



PROGRAMME STRUCTURE

M.Sc. Zoology Semester: III

Programme Outcome (PO) - For M.Sc. Zoology Programme	Upon successful completion of Masters of Science in Zoology students will be able to : <ul style="list-style-type: none">● Develop an understanding to associate theoretical concepts and practical skills of Zoological Sciences in day-to-day life● Gain the expertise in operating laboratory instruments with their basic mechanisms and applications● Analyze critically, think holistically and apply the knowledge of various dimensions of Animal Sciences in teaching and research● Correlate the impact of dynamics of ecology with evolution, embryology and development of specific behavior patterns in animals and humans● Accomplish different specialized tasks devotedly suiting to the needs to wildlife conservation, industry, research laboratories and academic institutions
Programme Specific Outcome (PSO) - For MSc Zoology Semester - III	<ul style="list-style-type: none">● To learn about different cytological and molecular level processes in both prokaryotes and eukaryotes including its regulation.● To correlate various level adaptations, variations and speciation using stratigraphy
To Pass	(1) At least 40% marks in each paper at the University Examination and 40% aggregate marks in Internal and External Assessment. (2) At least 33% Marks in each paper in Internal Assessment.





SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25))
Syllabus with effect from the Academic Year 2022-2023

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total	Total	Total
Core Course	PS03CZOO51	Clinical Physiology	T	4	3	30	70	100
	PS03CZOO52	Developmental Biology	T	4	3	30	70	100
	PS03CZOO53	Toxicology	T	4	3	30	70	100
	PS03CZOO54	Practical	P	4	3	30	70	100
	PS03CZOO55	Practical	P	4	3	30	70	100
Elective Course (Any One)	PS03EZOO51	Biological Chemistry	T	4	3	30	70	100
	PS03EZOO52	Aquaculture Technologies	T	4	3	30	70	100
	PS03EZOO53	Bioinformatics	T	4	3	30	70	100





Master of Science Zoology
M.Sc. Zoology Semester (III)

Course Code	PS03CZOO51	Title of the Course	Clinical Physiology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Student should be able to: i. Correlate various systems of the human body with homeostasis. ii. Understand pathophysiological conditions occurring in humans.
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Course Content		
Unit	Description	Weightage* (%)
1.	Homeostasis and the organization of body fluids, Control of Homeostasis, Positive and negative Feedback systems, Homeostatic Imbalances. An overview of human circulatory system. Disorders of circulatory system: respiratory acidosis and alkalosis, metabolic acidosis and alkalosis, Hypoxia, coagulation disorders, hypertension, thalassaemias and anemias.	25
2.	An overview of digestive system. Hormonal and neural regulation of GIT, Gastritis, GIT obstruction, ulcers An overview of Muscular System. Disorders of muscular system: Myasthenia Gravis, muscular dystrophy, fibromyalgia, muscular atrophy and hypertrophy, Rigor Mortis.	25
3.	An overview of Nervous System. Disorders of nervous system: multiple sclerosis, epilepsy, neuropathy, Guillain-Barre syndrome. Neurotoxicity: neurotoxins, anaesthetics, neuro-transmission inhibitors. An overview of Respiratory System. Disorders of respiratory system: Asthama, Chronic Obstructive Pulmonary Disease, Cystic fibrosis, Pnumonia, Pulmonary edema.	25
4.	An overview of human urinary system. Role of kidney in body water, electrolyte and acid-base balance. Renal malfunctions and hemodialysis. Nephrotic syndrome, Kidney stone, UTI Disorders of reproductive systems: prostate disorders, cryptorchidism and hernias, PMS, PMDD. Birth control: Physiology of birth control methods.	25





Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students should be able to read and understand diagnostic reports.
2.	Student should be able to understand, how to maintain health

Suggested References:	
Sr. No.	References
1.	Hall, J. E., & Guyton, A. C. (2016). Textbook of medical physiology (13 th Edn.). Elsevier, Philadelphia.
2.	Barrett, K. E., & Ganong, W. F. (2019). Ganong's review of medical physiology (26 th Edn.) McGraw-Hill Medical, New York.
3.	Tortora, G. J., & Grabowski, S. R. (2017). Principles of Anatomy and Physiology (15 th Edn). HarperCollins College, New York.

On-line resources to be used if available as reference material





On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science (Zoology)
M.Sc. Zoology Semester III

Course Code	PS03CZOO52	Title of the Course	Developmental Biology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To understand the abnormalities in gametes and defects in embryo2. To learn about early and late development of model animals including humans with reference to growth patterns of embryo and their role in developmental obstructions.3. To impart knowledge of axis formation in normal and abnormal conditions4. To provide the information on the role of environment and other epigenetic factors like estrogenic agents, pollutants5. To strengthen the comprehensive views of evolution and developmental processes
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Course Content		
Unit	Description	Weightage* (%)
1.	Introduction, gametogenesis, fertilization and molecular aspects of development: Introduction to animal development. Fertilization: Structure of gametes, Egg Differential gene expression and cell gene transcription, RNA processing, Control of gene expression at translation, Cell adhesion and cell signalling	25
2.	Early and late development: Early development in invertebrates and vertebrates: Cleavage and pattern of embryonic cleavage; Comparative account of gastrulation; Early development in Sea urchin, C. elegans; Drosophila; Amphibia; Birds; Mammals. Later embryonic development: Development of ectoderm, Neurulation and Central Nervous system. Neural crest cell; Development of mesoderm: Paraxial mesoderm, Intermediate mesoderm, Lateral plate mesoderm. Development of endoderm	25
3.	Body Axes: Establishment of body axes in C. elegans, Birds and Mammals, Tetrapod limb development: Proximo-distal, Anterior-Posterior, Dorsal-ventral; Cell death pathway Drosophila axis specification: Dorso-ventral pattern, Segmentation and Anterior-Posterior body plan, Maternal gradient, Segmentation genes	25





4.	<p>Hormones and environment- regulators of development: Hormones as mediators of development: Amphibian metamorphosis: Morphological and biochemical changes, Hormonal control. Insect metamorphosis: Imaginal discs-- Determination of axes in wing/leg imaginal discs. Hormonal control, and Molecular mechanism of action of ecdysone. Birth defects, Endocrine disruptors and cancer. Environment as a normal agent in producing phenotype: Polyphenisms and Plasticity, Temperature and sex, Environmental induction of behavioural phenotypes and Learning,</p>	25
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Teaching-Learning Methodology	<p>Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.</p>
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand of gametogenesis and evolving inadequacies
2.	Know about germ layer formation, late development and associated irregularities
3.	Correlate axis specification and congenital abnormalities
4.	Get information about role of environment in growth and development
5.	Understand relationship between ontogeny and phylogeny

Suggested References:





Sr. No.	References
1.	Barresi, M., J., F., Gilbert, S., F., (2019). Developmental biology. 12 th Edn. Sunderland, Mass: Sinauer Associates, United States
2.	Berrill, N., J., Karp, G., (1981). Development. McGraw Hill Inc. New York
3.	Balinsky, B. I., (2012). An introduction to Embryology. 5 th Edn. Cengage Learning, India
4.	Wolpert, L., Tickle, C., Arias, A., M., (2015). Principles of Development, Current Biology Ltd., London, New York.

