th Ed.) Cengage Learning & Nelson Education Press. (ISBN: 978-81-315-0020-0)
7. Practical Statistics for Field Biology by Jim Flower, Lou Cohen & Phil Jarvis. (2006) (2nd Ed.) John Wiley & Sons Ltd., England. (ISBN: 978-0-471-98296-8)
8. Principles of Conservation Biology by Martha Groom, Gary Meffe& Ronald Carroll. (2006) (3rd Ed.) Sinauer Associates, Inc., Sunderland, USA. (ISBN: 978-0-87893-518-5)

LAB-I

Practicals based on topics covered in Animal Systematics and Diversity And Cell Biology

List of Practicals

1. Classification of kingdom Protista
2. A key to common animal phyla
3. Identification of some common freshwater invertebrates
4. A key to common order of adult insects
5. To study the mouthparts of insects and types of antennae
6. Classification of porifera, coelentera, platyhelminths, Nematoda, Annelida, Arthopoda, Mollusca and Echinodermata.
7. Construct a UPGMA diagram using the given data
8. To study cladistic approaches of classification by building a cladogram
9. Topreparea temporarymountofOnionpeelandstudythe cells.
10. Tostudyandidentifythe chloroplastfromplantcell.
11. ToLocalize nucleusfromhumancheekcells.
12. Tostudyvariousstagesofmitotic celldivisionusingonionroottip.
13. Tostudyvarious stagesof meiotic celldivisionusing*Tradescantia* flowerbud.
14. Introduction of animal tissue culture laboratory with necessary equipments and accessories.
15. Preparation of culture media
16. Sterilization of culture media

LAB-II

Practical based on topics covered in Bioanalytical Techniques and Ecological Science

List of practicals:

1. Introduction to pH, buffer preparation, molar, normal and % solutions.
2. Calculations for making stock solutions
3. Separation of amino acids by TLC
4. Separation of cells by density gradient centrifugation
5. Determination of partition coefficient
6. To determine the Minimum Size of Quadrate by Species-Area-Curve Method
7. To determine analytical character of different species in the community
8. To Study Community Structure/characteristics – Frequency, Density and Abundance of Species by Quadrates (Random Sampling Method)
9. To Study Community Structure/characteristics – Frequency, Density and Abundance of Species by Line Transect Method
10. To Study Community Structure/characteristics – Frequency, Density and Abundance of Species by Belt Transect Method
11. To study various stages ecosystem succession and its role in community assemblance.
12. To study the Vegetation by Point-Frame Method
13. To study the Vegetation by Physiognomic Method (Biological Spectrum Method)
14. Field Visit to Protected Area (National Park / Sanctuary) or Natural Habitat / Ecosystem of Gujarat State

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – II

COURSE CODE:

NAME OF COURSE: FUNDAMENTALS OF BIOCHEMISTRY

Unit I Carbohydrate Metabolism:

- Introduction and classification carbohydrates
- Glycolysis pathway and regulation, Gluconeogenesis, glycogenolysis and glycogenesis, Coordinated regulation of glycolysis and gluconeogenesis
- Pentose phosphate pathway, Kreb's Cycle, Electron Transport chain.

Unit II Protein Metabolism:

- Proteins- structure, classification, properties, functions, and degradation.
- Types and properties of amino acids. Nitrogen incorporation and excretion (Urea Cycle).
- Vitamins: Water and Fat-soluble vitamins, chemistry, occurrence, and physiological role.

Nucleotides metabolism: Biosynthesis and Degradation of Nucleotides

Unit III Lipid Metabolism:

- Classification of lipids, chemical nature of fatty acids and glycerol.
- Structural lipids in membranes – glycerophospholipids, glycolipids and sulpholipids, sphingolipids and sterols.
- Lipid Metabolism: synthesis of fatty acids. Storage of fatty acids and utilization.

Unit IV Enzymology:

- Enzymes: Nature, function, classification, and nomenclature.
- Enzyme kinetics, mechanism of action, active sites, substrate binding,
- Regulation of enzyme activity.
- Chemistry and functions of Co-enzymes

References:

1. Lehninger's Principles of Biochemistry: D. L. Nelson and M. M. Cox, Macmillan, Worth Pub. Inc., NY.
2. Chemistry of Biomolecules by S. P. Bhutani, Ane Books Pvt. Ltd. CRC Press
3. Biochemistry: Lubert Stryer WH Freeman & Co., NY.
4. Harper's Biochemistry: R. K. Murray and others. Appleton and Lange, Stanford.
5. Text book of Biochemistry with clinical correlations by Delvin.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – II

COURSE CODE:

NAME OF COURSE: EVOLUTION AND ANIMAL BEHAVIOUR

Unit I: Evolution:

- Concept of evolution, origin of life on earth, Theories and evidences
- Molecular phylogeny, Evolution in action
- Sources of evolution, variations
- Role of mutations, Recombination, and ploidy
- Isolation, species concept,
- Hardy-Weinberg law and genetics drifts

Unit II:

- Geological time scale and its implication
- Adaptations: various types, Desert, Cursorial, Fossorial, Arboreal, Volant and Aquatic
- Mimicry, polymorphism
- Macro and Micro- evolution
- Evolution of man
- Trends in evolution
- Evolution-future prospects

Unit III Animal Behaviour:

- Introduction to Animal Behaviour, Origin and history of Ethology;
- Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour.
- Approaches and Methods in Study of Behaviour; Proximate and Ultimate Causations; Altrusim and Evolution - Group Selection, Kin Selection, Reciprocal Altrusim
- Concept of Learning, Memory, Cognition, Sleep and Aurosal, Biological clock and rhythms

Unit IV:

- Patterns of Behaviour; Stereotyped Behaviours (Orientation, Reflexes)
- Individual Behavioural patterns; Instinct vs. Learnt Behaviour;
- Associative learning, classical and operant conditioning, Habituation, Imprinting.
- Social and Sexual Behaviour Social Behaviour: Concept of Society; Communication and the senses
- Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
- Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

References:

1. Mohan P. Arora 1995. Animal Behaviour, Himalaya Publishing House
2. V.K. Aggarwal, 2010 Animal Behaviour (ethology) , S.Chand3.S. K. Singh, 2015. Text book of Wild Life Management, CBS.
3. Techniques for wildlife Census in India by W. A. Rogers (A field manual) (1991); Wildlife Institute of India, Dehradun.
4. Wildlife Wealth of India by T. C. Majupuria. (1986) Tecpress Services, L. P., 487 / 42 SOLWattenslip, Pratunam Bangkok, 10400, Thailand.
5. Ali, S. Ripley S.D (2002). Handbook of Birds of India, Pakistan 10-Vols. Oxford University
6. The Book of Indian Animals by S.H. Prater (1990), BNHS - Publication, Bombay.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – II

COURSE CODE:

NAME OF COURSE: MAMMALIAN PHYSIOLOGY

Unit I:

- **Physiology of digestion and absorption.** An overview of human digestive tract. Physiological role of digestive juices. Digestion and absorption of carbohydrates, proteins and fats.
- Energy balance, BMR.
- **Physiology of Excretory Systems:** An overview of human urinary system. The functional anatomy of human kidney and the functional units. Ultrafiltration, reabsorption, and secretion as transport mechanisms involved in urine formation. Physiological roles of aldosterone, anti-diuretic hormone and rennin-angiotensin system in renal functions.

Unit II:

- **Physiology of Circulation:** An overview of human circulatory system. The myogenic heart. Pacemaker system and conducting fibers, Neural, and chemical regulation, Cardiac cycle, cardiac output, blood pressure and regulation, Blood-components and functional significance. Blood coagulation and factors involved in coagulation. Haemopoiesis and blood groups, Lymph- composition and dynamics.

Unit III:

- **Physiology of Nervous System:** An overview of the human nervous system and organization. Structure of neuron, types of neurons, neuralgia, myelination. Electrical signals and signal transmission. Membrane channels, resting and action potentials, propagation of nerve impulses, synapses and types, synaptic knobs and synaptic potentials. Neurotransmitters: Physiological role of acetyl choline, aminoacids, GABA, catecholamines, nitric oxide and neuropeptides. General properties of sensory receptors, chemical senses, hearing and vision.

Unit IV:

- **Physiology of Muscular System:** An overview of the muscular tissue: types of muscle tissue, properties, and functions of the muscle tissues. Contraction and relaxation processes and metabolism of skeletal muscle fibres.
- **Physiology of Respiration:** An overview of human respiratory system, Respiratory movements, and the exchange of respiratory gases at pulmonary surfaces, Neural and humoral control of respiration. Transport of respiratory gases in blood.

Reference Books:

1. Animal physiology by Verma, Tyagi and Aggarwal, Pub. S. Chand & Company Ltd. New Delhi. ISBN-81-219-0351-3.
2. A textbook of Animal physiology by A. K. Berry, Emkay Publications, Delhi. ISBN-81-85712-03-4.
3. Animal physiology by Mohan P. Arora, Himalaya publishing House. ISBN-81-7866-723-1.
4. Animal physiology by Goyal and Shastry, Rastogi Publications. ISBN-81-7133-864-X.
5. Tortora, G. J.: Principles of Anatomy and Physiology. John Wiley & Sons,Inc.
6. Guyton, A.C and Hall J.E.: Textbook of Medical Physiology. W.B.Saunders Co. Philadelphia.
7. Chatterjee, C.C.: Human Physiology (Vol. I, II, III). Medical & Allied Agency.
8. James A. Wilson: Principles of Anatomy and Physiology. Macmillan Publishing Co.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – II

NAME OF COURSE: ENTOMOLOGY AND ECONOMIC ZOOLOGY

Unit-1: Overview of Entomology

- Significance of Insects to human importance: Reasons why insects are so successful.
- Classification of Class Insecta and Arachnida with special emphasis medically important Arthropods.
- Insect Morphology: Exoskeleton, Head, thorax, and abdomen.
- Insects Physiology: Digestive system, Excretory system, Circulatory system, Reproductive system, Nervous system, and Endocrine system.
- Insect Development: Growth & development, Metamorphosis.