On-line resources to be used if available as reference material
On-line Resources
Relevant review articles/research papers/handouts of latest development in the subject





Master of Science (Zoology)
M.Sc. Zoology Semester III

Course Code	PS03CZOO53	Title of the Course	Toxicology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none"> 1. To learn about the dose-response relationships and understand the toxicity of various substances 2. To comprehend the knowledge of absorption, distribution, metabolism and elimination of xenobiotics 3. To provide an overview on legislative measures in the field of food, drugs and environmental toxicants
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Course Content		
Unit	Description	Weightage* (%)
1.	<p>Definition and scope of toxicology: Eco-toxicology and its environmental significance, Biochemical Aspects of Toxicology Toxic effects: Basic for general classification & nature. Measurement of Dose-Response Relationships, Synergism and Antagonism 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 aspirin with their toxic effects on tissues.</p>	25
2.	<p>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 Excitable membrane function. Altered calcium Homeostasis. Covalent binding of cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity. Toxicity testing: Models for toxicity testing; Acute and Chronic toxicology testing, Experimental design; Genetic toxicity testing & Mutagenesis assays In vitro Test systems – Bacterial Mutation Test, Ames test, <i>In vivo</i> Mammalian Mutation tests –DNA repair assays, Chromosome damage test, Evaluation of Apoptosis and necrosis</p>	25
3.	<p>Pesticides: Insecticides: Organochlorines, Anti cholinesterases- Organophosphates and Carbamates, Fungicides: Captan, Di-thio carbamates, Herbicides: 2,4 D, Atrazine; Food additives: Preservatives,</p>	25





	Processing aids, Flavor and taste modifiers, Nutritional additives; Role of diet in cardio-vascular disease and cancer. Toxicology of food additives; Metal Toxicity: Toxicology of Arsenic, mercury, lead and cadmium.	
4.	Regulatory Toxicology: Rules and Regulations of Nuclear Regulatory Commission (NRC); Environmental Protection Agency (EPA); Food and Drug Administration (FDA); Drug Enforcement Administration (DEA); Occupational Safety and Health Assessment (OSHA); Committee for Purpose of Control and supervision of experimental on animals (CPCSEA)	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn the toxicity testing methods and designing of animal experimentations in pharmaceutical and drug industries or research organizations
2.	Correlate concentrations of doses, duration of exposure and animal responses





Suggested References:

Sr. No.	References
1.	Klaassen, C., D., (Ed) (2013). Casarett and Doull's toxicology : the basic science of poisons. McGraw-Hill Education, New York.
2.	Timbrell, J. A., (2008). Principles of biochemical toxicology. Taylor and Francis Ltd., London.
3.	Smart, R. C., Hodgson, E., (Ed.) (2013). Molecular and biochemical toxicology. John Wiley and Sons, Inc.
4.	Barley, F., (2007). Principles of Toxicity testing. CRC Press, New York

On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science Zoology
M.Sc. Zoology Semester (III)

Course Code	PS03CZOO54	Title of the Course	Lab-1
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn to determine concentration of blood parameters like glucose, lipid parameters, etc.2. To correlate the developmental stages in frog and chick3. To understand the sperm morphology, motility and vitality related aspects
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PS03CZOO54 (Lab-1)

1. Determination of serum glucose by GOD/POD method
2. Estimation of total cholesterol, HDL, LDL
3. Demonstration of blood pressure using digital and conventional methods
4. Observation of anatomy slides
5. Comparison of bleeding and clotting time in male and female
6. Determination of Salivary Amylase activity
7. Oxygen saturation measurement using pulse oximeter
8. Measurement of muscle strength
9. Lung capacity measurement using spirometer
10. Observation of permanent slides of developmental stages of frog and chick
11. To study mammalian sperm:
 - (a) Morphology and morphological abnormalities
 - (b) Live: dead ratio
 - (c) vitality
 - (d) Acrosomal intactness
 - (e) Mitochondrial activity
 - (f) hypoosmotic test
 - (g) Localization of DNA/RNA
12. Preparation of permanent slide of chick embryo
13. Demonstration of teratogenesis in chick embryo
14. Localization of enzymes in embryo
15. Study of permanent slides of mitosis and meiosis
16. Preparation of slide of Polytene chromosome from Chironomus larva
17. Study of developmental stages of drosophila





Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Work with clinical samples and carry out analysis.
2.	Describe cleavage patterns, gastrulation and organogenesis processes

Suggested References:	
Sr. No.	References
1.	Pal, G., K., Pal, P., (2020). Textbook of Practical Physiology. 5 th Edn. Universities Press (India) Pvt. Ltd., Hyderabad
2.	Marí-Beffa, M., Knight, J., (2011). Key Experiments in Practical Developmental Biology. 1 st Edn. Cambridge University Press, United Kingdom





Master of Science Zoology
M.Sc. Zoology Semester (III)

Course Code	PS03CZOO55	Title of the Course	Lab-2
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To understand the basic principles and instrumentation of spectrophotometry2. To learn the concepts of protein purification and quantification of major biomolecules
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PS03CZOO55 (Lab-2 A)

1. To study Beer Lambert's Law using any color solution
2. To determine absorption maxima of a colored solution
3. Standard curve preparations for glucose, cholesterol, protein
4. To calculate isoelectric points of amino acids
5. Qualitative analysis of carbohydrates and proteins
6. Quantitative measurements of: Glycogen and Glucose
7. To analyze protein concentrations
8. To estimate lipids and total cholesterol levels

PS03CZOO55 (Lab-2 B)

Practicals related to elective papers

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%





3.	University Examination	70%
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Course Outcomes: Having completed this course, the learner will be able to

1.	Gain experience of correlating various biochemical solutions based on solubility, alkalinity and quantifications
2.	Describe significance of carbohydrates, proteins and cholesterol levels in biological samples

Suggested References:

Sr. No.	References
1.	Godkar, P., B., (2020). Textbok of Medical Laboratory Technology. 3 rd Edn. Bhalani Publishing House, New Delhi
2.	Marí-Beffa, M., Knight, J., (2011). Key Experiments in Practical Developmental Biology. 1 st Edn. Cambridge University Press, United Kingdom





Master of Science (Zoology)
M.Sc. Zoology Semester III

Course Code	PS03EZOO51	Title of the Course	Biological Chemistry
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	<ol style="list-style-type: none">1. To understand fundamental aspects of bioenergetics and mechanism of enzymes2. To learnt about structure and functions of proteins and amino acids3. To study carbohydrate metabolic pathways and regulatory measurements4. To gain knowledge related to lipid metabolism and monitoring parameters
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Course Content		
Unit	Description	Weightage* (%)
1.	Matter and energy, Atomic structure, ions, electrolytes, free radicals, solutions, colloids, suspensions, chemical reactions, acids, bases, pH. Principles of Bioenergetics: Bioenergetics and Thermodynamics, ATP, Biological oxidation-reduction reactions. 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 Oxidative phosphorylation and electron transport chain	25%
2.	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.	25%
3.	Carbohydrate Metabolism: Glycolysis pathway and regulation. Cori cycle, Gluconeogenesis, glycogenolysis and glycogenesis. Pentose phosphate pathway, Synthesis of complex polysaccharides-glycoproteins and proteoglycans.	25%
4.	Lipid Metabolism: Chemical nature of fatty acids, synthesis of fatty acids. Storage of fatty acids and utilization. Regulation of lipid metabolism. Biochemistry of phospholipids, cholesterol, sphingolipids, prostaglandins, thromboxanes and oxy eicosatetraenoic acids.	25%

Teaching-	Topics will be taught and discussed in interactive sessions using
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Learning Methodology	conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Explain various metabolic activities leading to synthesis or breakdown of different macromolecules
2.	Learn structural and functional correlations of major building blocks of human body
3.	Understand and explain the process of energy generation in the cell

Suggested References:	
Sr. No.	References
1.	Nelson, D., L., Cox, M., (2013). Lehninger Principles of Biochemistry. 6 th Edn. W. H. Freeman Publications, New York
2.	Stryer, L., (2002). Biochemistry- clinical companion. 5 th Edn. H. Freeman & Co Ltd, New York
3.	Rodwell, V., Bender, D., Weil, A., P., Kennelly, P., Botham, K., (2015). Harper's Illustrated Biochemistry. 30 th Edn. McGraw-Hill Education, India
4.	Voet, D., Voet, J., G., (2010). Biochemistry. 4 th Edn. John Wiley & Sons, Inc, United States
5.	Zubay, G., (1997). Biochemistry. 4 th Edn. Brown (William C.) Company, United States





On-line resources to be used if available as reference material

On-line Resources

Relevant review articles / research papers / handouts of latest development in the subject.





Master of Science (Zoology)
M.Sc. Zoology Semester III

Course Code	PS03EZOO52	Title of the Course	Aquaculture Technologies
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To understand culture practices of IMCs and shrimps/ prawns; and to get information on induced breeding techniques and hatchery management2. To know the major diseases of cultivable fishes as well as shrimps and their management3. To get the knowledge of fish nutrition and formulation of supplementary feed4. To learn the importance of different molecular and cytogenetics techniques in aquaculture5. To acquire information on recent developments in aquaculture
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Course Content		
Unit	Description	Weightage* (%)
1.	Culture practices and induced breeding: Culture practices: Indian major carps and exotic carps; Shrimps and prawns. Induced Breeding: Hormonal regulation of gonadal development, Activity of Gonadotropin. releasing hormone, application of hormones in aquaculture. Sex determination and control. Induction of maturation and spawning.	25
2.	Diseases: Fish and Prawn/ Shrimp Diseases: Types of Diseases- viral, bacterial, fungal, protozoan and other parasitic diseases; Diagnosis; Control measures; Water quality parameters, Role of biopesticides; Application of monoclonal antibodies; Vaccines and immunostimulants; Drug resistance	25
3.	Fish nutrition: Aquafeed: Nutrition, Feed formulation, Feed additives, Alternative feed ingredients. Nutritional diseases of fish. Fish products and byproducts, fish processing, production of fish sauce by lactic acid fermentation. Microbial hazards in seafood.	25
4.	Cytogenetics and molecular techniques in fisheries: Comet Assay, Micronuclei Test, Fish Cell Culture, Application of Hybridoma Technology, Transgenesis and Androgenesis and recent developments in marine biotechnology. Inheritance of quantitative traits. Jellyfish Green Fluorescent Proteins and their applications.	25





Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn culture techniques of economically important fish and shrimp species; and learning hypophysation technique
2.	Understand management of diseases in intensive aquaculture practices
3.	Correlate nutritional aspects of cultivable fish species with formulation of fish feed
4.	Apply the information of recent molecular and cytogenetics techniques for better management of aquaculture
5.	Gain knowledge of therapeutically active molecules in various diseases and other advanced applications

Suggested References:	
Sr. No.	References
1.	Jayaram, K., C., (1981). The fresh water fishes of India, Pakistan, Bangladesh, Burma





	and Sri Lanka. 1 st Edn. Zoological Survey of India, Calcutta
2.	Jhingran, V. G. (1991). Fish and Fisheries of India. 3 rd Edn. Delhi : Hindustan Publication Corporation, India
3.	Kurian, C., V., Sebastian, V., O., 1986. Prawns and Prawn fisheries of India. 5 th Edn., Hindustan Publication Corporation, India
4.	Balakrishna Nair, N. and D.M. Thampy, 1980 A text Book of Marine Ecology, The Macmillan Co. of India Ltd., New Delhi.
5.	Lakra, W., S., Abidi, S., A., H., Mukherjee, S., C., Ayyappan, S., (2004). Fisheries Biotechnology. Narendra Publication House, Jammu.
6.	Pillay, T.,V., R., Kutty, M., N., (2012). Aquaculture – Principles and Practices. 2 nd Edn. Blackwell Publishing, New Delhi

On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science (Zoology)
M.Sc. Zoology Semester III

Course Code	PS03EZOO53	Title of the Course	Bioinformatics
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	<ol style="list-style-type: none"> 1. To get knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics 2. To explore existing software effectively to extract information from large databases and to use this information in computer modelling 3. To get problem-solving skills, including the ability to develop new algorithms and analysis methods. 4. To train student for understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.
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Course Content		
Unit	Description	Weightage* (%)
1.	<ul style="list-style-type: none"> ❖ Introduction to Bioinformatics: <ul style="list-style-type: none"> ▪ Introduction and Bioinformatics Resources: ▪ Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, Literature databases: ▪ Describe about various approaches in genome sequencing and NGS ▪ Overview of Sequence trace files (or chromatograms) raw data output from sequencer machines, Assembling and storing of the sequencer data files. ▪ Nucleic acid sequence databases: GenBank, EMBL, DDBJ ▪ Protein sequence databases: SWISS-PROT, TrEMBL, PIR, PDB, SCOP, CATH ▪ Genome Databases at NCBI, EBI, TIGR, SANGER ▪ Other Databases of Patterns/Motifs/System Biology (Gene and protein network database and resources) ❖ Sequence analysis: <ul style="list-style-type: none"> ▪ Various file formats for bio-molecular sequences: GENBANK, FASTA, GCG, MSF, NBRF-PIR etc. ▪ Basic concepts of sequence similarity, identity and homology, Definitions of homologues, orthologues, paralogues, xenologus. ▪ Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series. ▪ Database Searches: what are sequence-based database 	25%





	<p>searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA.</p> <ul style="list-style-type: none">▪ Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Needleman & Wunchsh, Smith & Waterman algorithms for pairwise alignments, Progressive and hierarchical algorithms for MSA.▪ Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results.	
2.	<ul style="list-style-type: none">❖ Gene prediction:<ul style="list-style-type: none">▪ Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions, Evaluation of Gene Prediction methods.❖ Computational RNA Structure analysis:<ul style="list-style-type: none">▪ Secondary and tertiary structure of RNA. Various algorithms of RNA folding and their analysis. Energy minimization in RNA folding. RNA sequence alignment based on secondary structure and its applications in functional genomics and phylogeny.❖ Transcriptomics:<ul style="list-style-type: none">▪ Complete transcript cataloguing and gene discovery sequencing▪ Microarray based technologies and computation based technologies	25%
3.	<ul style="list-style-type: none">❖ Genomics:<ul style="list-style-type: none">▪ Concepts and tools for genomics and comparative Genomics▪ Ancient conserved regions▪ Horizontal gene transfer▪ Functional classification of genes▪ Gene order (synteny) is conserved on chromosomes of related organisms.▪ Prediction of gene function based on a composite analysis.▪ Functional genomics.▪ Putting together all of the information into a genome database.❖ Phylogenetic analysis:<ul style="list-style-type: none">▪ Definition and description of phylogenetic trees and various types of trees, Molecular basis of evolution, Method of construction of Phylogenetic trees: Distance based method (UPGMA, NJ), Character Based Method (Maximum Parsimony and Maximum Likelihood method).	25%
4.	<ul style="list-style-type: none">❖ Proteomics and Protein Computational Biology:<ul style="list-style-type: none">▪ Tools for proteomics: Acquisition of protein structure information, databases and applications.	25%





	<ul style="list-style-type: none">▪ Structural classification of proteins, Protein structure analysis structure alignment and comparison,▪ Secondary structure and evaluation: algorithms of Chou Fasman, GOR methods.▪ Tertiary Structure: Basic principles and protocols, Methods to study 3D structure; Prediction of specialized structures. Protein folding, Protein modelling, Method of protein structure evaluation; Active site prediction.▪ Protein-protein and protein-ligand interaction/Docking; Drug Designing, QSAR studies.❖ Protein structure comparison and classification:<ul style="list-style-type: none">▪ Classes, Folds, Motif, Domain;▪ Purpose of structure comparison▪ Algorithms such as FSSP, VAST and DALI.▪ Principles of protein folding and methods to study protein folding.	
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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Know about the basic concepts of Bioinformatics and its significance in Biological data analysis.
2.	Learn the basics and advance of sequence alignment and analysis.
3.	Get overview about biological macromolecular structures and structure prediction methods.





4.	Understand the structural organisation, structural properties and various techniques employed in the structure determination of Biological macromolecules – DNA & Protein.
5.	Exposure to computational methods, tools and algorithms employed for Biological Data Interpretation.
6.	Have hands on training on various computational tools and techniques employed in Biological sequence analysis.
7.	Get exposed to various tools and methodologies used in multiple sequence alignment, phylogenetic analysis and genetic diversity analysis observed in biological sequences.
8.	Knowledge on chemical databases, various advanced techniques and tools like docking, QSAR studies etc employed in computational drug discovery.
9.	Knowledge about various approaches in genome sequencing and NGS.

Suggested References:

Sr. No.	References
1.	Clavarie, J. M., Notredame, C., (2003). Bioinformatics: A Beginners Guide. Wiley India Private Limited. Uttarpradesh
2.	Mount, D., W., (2004). Bioinformatics: Sequence and Genome Analysis. 2 nd Edn. Cold Spring Harbor Laboratory Press. United States.
3.	Rastogi, S.C., Mendiratta, N, Rastogi, P., (2013). Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. 4 th Edn. Prentice Hall India Learning Private Limited, New Delhi
4.	Lesk, A., M., (2013). Introduction to Bioinformatics. 4 th Edn. Oxford University Publications, India
5.	Ghosh, Z., Mallick, B., (2008). Bioinformatics: Principles and applications. Illustrated Edition. Oxford University Press, India
6.	Orengo, C., Jones, D., Thornton, J., (2002). Bioinformatics: Genes, Proteins and Computers. 1 st Edn. Taylor and Francis Publications, United Kingdom
7.	Webster, D., (2000). Protein structure prediction, methods and protocols. 1 st Edn. Humana Press, New Jersey

On-line resources to be used if available as reference material

On-line Resources





Nucleotide Sequence Databases (the principal ones)

- [NCBI](#) - National Center for Biotechnology Information
- [EBI](#) - European Bioinformatics Institute
- [DDBJ](#) - DNA Data Bank of Japan

Protein Sequence Databases

- [SWISS-PROT & TrEMBL](#) - Protein sequence database and computer annotated supplement
- [UniProt](#) - UniProt (Universal Protein Resource) is the world's most comprehensive catalog of information on proteins. It is a central repository of protein sequence and function created by joining the information contained in Swiss-Prot, TrEMBL, and PIR.
- [PIR](#) - Protein Information Resource
- [MIPS](#) - Munich Information centre for Protein Sequences
- [HUPO](#) - HUMAN Proteome Organization

Database Searching by Sequence Similarity

- [BLAST @ NCBI](#)
- [PSI-BLAST @ NCBI](#)
- [FASTA @ EBI](#)
- [BLAT](#) Jim Kent's Blat is just superb in terms of speed and the integrated view you get for viewing the results