Unit-2: Insect Ecology, Behaviour and control

- Insects and climate: Temperature, Light, Rainfall, Wind and Influence of Climate change.
- Insect population dynamics: Population functions and factors affecting population size.
- Climate change and its influence on Malaria in India.
- Insect behavior: mating, feeding and defensive strategies.
- Biological control of vectors through predators and pathogens.
- Genetic control of vectors: Sterile Insect Technology (SIT)
- Insect Growth Regulators (IGR): Chitin synthesis inhibitors and juvenile hormones.
- Synthetic insecticides: Organochlorides, Organophosphates, Carbamates, Pyrithroids.
- Repellents & attractants: DEET, Semiochemicals.

Unit-3: Poultry Breeding:

- Habitat of fowl, food and feeding of fowl, Breeds of fowl
- Breeding in fowls, Eggs and hatching, Rearing of chickens
- Diseases of Poultry, Poultry Products
    - **Aquaculture:**
- Scope, history and present status of Aquaculture
- Different systems of Aquaculture
- Cultivable fish species, Planning, layout and construction of fish farm

Unit-4: Dairy Farming:

- Importance of Livestock to agriculture and its relation to national economy
- Study of Breeds of Buffalos (Murrah, Surti and Mehsana), Cow (Sahiwal, Haryana, Holsterin, Jersey and Red Done)
- Milk Production in India per capita consumption of milk in Gujarat
- Status of dairy industry in India and Gujarat and the role of cooperative societies

- Methods of housing animals, Management of Livestock and control of external and internal parasites
- Important disease of Livestock, care of cows at and after calving, raising of calves
- Milking Systems- methods and principles of clean milk productions

SUGGESTED REFERENCES:

1. Biology of Disease Vectors, 2nd Ed., William C. Marquardt, 2004, Elsevier Academic Press.
2. Medical and Veterinary Entomology, 2nd Ed., Gary Mullen & Lance Durden.
3. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods, Revised Edition. by Bruce Eldridge & John Edman.
4. Manual of Medical Entomology by Deane P. Furman & Paul Catts.
5. Infectious Diseases of Arthropods by Goddard.
6. Medical Entomology for Students 5th edition by Mike Service.
7. General and Applied Entomology by David and Anantha krishnan.
8. Ecology of Insects by Martin R. Speight Pub: Wiley-Blackwell.
9. Gupta S.K.,Gupta P.C.(2006) Genera and Appied Ichthyology.
10. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea &Fabiger Publisher.
11. Tomar B.S. (2011) Introduction To Economic Zoology. Emkay Publications, Delhi-110051.
12. Jawaid Ahsan,(1985) A Handbook on Economic Zoology,S.Chand & Company Ltd.,New Delhi
13. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
14. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
15. K.D.Chatterjee,K.D CBS Publishers & Distributors, Private Ltd.,New Delhi. Parasitology, Protozoology and Helminthology

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LAB-I

Practicals based on topics covered in Fundamentals of Biochemistry and Evolution and Animal Behaviour

List of Practicals:

1. Estimation of Reducing Sugar in Jaggery by Cole's Method
2. Estimation of Protein by Folin-Lowry Method
3. Estimation of Reducing Sugar by DNS Method
4. Total Sugar Estimation by Phenol Sulphuric method
5. Estimation of RNA by Orcinol Method
6. Estimation of Amino Acid (Proline)
7. Estimation of Amino Acid (Methionine from Food Grains)
8. To study evolution through chart
9. To study the behavioural responses of wood lice to dry and humid conditions.
10. To study geotaxis behaviour in earthworm.
11. To study the phototaxis behaviour in insect larvae.
12. Human maze learning to investigate acquisition in a motor performance widely utilized in research for human learning.
13. To study the effect of task 1 and task 2 through the process of trials and error by performing maze learning.
14. To study the development of eye and hand coordination.
15. To observe antennae grooming behaviour of cockroach.
16. To study charts of optical illusion.
17. Study and actogram construction of locomotor activity of suitable animal models.
18. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

LAB-II

Practicals based on topics covered in Mammalian Physiology and Entomology and Economic Zoology

List of Practicals:

1. Determination of Bleeding time
2. Determination of Clotting time
3. Preparation of haemin crystals
4. Test for salivary amylase
5. Determination of haemoglobin by hemoglobinometer
6. Determination of RBCs by haemocytometer
7. Determination of WBCs by hemacytometer
8. Osmotic fragility test
9. Blood grouping
10. Qualitative analysis of urine sample
11. Collection of medically important Insects and identification up to genus level.
12. Maintenance and study the stages life cycle of Cockroach / house fly / mosquito.
13. Preparation of permanent mounts of mosquito respiratory siphon and trumpet.
14. Preparation of permanent mounts of Insect leg and antennae.
15. Preparation of permanent mounts of wings of Cockroach / house fly / mosquito.
16. Dissection, mounting and preparation of permanent slides of Insect mouth parts.
17. Study of Poultry Diseases
18. Study of Breeds fowl
19. Study of Cultivable fish species
20. Study of Diseases seen in Cows and Buffaloes
21. Visit to poultry farm/ animal breeding centre/ fish farm/honey bee keeping.
22. Submission of visit report

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

COURSE CODE:

NAME OF COURSE: GENETICS AND MOLECULAR BIOLOGY

Unit-1: Histone proteins, Nucleosome, Heterochromatin

- Histone proteins, Nucleosome, solenoid structure and organization of DNA in the chromosome.
- Properties of Heterochromatin, constitutive and facultative heterochomatin.
- X- chromosome inactivation.
- Units of inheritance: Newer concepts of genome organisation.
- Split genes, pseudo genes, overlapping genes, unique sequences, repetitive sequences transposons and conserved genes.

Unit-2: Linkage, Crossing over and Chromosome mapping

- Linkage, Crossing over
- Cytological basis of crossing over, Molecular mechanism of crossing over
- Morphology and classification of chromosomes.
- Chromosome mapping: two factor crosses, three factor crosses
- Sex determination and sex linkage:Mechanism of sex determination, Environmental factors and sex determination, molecular basis of sex determination, sex differentiation: *Chlamydomonas,* sex linked inheritance.

Unit-3: DNA as a hereditary material and Gene structure and expression

- Structure of Nucleic acids, Structural differences in prokaryotic and eukaryotic DNA
- DNA replication and DNA methylation
- The Concept of Gene
- Genetic code, Transcription and RNA processing
- Translation and post translational modifications
- Regulation of gene expression and Operon model

Unit-4: Structural Changes in DNA material and Extra Chromosomal inheritance

- Molecular basis of spontaneous and induced mutations
- DNA damages and repair
- Numerical chromosomal aberrations (Aneuploidy and Euploidy)
- Structural chromosomal abnormalities (Translocations, Inversions, Deletions, Insertions Duplications, Dicentric and isochromosomes, Ring chromosomes, Chromosomes breaks, gaps and fragile sites, Marker chromosomes).
- Extra-chromosomal inheritance

Reference Books:

1. Human Cytogenetics: Constitutional analysis by D. E. Rooney. Oxford University Press. New York (ISBN: 0-19-96384-3 (Hbk.).
2. Strickberger M.W. Genetics. Third Edition. Prentice-Hall of India Pvt. Ltd, New Delhi, 2005. ISBN: 81-203-0949-9.
3. Emund W. Sinnot, L. C. Dunn & T. Dobzhansky. Principles of Genetics, Tata Mcgraw Hill Publishing Company Limited, New Delhi, ISBN: 978-0070994133.
4. P. K. Gupta, Genetics. Rastogi Publications, Meerut, India., ISBN: 81-7133-842-9.
5. Gardner E. J., Simmons M. J. & Snustad D. P. Principles of Genetics. Eighth edition. John Wiley & Sons Inc. ISBN 9971-51-346-3.
6. Klug W. S. & Cummings M. R. Concepts of Genetics. Seventh edition. Pearson Education. ISBN 81-317-0811-X.
7. Stent G. S. & Calendar R. Molecular Genetics: An Introductory Narrative. Second edition CBS Publishers and Distributors, New Delhi ISBN 81-239-0857-1.
8. Streips U. And Yasbin R. Modern Microbial genetics, Wiley-Liss, USA. ISBN: 0-471-38665-0.
9. Molay S., Cronan J. & Frifelder, D. Microbial Genetics Narosa Publishing House, New Delhi. ISBN: 81-7319-697-4.
10. Genetics by B. D. Singh

Shri Govind Guru University, Godhara

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

COURSE CODE:

NAME OF COURSE: DEVELOPMENTAL BIOLOGY

UNIT-I:

- Basic concepts of development: Potency, commitment, specification.
- Basic concepts of development: induction, competence, determination, and differentiation.
- Morphogenetic gradients; cell fate and cell lineages.
- Genomic equivalence.

UNIT-II:

- The cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.
- Gametogenesis, fertilization, and early development.
- Production of gametes, cell surface molecules in sperm-egg recognition in animals.
- Embryo sac development; zygote formation, cleavage, blastula formation, embryonic fields,
- gastrulation and formation of germ layers in animals.