Sequence Alignment

- [USC Sequence Alignment Server](#) - align 2 sequences with all possible varieties of dynamic programming
- [T-COFFEE](#) - multiple sequence alignment
- [ClustalW @ EBI](#) - multiple sequence alignment
- [MSA 2.1](#) - optimal multiple sequence alignment using the Carrillo-Lipman method
- [BOXSHADE](#) - pretty printing and shading of multiple alignments
- [Splign](#) - Splign is a utility for computing cDNA-to-Genomic, or spliced sequence alignments. At the heart of the program is a global alignment algorithm that specifically accounts for introns and splice signals.
- [Spidey](#) - an mRNA-to-genomic alignment program

Protein Domains: Databases and Search Tools

- [InterPro](#) - integration of Pfam, PRINTS, PROSITE, SWISS-PROT + TrEMBL
- [PROSITE](#) - database of protein families and domains
- [Pfam](#) - alignments and hidden Markov models covering many common protein domains
- [SMART](#) - analysis of domains in proteins
- [ProDom](#) - protein domain database
- [PRINTS Database](#) - groups of conserved motifs used to characterise protein families
- [Blocks](#) - multiply aligned ungapped segments corresponding to the most highly conserved regions of proteins

Protein 3D Structure

- [PDB](#) - protein 3D structure database
- [RasMol / Protein Explorer](#) - molecule 3D structure viewers
- [SCOP](#) - Structural Classification Of Proteins
- [UCL BSM CATH classification](#)





- [The DALI Domain Database](#)
- [FSSP](#) - fold classification based on structure-structure alignment of proteins
- [SWISS-MODEL](#) - homology modeling server
- [Structure Prediction Meta-server](#)
- [K2](#) - protein structure alignment
- [DALI](#) - 3D structure alignment server
- [DSSP](#) - defines secondary structure and solvent exposure from 3D coordinates
- [HSSP Database](#) - Homology-derived Secondary Structure of Proteins
- [PredictProtein & PHD](#) - predict secondary structure, solvent accessibility, transmembrane helices, and other stuff
- [Jpred2](#) - protein secondary structure prediction
- [PSIpred \(& MEMSAT & GenTHREADER\)](#) - protein secondary structure prediction (& transmembrane helix prediction & tertiary structure prediction by threading)

Phylogeny & Taxonomy

- [The Tree of Life](#)
- [Species 2000](#) - index of the world's known species
- [TreeBASE](#) - a database of phylogenetic knowledge
- [PHYLIP](#) - package of programs for inferring phylogenies
- [TreeView](#) - user friendly tree displaying for Macs & Windows

Gene Prediction

- [Genscan](#) - eukaryotes
- [GeneMark](#)
- [Genie](#) - eukaryotes
- [GLIMMER](#) - prokaryotes
- [tRNAscan - SE 1.1](#) - search for tRNA genes in genomic sequence
- [GFF \(General Feature Format\) Specification](#) - a standard format for genomic sequence annotation

Metabolic, Gene Regulatory & Signal Transduction Network Databases

- [KEGG](#) - Kyoto Encyclopedia of Genes and Genomes
- [BioCarta](#)
- [DAVID](#) - Database for Annotation, Visualization and Integrated Discovery - A useful server to for annotating microarray and other genetic data.
- [stke](#) - Signal Transduction Knowledge Environment
- [BIND](#) - Biomolecular Interaction Network Database
- [EcoCyc](#)
- [WIT](#)
- [PathGuide](#) A very useful collection of resources dealing primarily with pathways
- [SPAD](#) - Signaling Pathway Database
- [CSNDB](#) - Cell Signalling Networks Database
- [PathDB](#)
- [Transpath](#)
- [DIP](#) - Database of Interacting Proteins
- [PFBP](#) - Protein Function and Biochemical Networks





PROGRAMME STRUCTURE

M.Sc. Zoology Semester: IV

Programme Outcome (PO) - For M.Sc. Zoology Programme	Upon successful completion of Masters of Science in Zoology students will be able to : <ul style="list-style-type: none">● Develop an understanding to associate theoretical concepts and practical skills of Zoological Sciences in day-to-day life● Gain the expertise in operating laboratory instruments with their basic mechanisms and applications● Analyze critically, think holistically and apply the knowledge of various dimensions of Animal Sciences in teaching and research● Correlate the impact of dynamics of ecology with evolution, embryology and development of specific behavior patterns in animals and humans● Accomplish different specialized tasks devotedly suiting to the needs to wildlife conservation, industry, research laboratories and academic institutions
Programme Specific Outcome (PSO) - For MSc Zoology Semester - II	<ul style="list-style-type: none">● To understand methods and applications of analytical techniques for characterization and separation● To study complexities of behavioral patterns in captivity and in wild● To learn about immune system, defense mechanisms and related abnormalities
To Pass	(1) At least 40% marks in each paper at the University Examination and 40% aggregate marks in Internal and External Assessment. (2) At least 33% Marks in each paper in Internal Assessment.





SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
 (Reaccredited with 'A' Grade by NAAC (CGPA 3.25))
 Syllabus with effect from the Academic Year 2022-2023

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total	Total	Total
Core Course	PS04CZOO51	Animal Biotechnology	T	4	3	30	70	100
	PS04CZOO52	Molecular and Applied Endocrinology	T	4	3	30	70	100
	PS04CZOO53	Practical	P	4	3	30	70	100
	PS04CZOO54	Viva-Voce	=	1	=	=	50	50
Elective Course (Any Two)	PS04EZOO51	Genetics	T	4	3	30	70	100
	PS04CZOO52	Research Ethics and Scientific Writing	T	4	3	30	70	100
	PS04EZOO53	Nutritional and Clinical Biochemistry	T	4	3	30	70	100
	PS04EZOO54	Biomaterials and Tissue Engineering	T	4	3	30	70	100
	PS04EZOO55	Biodiversity and Conservation	T	4	3	30	70	100
		OR						
Core Course	PS04CZOO51	Animal Biotechnology	T	4	3	30	70	100
	PS04CZOO52	Molecular and Applied Endocrinology	T	4	3	30	70	100
	PS04CZOO53	Practical	P	4	3	30	70	100
	PS04CZOO54	Viva-Voce	=	1	=	=	50	50
Elective Course	PS04EZOO56	Dissertation	=	12	=	=	300	300