UNIT-III

- Embryogenesis, establishment of symmetry.
- Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in
- Dictyostelium.
- Axes and pattern formation in Drosophila, amphibia and chick.
- Organogenesis – vulva formation in Caenorhabditis elegans; eye lens induction, limb
- Development and regeneration in vertebrates.

UNIT-IV

- Hormones as mediators of development: Amphibian metamorphosis, Insect metamorphosis
- Teratogenic agents, Teratogenesis,
- Causes and genetic regulation of Aging.
- Sex determination in Mammals
- Infertility, IVF

References:

1. Scott F Gilbert, Developmental Biology, 8th edition, Sinauer Associates Inc., USA. ISBN 0-87893-250-X
2. Shastry and Shukal, Developmental Biology, Rastogi Publications, ISBN 81-7133-734-1
3. Klug W. S. & Cummings M. R. Concepts of Genetics. Seventh edition. Pearson Education. ISBN 81-317-0811-X
4. Fundamentals of Genetics by B D Singh.
5. P. K. Gupta, Genetics. Rastogi Publications, Meerut, India, ISBN: 81-7133-842-9.
6. Gardner E. J., Simmons M. J. & Snustad D. P. Principles of Genetics. Eighth edition. John Wiley & Sons Inc. ISBN 9971-51-346-3.
7. Elements of Breeding and breeds of cattle and Buffalo- P Kanakraj, Jaypee Brothers Medical, ISBN: 978-8180618420

Shri Govind Guru University, Godhara

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

COURSE CODE:

NAME OF COURSE: Advance Techniques in Zoology

Unit 1: Techniques for biodiversity assessment

- Quantitative assessment of biodiversity: different types of transects, quadrates and
- data analysis.
- Population census techniques for vertebrates.
- Invertebrate sampling techniques
- Phylogenetic analysis of DNA sequences.

Unit 2: Remote Sensing and Applications

- Introduction to remote sensing, History and scope
- Energy sources and EMR, RS sensors and platforms
- Image processing and classification
- Land cover and Land use analysis, Analysis of spatial data
- RS applications in different fields

Unit 3: GIS Basics

- Fundamentals of GIS and functions of GIS
- Software for GIS (GIS lab)
- Spatial data models
- Presentation of GIS data

Unit 4: GIS Applications

- Ecological modelling through GIS
- Species distribution models
- Fragmentation analysis
- Applications of GIS

References:

1. Krishnamurthy K. V. 2003 An Advanced Textbook on Biodiversity Principles and Practice. Oxford & IBH Publishing C. Pvt. Ltd. New Delhi.
2. Shantharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Shri Govind Guru University, Godhara

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

COURSE CODE:

NAME OF COURSE: Wildlife and Conservation Biology- I

UNIT I

- Wildlife: Definition, Scope and Significance of wildlife conservation
- Wildlife and habitats of Indian subcontinent
- Conservation: Definition, History and Background and types of conservation
- Important issues for wildlife conservation in India.

UNIT II

- Wildlife management (History and current advances)
- Protected areas andsome important Protected areas of India and Gujarat.
- Habitat improvements and management
- Current wildlife conservation practices in India

UNIT III

- Estimating number of wildlife (Census techniques)
- Measuring habitat use and occupancy.
- Wildlife habitat evaluation techniques
- Wildlife population monitoring techniques.

UNIT IV

- Human-wildlife Interaction
- Management and mitigation of conflicts
- Case studies on Human-wildlife conflicts and mitigation actions
- Immobilization and rescue of wildlife

References:

1. Sinclair A. R., Fryxell J M and Caughly G. (2006) Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.
2. Gopal R. (1992) Fundamentals of Wildlife Management. Justice Home, Allahabad, India.
3. Jairajpuri M. S. (1990) Collection and preservation of animals. Zoological Survey of India.
4. Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton

University.

5. Gadgil, M. (2002) A methodology manual for scientific inventorying, monitoring and conservation of Biodiversity
6. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.
7. T A Bookhout 1996. Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, ML
8. D E Wilson 2002. Measuring and Monitoring Biological Diversity: Standard Methods. The Smithsonian Institution, USA
9. J P Sands et al. 2012. Wildlife Science: Connecting Research with Management. CRC Press, Taylor and Francis Group.

Shri Govind Guru University, Godhara

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

COURSE CODE:

NAME OF COURSE: Fisheries and Aquaculture-I

UNIT I

- Introduction to fisheries biology
- External morphology of fish
- General characters and classification of fishes
- Structural and functional adaptation of fishes

UNIT II

- History, scope and types of aquacultures
- Status of aquaculture in India
- Fishing crafts and gears
- Cultivable fauna and flora in aquaculture

UNIT III

- Digestive system of fish
- Respiratory system of fish
- Blood vascular system of fish
- Nervous system of fish
- Urinogenital system of fish

UNIT IV

- Introduction to fishing methods
- Fisheries research institutes in India
- Composite fish culture and poly culture
- Integrated fish farming
- Sewage fed fish culture, cage culture and pen culture

References

1. Day, F. 1981. Fishes of India, Vol.I and Vol. II. William Sawson& Sons Ltd., London. 2.
2. Jhingran, C.G. 1981. Fish and Fisheries of India. Hindustan Publishing Co., India.