Master of Science (Zoology)
M.Sc. Zoology Semester IV

Course Code	PS04CZOO51	Title of the Course	Animal Biotechnology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to : (1) Learn maintenance of subculture and cell lines (2) Understand the pharmaceutical importance and toxicological aspects of cell culture
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Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to animal tissue culture (Background, Advantages and limitations of tissue culture, major differences between in vivo and in vitro, types of tissue culture) Biology of cultured cells (Brief description on cell adhesion, cell proliferation, energy metabolism and origin of cultured cells) General out-line of cell types (epithelial tissue, connective tissue, muscular tissue and nervous tissue) Stem cells, germ cells and amniocytes (Culture of embryonic stem cells, culture of amniocytes, applications of stem cells) Aseptic Techniques (Objectives of aseptic techniques, elements of aseptic environment, sterile handling) Sterilization (Different types- dry heat (hot air oven, wet heat (autoclaving), various chemical agents used in sterilization, irradiation techniques (UV and Gamma Ray) Culture of specialized cells (liver, epidermal, astrocytes, testis and ovary)	25
2.	Defined media and supplements (Physicochemical properties, balanced salt solutions, serum, selection of medium and serum) Serum- Free Media (Disadvantages of serum, advantages of Serum-free media, Preparation of serum free media, Animal protein free media) Primary culture (Initiation of primary cell culture, isolation of tissue, types of primary culture, mechanical and enzymatic disaggregation) Sub culture and cell lines (Subculture and propagation, routine maintenance, subculture of monolayer and suspension cultures) Monitoring for contamination- Visible microbial contamination, mycoplasma, Viral contamination, Eradication of contamination	25
3.	Cell cloning and selection (Feeder layer, suspension cloning, separation of clones)	25





	<p>Cell separation (Centrifugation, Antibody based techniques, FACS) Cell differentiation (Stem cell plasticity, markers of differentiation, induction of differentiation, differentiation and malignancy) Transformation and Immortalization (Immortalization with viral genes, Immortalization of human fibroblasts, telomerase induced immortalization, Aberrant growth control, tumorigenicity) Characterization (Need for characterization, characterization based on cell morphology, DNA and RNA content, enzyme activity and antigenic markers)</p>	
4.	<p>Reproductive biotechnology: artificial insemination, super ovulation, embryo recovery and in vitro fertilization, ISCI, ZIFT, GIFT, 3 D culture and Idmoc, culture and cryopreservation of embryos, applications of transgenic animal biotechnology; animal cloning- basic concept, cloning for conservation of endangered species. Vaccinology: conventional methods of animal vaccine production, recombinant approaches to vaccine production, modern vaccines.</p>	25

Teaching-Learning Methodology	<p>Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.</p>
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Student should be able to maintain and work in animal cell culture as well as vaccine production lab





Suggested References:

Sr. No.	References
1.	Freshney, R., I., (2015). Culture of Animal cells: a manual of basic technique and specialized applications. 6 th Edn. John Wiley & Sons, Chicago.
2.	Masters, J., R., (2000). Animal Cell Culture: a practical approach. 3 rd Edn. Oxford University Press, United Kingdom
3.	Davis, J., M., (Ed.) (2000). Animal Cell Culture: essential methods. John Wiley and Sons, United Kingdom.
4.	Barresi, M., J., F., Gilbert, S., F., (2019). Developmental biology. 12 th Edn. Sunderland, Mass: Sinauer Associates, United States

On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science (Zoology)
M.Sc. Zoology Semester IV

Course Code	PS04CZOO52	Title of the Course	Molecular and Applied Endocrinology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To explain characteristics of different endocrine glands and their secretions2. To examine the structural and functional relationships amongst hypothalamus, pituitary and other glands3. To study the chemical classes of hormones and mechanism of hormone action4. To correlate the normal vs pathophysiological conditions of endocrine organs and glands5. To review the bioanalytical techniques for hormone estimation
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Course Content		
Unit	Description	Weightage* (%)
1.	Introduction: A brief history of discovery of hormones. An overview of vertebrate endocrine system. Structural features and hormones of endocrine glands- hypothalamus, pituitary, pineal, thyroid, parathyroids, GI tract, pancreatic islets, adrenals and gonads. Endocrine methodologies: Ablation and replacement, bioassays, immunoassays, Immunocytochemistry, autoradiography, electrophysiological and pharmacological methods, hormone-receptor interactions, cloning techniques.	25
2.	General classes of hormones: Peptide, Thyroid, Steroid, Neurotransmitters, Neuropeptides, Chalone, Peptide-growth stimulating factors, Eicosanoids and pheromones Hormones and endocrine glands: Synthesis and control of synthesis, Storage, Metabolism and functions. Endocrinology of pregnancy, Parturition and Lactation.	25
3.	Mechanisms of hormone action: Receptors and types- Membrane receptors, Nuclear receptors; Receptor regulation and signal transduction, Second messengers, Permissive actions of hormones and termination of hormone action.	25
4.	Pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones. Imaging and nuclear medicine in endocrine disease and hormone-replacement therapies.	25





Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Awareness about the structure and function of endocrine glands and organs
2.	Learn about Hypothalamo-pituitary axis and interactions with other endocrine secretions
3.	Examine the hypo- and hyper- levels of hormones leading to endocrine pathologies
4.	Understand electrophysiological and endocrine methodologies

Suggested References:	
Sr. No.	References
1.	Bolander, F., F., (1989). Molecular Endocrinology. 3 rd Edn. Academic Press, Elsevier, United States
2.	Lodish, H., Berk, A., Kaiser, C., Kreiger, M., Scott, M., Bretscher, A., et al., (2008). Molecular Cell Biology. 6 th Edn. WH Freeman and Company, New York
3.	Norris, D. O., Carr, J., A., (2013). Vertebrate Endocrinology. 5 th Edn. Academic Press, New York
4.	Tortora, G. J., & Grabowski, S. R. (2017). Principles of Anatomy and Physiology (15 th Edn). HarperCollins College, New York.





5.	Brook, C., G., D., Marshall, N. J., (2001). Essential Endocrinology. 4 th Edn. Wiley-Blackwell Publishing, United States
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On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Course Code	PS04CZOO53	Title of the Course	Lab-1
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn lab lay out for animal cell culture laboratory.2. To maintain sterile conditions and culture cell lines.3. To estimate various biochemical parameters in clinical specimens.4. To study histology of endocrine tissues and organs
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PS04CZOO53 (Lab-1)

1. Lab instruments (CO₂ incubator, biosafety, inverted microscope)
2. Viable count (trypan blue)
3. MTT assay
4. Primary and secondary culture of animal cells
5. Comparative studies of endocrine glands of selected invertebrates and vertebrates
6. Estimation of serum glucose and serum cholesterol
7. Determination of serum calcium and serum inorganic phosphorous
8. Estimation of hepatic glycogen
9. Dissection of pituitary gland and HE staining
10. Histological observations of endocrine glands
11. Study of pathology of endocrine glands
12. Study of oestrous cycle and menstrual cycle