3.Maheswari, K. 1993. Common fish diseases and their control. Institute of Fisheries Education, Powakads, M.P.

4. Santhanam,R. 1980. Fisheries Science. Daya Publishing House, New Delhi.

5. Yadav, B.N. 1997. Fish and Fisheries. Daya Publishing House, New Delhi

6. FAO Volumes for fish identification.
7. Bal D.V. and Rao, K.V. 1990. Marine Fisheries of India. Tata McGraw Hill Publishing Co. Ltd., New York.
8. Biswas, K. P. 1996. A Text Book of Fish, Fisheries and Technology. Narendra Publishing House, Delhi.
9. Srivastava, C.B.L. 1999. Fish Biology. Narendra Publishing House, Delhi.

SEM-III LAB-I

Practicals based on topics covered in Genetics and Molecular Biology and Devlopmental Biology

List of Practicals:

1. Demonstration of barr bodies
2. Whole blood culture for chromosome preparation
3. To prepare and perform Giemsa staining
4. Isolation of chromosomal DNA
5. To study embryology of frog through slides/chart
6. To study different developmental stages of chick embryo through permanent slides/chart.
7. To prepare whole mount of chick embryo.
8. To study the morphology and motility of sperm.
9. To study viability of sperm.
10. Total count of spermatozoa in semen sample.
11. Acrosomal integrity test.
12. Teratogen activity test

SEM-III LAB-II

Practicals based on topics covered in Advance Techniques in Zoology and Wildlife and Conservation Biology- I

List of Practicals:

1. Principal and Application of hand-held GPS
2. Use of GPS essential mobile app
3. Reading of Toposheets and Maps for identification of different features
4. Download and processing of satellite images
5. Calculating change detection through LILC classification
6. Calculation of different indices using geo-processing
7. Geo referencing of toposheets
8. Study and application of different vector models and features using GIS software
9. Preparation of map using GIS
10. Use of different web applications used in RS and GIS analysis
11. Study and Mapping of wildlife habitats of Indian subcontinent
12. Identification of different signs of wild animals
13. Identification of birds
14. Vegetation sampling
15. Wildlife population estimation techniques and calculating density
    a. Transect method
    b. Point count
    c. Block count
16. Study of different equipment used for immobilization and rescue of wild animals
17. Visit to any one Protected area within Gujarat and submission of field excursion report

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

COURSE CODE:

COURSE NAME: Immunology

Unit I

- Immunity: Innate and Adaptive, Cells of the Immune system: Haematopoiesis and its regulation
- Cells and organs of the immune system: Primary and secondary lymphoid organs
- Induced Innate immunity: receptors of the innate immunity (TLR and sensing of PAMPs, CLR, RLR and CLR); Inflammatory responses, Natural Killer cells
- Antigens: Immunogenicity versus antigenicity, Epitopes, Haptens.
- Complement system: The Major Pathways of Complement Activation: Classical, alternative and lectin complement pathways, functions of complement, regulation of complement, complement deficiencies, microbial complement evasion strategies

Unit II

- Antibody: Structure of immunoglobulin; classes of immunoglobulins, Signal transduction pathways emanating from the BCR
- The Organization and Expression of Lymphocyte Receptor Genes: Hozumi and Tonegawa's Experiment, Multigene organization of Ig Gene, Mechanism of VDJ recombination, B cell receptor expression: Allelic exclusion,B cell isotype switching and somatic hypermutation; expression of membrane bound and soluble immunoglobulin; T cell receptor genes and expression
- Basics of Antigen-antibody interactions: Immunoprecipitation and agglutination based techniques, Methods to determine affinity of antigen-antibody interactions, Immunofluroscence, FACS

Unit III

- The Major Histocompatibility Complex and Antigen Presentation: The structure and function of MHC molecules, general organization and inheritance of MHC genes, The role and expression Pattern of MHC, Endogenous and exogenous pathway of antigen processing and presentation; presentation of non-peptide antigens.
- B Cell activation: T dependent and T independent B cell responses and memory generation
- T Cell activation: Two signal hypothesis, superantigens, activation and differentiation of T cell into effector and memory cells.T_H1 and T_H2 responses.

Unit IV

- Cell mediated effector response (Generation of effector CTL's, Granzyme and Perforin Mediated Cytolysis, Fas-FasL Mediated Cytolysis, NK cell mediated cytolysis
- Cytokines: properties, receptors, associated diseases, therapeutic applications, cytokine signalling pathways: JAK-STAT and FAS-FASL signalling pathways
- Immune response to infection by viruses, bacteria, fungi and parasite: Mechanism of Immune response and evasion by pathogen

References:

1. Owen, J. A., Punt, J., &Stranford, S. A. (2013). ***Kuby immunology*** (7thEdn). New York: WH Freeman.
2. Murphy, K., & Weaver, C. (2016). ***Janeway's immunobiology*** (9thEdn) Garland Science.
3. Male, D., Brostoff, J., Roth, D., &Roitt, I. (2012). ***Immunology***(8thEdn) *With STUDENT CONSULT Online Access*. Elsevier Health Sciences.
4. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2014). ***Cellular and molecular immunology*** (6thEdn) Elsevier Health Sciences.
5. Relevant review articles / research papers / handouts of latest development in the subject.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

COURSE CODE:

NAME OF COURSE: TOXICOLOGY AND HISTOLOGICAL TECHNIQUES

Unit I

- Definition and scope of toxicology: Eco-toxicology and its environmental significance.
- Toxic effects: Basic for general classification & nature. Dose-Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures.
- Factors influencing Toxicity. Pharmacodynamics &Chemodynamics, dose conversion between animals and human
- Diagnosis of toxic changes in liver and kidneys : Metabolism of drugs: paracetamol and asprin with their toxic effects on tissues.

Unit II

- Xenobiotics Metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reaction/Conjugation: Methylation, Glutathione and amino acid conjugation. Detoxification.
- Biochemical basis of toxicity: Metabolism of Toxicity: Disturbances of Exitable membrane function. Altered calcium Homeostasis. Covalent binding of cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity.
- Toxicity testing: Test protocol, Genetic toxicity testing & Mutagenesis assays: In vitro Test systems – Bacterial Mutation Test, Ames Test, Fluctuation Tests, *In vivo* Mammalian Mutation tests –DNA repair assays, Chromosome damage test, Evaluation of Apoptosis and necrosis.

Unit III

- Pesticide toxicity: Insecticides: Organochlorines, Anti cholinesterases – Organophosphates and Carbamates, Fungicides. Herbicides, Environmental consequences of pesticide toxicity.
- Biopesticides.
- Food Toxicity: Role of diet in cardio-vascular disease and cancer. Toxicology of food additives.

Unit IVHistological Techniques

- Introduction to histology and histochemistry
- Tissue processing, fixation and microtomy
- Staining methods: acid, basic, neutral and vital stains and various histochemical stains

- Staining of frozen and paraffin sections

Reference Books:

1. Klaassen, C. D (8th Eds.). (2013). *Casarett and Doull's toxicology: the basic science of poisons* . New York: McGraw-Hill.
2. John A. Timbrell (4th Edn) (2008) Principles of biochemical toxicology. Taylor & Francis Ltd, London,.
3. Smart, R. C., & Hodgson, E. (4th Eds.). (2013). Molecular and biochemical toxicology. John Wiley & Sons.
4. Relevant review articles / research papers / handouts of latest development in the subject.
5. Bloom and Fawcett. D. 1972 Text book of histology 10th ed. 3.
6. David H.C. 1987 Histology 9th ed. (Horper International Pub)
7. McManus J.F.A. and Mowry R.W. 1960 Staining methods.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

COURSE CODE:

NAME OF COURSE: BIOSTATISTICS AND RESEARCH METHODOLOGY

Unit I: Basics and concepts of Biostatistics:

- Types of Biological Data: Qualitative Data -Nominal, Ordinal, Ranked; Quantitative Data: Discrete and Continuous.
- Understanding of Population and sample
- Methods of Collection of Data: (i) Experimental Data and (ii) Survey Data- Simple random Sample (with and without replacement), stratified sampling and cluster sampling.
- Tables: Frequency Distributions, Relative Frequencies.
- Graphical Presentation: Bar charts, Histograms, Frequency Polygons, One way scatter plots, Box plots, two-way scatter plots, line graphs.

Unit II: **Statistical tests in Biology**

- Measures of Central Tendency: Mean, Median and Mode, quartiles, deciles and percentiles (both for raw data and grouped data)
- Measures of Dispersion: Range, Interquartile Range, Variance, Standard Deviation and Coefficient of Variation.
- Measures of Skewness and Kurtosis.
- Student's t-test: Paired and Unpaired
- Analysis of Variance
- Regression and Correlation analysis
- Chi-square test

Unit III:**Basic research methodology**

- Research problem, Aims & Objectives, Thesis, report, paper writing.
- Hypotheses testing, Mentoring and mentor-mentee responsibility.
- Optimization of protocol, Graphical data analysis, data validation,
- Multivariate analysis and Plagiarism

Unit IV:**Scientific writing**

- Types of scientific research
- Research scheme and research proposal writing
- National and international Funding agency and its role
- Review writing and submission.