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Culture and maintain cell lines
1.	Perform cell viability studies





2	Learn structure and function relationships of endocrine glands and tissues
3.	Understand different stages of reproductive cycles

References:

1	Freshney, R., I., (2015). Culture of Animal cells: a manual of basic technique and specialized applications. 6 th Edn. John Wiley & Sons, Chicago.
2.	Lavin, N., (2018). Manual of Endocrinology & Metabolism. 5 th Edn. Wolters Kluwer India Private Limited, Pune, Maharashtra





Master of Science (Zoology)
M.Sc. Zoology Semester IV

Course Code	PS04EZOO51	Title of the Course	Genetics
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To learn about principles of genetics and mendelian laws2. To correlate the effects of various mutagenic agents on genotype3. To understand and interpret the pedigree chart and correlate inheritance4. To study the molecular mechanisms, testing methods and remedial measures of disorders
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Course Content		
Unit	Description	Weightage* (%)
1.	Mendelian principles and its extensions: Dominance, segregation, independent assortment; Codominance, incomplete dominance, gene interactions, Pleiotropy, genomic imprinting, penetrance and expressivity, Linkage and crossing over, sex linkage, sex limited and sex influenced characters; Autosomal and sex linked inheritance	25
2.	Mutation and mutagenesis, DNA repair, Types of mutations; Silent mutations; Mutagens; Mutations from mispairing and recombination. DNA repair system; Repair by recombination; Repair system in bacteria and eukaryotes	25
3.	Fundamentals of chromosomes, structure and inheritance Chromosome organization, Chromosomal abnormalities; autosomal and recessive disorders, Pedigree analysis; Mendelian and non-Mendelian pedigrees; Mosaicism, Chimerism, Polygenic and Multifactorial inheritance, inborn errors of metabolism	25
4.	Structure and molecular genetics of Mitochondria; mitochondrial, muscle and neurological disorders, Cancer- Diagnosis, Testing. Features of human genome: Mapping of human genome. Human genome project. Manipulation of human genes. Creating animal models of diseases. Gene therapy and other molecular genetic based therapeutic approaches.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a
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	suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand role of genes in growth, development and diseases
2.	Learn about pedigree charts and prediction of congenital abnormalities
3.	Comprehend the importance of causative factors in progression of carcinogenesis

Suggested References:	
Sr. No.	References
1.	Karp, G., Iwasa, J., Marshall, W., (2016). Cell and molecular biology-concepts and experiments. 8 th Edn. John Wiley & Sons, New York.
2.	Brown, T., A., (2017). Genomes. 4 th Edn. John Wiley & Sons, New York
3.	Hartl, D., L., Clark, A., G., (2006). Principles of population genetics. 4 th Edn. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts
4.	Emery, A., E., H., Mueller, R. F., (1988). Elements of medical genetics. Reprint Edition. Churchill Livingstone, Edinburgh.





On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science Zoology
M.Sc. Zoology Semester (IV)

Course Code	PS04EZOO52	Title of the Course	Research Ethics and Scientific Writing
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To inculcate professional ethics in students of Science, especially in Biology2. To familiarize types of plagiarism and tools for their detection3. To teach various modes of data collection and its processing4. To impart professional, scientific writing skills
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Course Content		
Unit	Description	Weightage* (%)
1.	Definition and significance of ethics; Professional ethics in Scientific research and development: Common ethical breaches; data fabrication; data falsification. Plagiarism: redundant publication; duplicate publication.	25
2.	Types of plagiarism; tools and techniques for detection of plagiarism. Conflict of interest; salami slicing and authorship issues. Good Laboratory Practices (GLP): Instrument validation, reagents and materials certification, documentation and its record, Quality assurance and certification of laboratory facilities.	25
3.	Data collection methods: Primary data and secondary data. Internet, online data collection, journals and books. References: Basic types of referencing; Quoting, paraphrasing and citing. APA, MLA and the Chicago/ Turabian styles of listing references.	25
4.	Scientific writing: Basic differences between popular and scientific writing; fundamental rules of scientific writing; structure and content of research papers, thesis and dissertations. Do's and don'ts for scientific writing. Tools and techniques for correction and editing of manuscripts. Selection and publication in journals.	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of
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	information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the significance of professional ethics in Scientific research
2.	Appreciate the types and pitfalls of plagiarism
3.	Learn how to collect data from primary and secondary sources
4.	Understand the differences between, common, popular and scientific writing and learn the basics of scientific writing

Suggested References:	
Sr. No.	References
1.	Govindrajan, M., Senthilkumar, S., Natarajanv, M., S., (2013). Professional Ethics and Human Values. PHI Publishers, India
2.	Alley, M., (1998). The craft of Scientific writing. 3 rd Edn. Springer Publications, Germany
3.	Spier, R., E., (2003). Science and Technology ethics. 1 st Edn. Routledge Publications. Singapore
4.	Kumar, P., Kumar, P., (2020). Scientific writing and Research Quality. Discovery Publishing House Pvt Ltd, New Delhi

On-line resources to be used if available as reference material





On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science (Zoology)
M.Sc. Zoology Semester IV

Course Code	PS04EZOO53	Title of the Course	Nutritional and Clinical Biochemistry
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	Students should be able to: 1. Relate nutrition to the metabolism 2. Understand pathological conditions of diabetes, obesity and protein calorie malnutrition
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Course Content		
Unit	Description	Weightage* (%)
1.	Basic concept- composition of human body: Energy content of food. Measurements of energy expenditure. Energy requirements of man, woman and factor affecting energy requirements, Basal metabolic rate, factors affecting BMR. Carbohydrates- Dietary requirements and sources of available and unavailable carbohydrates and action of dietary fibres. Disorders of carbohydrate metabolism: Glycosuria, Diabetes mellitus.	25
2.	Proteins: protein reserves of body. Nitrogen balance studies and factor affecting it. Protein quality and essential amino acids. Cereal proteins requirement at different stages of development Protein energy malnutrition (PME)-Marasmus and Kwashiorkor disease. Starvation –protein metabolism in prolonged fasting, high proteins, low caloric weight reducing diets.	25
3.	Lipids-major classes of dietary lipids. Properties and composition of plasma lipo-proteins. Essential fatty acid and their physiological function. Clinical inter-relationship of lipids, lipoproteins and apolipoproteins. Tests for apolipoproteins, HDL, LDL, cholesterol and Triglyceride disorder. Obesity-factor leading to obesity –environmental and genetic. Role of leptin in regulation of body mass.	25
4.	Electrolytes and water balance Clinical Nutrition: Role of diet & nutrition in prevention and treatment of diseases. Dental caries, Fluorosis, Renal failure, Hyperlipidaemia, atherosclerosis. Inherited metabolic disorders: Phenylketonuria, Maple syrup disease, Homocystinuria, Galactosemia, Gout, Diabetes Insipidus and Diabetes mellitus.	25





	Anti-nutrients-naturally occurring food born toxicants, Protease inhibitors, hepatotoxins, allergens, toxins from mushroom, animal and sea foods.	
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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand, follow and advise nutritional principles for maintenance of health

Suggested References:	
Sr. No.	References
1.	Swaminathan, M., (2017). Food and Nutrition. 2 nd Edn. The Bangalore Printing and Publishing Co. Ltd., Bangalore.