References:

1. Fundamentals of statistics by S.C. Gupta
2. Principles of Biostatistics by Marcello Pagano and Kimberlee Gaurea
3. Biostatistics: A Foundation for Analysis in the Health Sciences by Daniel, Wayne (Seventh Edition), Wiley India Pub.
4. Kothari, Research Methodology, Methods and Techniques

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

COURSE CODE:

NAME OF COURSE: WILDLIFE AND CONSERVATION BIOLOGY- II

Unit I: Wildlife Research and Monitoring

- Conventional Research & Monitoring techniques
- Advanced research & Monitoring techniques
- Camera trapping
- Radio telemetry

Unit II: Advances in wildlife Research

- Non-invasive conservation genetics
- Wildlife diseases and health
- Use of information technology in wildlife research (in silico wildlife research)
- Wildlife forensics and Wildlife crime control: case studies
- Captive breeding programmes

Unit III: Important legislations for wildlife

- Indian Wildlife Protection Act (1972)
- Forest Act (1927)
- National Biodiversity Act (2002)
- Importance of law and regulations in wildlife conservation

Unit IV: Wildlife conservation at global scale

- IUCN as a global conservation organization
- CITIES
- TRAFFIC
- Opportunities for wildlife research

References

1. Sinclair A. R., Fryxell J M and Caughly G. (2006) Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.
2. Gopal R. (1992) Fundamentals of Wildlife Management. Justice Home, Allahabad, India.

3. Jairajpuri M. S. (1990) Collection and preservation of animals. Zoological Survey of India.
4. Magguran, A.E. (1996). Ecological diversity and its measurements. Princeton University.
5. Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity
6. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.

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MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

COURSE CODE:

NAME OF COURSE: FISHERIES AND AQUACULTURE-II

Unit I

- Inland fisheries of India and Gujarat
- Marine fisheries of India and Gujarat
- Coral reefs and their ecological importance
- Mangroves and their ecological importance

Unit II

- Pearl culture
- Freshwater fish culture, induce breeding and preservation of fish
- Prawn culture
- By products of fishing industry

Unit III

- Migration in fish
- Parental care and sexual selection in fish
- Communication in fish
- Fisheries rules and regulation in India and Gujarat

Unit IV

- Ornamental fish production and management
- Mussel farming in India
- Nutrition in aquaculture
- Aquarium management

References

1. Day, F. 1981. Fishes of India, Vol.I and Vol. II. William Sawson& Sons Ltd., London. 2.
2. Jhingran, C.G. 1981. Fish and Fisheries of India. Hindustan Publishing Co., India.
3. Santhanam,R. 1980. Fisheries Science. Daya Publishing House, New Delhi.
4. Yadav, B.N. 1997. Fish and Fisheries. Daya Publishing House, New Delhi
5. Bal D.V. and Rao, K.V. 1990. Marine Fisheries of India. Tata McGraw Hill Publishing Co. Ltd., New York.
6. Upadhyay V. B.2015. Economic Zoology. Rastogi publications.

SEM-IV LAB-I

Practicals based on topics covered in Immunology, Toxicology and Histological Techniques

List of Practicals:

1. To Perform Differential Leukocyte count
2. To learn the technique of Ouchterlony Double Diffusion
3. To learn the technique of Radial Immunodiffusion
4. To learn the technique of Immunoelectrophoresis
5. To perform sandwich Dot ELISA test for antigen
6. To learn the technique of latex -agglutination
7. To separate lymphocytes by density gradient method
8. Estimation of Organic matter of bottom soil.
9. To estimate Lipid peroxidation (LPD) in given tissue
10. To estimate total protein content in given tissue by Folin phenol reagent.
11. Measure the adulteration of Food.
12. Effect of Hypotonic, Hypertonic, Isotonic saline and various concentration of toxin in mammalian blood.

SEM-IV LAB-II

Practicals based on topics covered in Biostatistics and Research Methodology &Wildlife and Conservation Biology- II

List of Practicals:

1. To convert ungrouped data in to grouped data using Sturge's formula.
2. To study representation of data by one dimensional diagram.
3. To study representation of data by two-dimensional diagram.
4. To study representation of data by means of graphs. (Histogram & frequency polygon).
5. To study the data representation by graphs (Frequency polygon & frequency curve).
6. To apply the concept of skewness in the field of biosciences.
7. To apply the concept of F- test for biological problems.
8. To apply the concept of x^2 – test for biological problems.
9. Study of different equipment used for wildlife monitoring
    a. Camara trap
    b. Radio telemetry (Collar and transmitter)
10. Identification of mammalian hairs
11. Identification of endo-parasites from wildlife feacalmatters
12. Preparation of a research design for any wildlife research.
13. Study and use of different mobile apps related to wildlife
    a. e-Bird
    b. Road kills
    c. and other important
14. Case study preparation for at least any one of the following issues
    a. Wildlife crime related issue
    b. Redlist assessment of a species
    c. CITES or TRAFFIC species
15. Participation in at least one Nature Education Camp or Workshop/ Seminar/Training related to wildlife