2.	Rodwell, V., Bender, D., Botham, K., Kennelly, P., Weil, A., P., (2018). Harper's Illustrated Biochemistry. 31 st Edn. McGraw-Hill Education, Ahmedabad.
3.	Brody. T., (1998). Nutritional Biochemistry. 2 nd Edn. Academic Press, United States.
4.	Nelson, D., L., Cox, M., M., (2017). Lehninger Principles of Biochemistry. 7 th Edn. W. H. Freeman & Co Ltd, Macmillan Publishers, United States.

On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science Zoology
M.Sc. Zoology Semester (IV)

Course Code	PS04EZOO54	Title of the Course	Biomaterials and Tissue Engineering
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To impart knowledge on the types and properties biomaterials used in medicine.2. Understand the composition of implants and their pros and cons.3. Learn tissue engineering and its applications4. Gain an understanding of stem cells and their emerging role in treatment of genetic and somatic disorders.
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Course Content		
Unit	Description	Weightage* (%)
1.	Biomaterials: Introduction-definition of biomaterials, applications of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties, physical properties and mechanical properties of materials. Types of implant materials: Metallic, polymeric, ceramic and composite materials.	25
2.	Properties of commonly used implant materials: Stainless steel and alloys; importance of stress- corrosion cracking; role of passive films in tissue adhesion. Polymeric implant materials: general classification; Polyolefins, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. Biodegradable polymers and synthetic polymers and their applications. Ceramic implant materials: Bioceramics; Common types of bioceramics. Bio -reabsorbable and bioactive ceramics Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: different reinforcement materials, Composite theory of fiber reinforcement.	25
3.	Tissue engineering: Introduction, stem cells, morphogenesis, generation of tissue in the embryo, Tissue homeostasis, Cellular signaling, Extracellular matrix as a biologic scaffold for tissue engineering, Scaffold fabrication, bioactive scaffold, Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering.	25





4.	Basic Biology Of Stem Cells: Stem Cells: Introduction, hematopoietic differentiation pathway; Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis and differentiation. Stem cell systems- Liver, neuronal stem cells, Types and sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pluripotent stem cells.	25
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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand about various types of biomaterials for a wide range of biomedical applications.
2.	Basic functions and performance of implant materials as well as corrosion and degradation mechanisms of biomaterials.
3.	Choice of biomaterials based on function, biological environments, toxicity, bioadhesion and implant surface interaction with tissues. Scaffolds for tissue-engineering, growth factor, stem cell signaling.





Suggested References:

Sr. No.	References
1.	Palsson, B., O., Bhatia, S., N., (2003). Tissue Engineering. Pearson Publishers, India
2.	Meyer, U., Meyer, T., Handschel, J., Wiesmann, H., P., (2009). Fundamentals of Tissue Engineering and Regenerative Medicine. Springer Publications, Germany
3.	Park, J., (1984). Biomaterials Science and Engineering. Springer Publications, Germany
4.	Bhat, S., V., (2017). Biomaterials. 3 rd Edn. Alpha Science International Ltd, Ahmedabad

On-line resources to be used if available as reference material

On-line Resources

Relevant review articles/research papers/handouts of latest development in the subject





Master of Science (Zoology)
M.Sc. Zoology Semester IV

Course Code	PS04EZOO55	Title of the Course	Biodiversity and Conservation
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. To impart knowledge of fundamental concepts of biodiversity, the range of its extant and the need for conservation.2. To provide information of the main threats to biological diversity and the ability to evaluate the effects of human influences on biodiversity.3. To demonstrate the differences between the different categories of red listed species.4. To understand different modes of biodiversity conservation, their merits and limitations.5. To integrate the information generated from scientific investigations and use findings to address conservation and biodiversity issues.
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Course Content		
Unit	Description	Weightage* (%)
1.	Biodiversity: Concepts, levels and types, changes in time and space, evolution, species concept; significance of biodiversity for life security. Biogeography. Terrestrial, Marine, Aquatic and Agricultural biodiversity: Changing patterns and practices. Influence of modern lifestyle on biodiversity. Pros and cons of genetically modified species	25
2.	Global conservation measures, institutions and conventions; IUCN concept of threatened and endangered species. The Red Data Books of Indian plants and animals. Causes and consequences of loss of biodiversity. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): aims, major ratifications and amendments. Exotic and invasive species: A few case studies of intentional and non-intentional introduction of exotic species and their influence on local biodiversity.	25
3.	Principles and strategies of biological diversity conservation: <i>in-situ</i> conservation and <i>ex-situ</i> conservation. Biosphere reserves, major protected areas (sanctuaries, national parks, biosphere reserves) of India and Gujarat. Wetlands, mangroves and coral reefs for conservation of wild biodiversity. Concept of Sacred groves and their role in biodiversity conservation.	25





	Role of botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks in conservation of plants and animal sperms. Role of Zoos, breeding centers in conservation of animals.	
4.	<p>Biodiversity hot spots in India and world; Indian Biodiversity Act 2002; Major objectives of biodiversity authority board; Biodiversity and economics with special reference to India; People's Biodiversity register: Objectives, importance and modality of preparation.</p> <p>General account of the activities of Botanical Survey of India (BSI) and Zoological Survey of India (ZSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), Department of Biotechnology (DBT) and Department of Environment and Forest, Wild life Protection Society of India, Wildlife Institute of India (WII), Animal Welfare Board of India and Bombay Natural History Society (BNHS) in the context of Indian biodiversity conservation.</p>	25

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the concept of biodiversity, its role for our survival, different direct and indirect threats on biodiversity.





2.	Appreciate the global and national initiatives and local traditions for biodiversity conservation.
3.	Become familiar with different modes of conservation, institutes involved in biodiversity conservation.
4.	Learn various guidelines and regulations for utilizing the biodiversity judiciously.

Suggested References:

Sr. No.	References
1.	Wilson, E., O., (1988). Biodiversity. The National Academies Press. Harvard. Washington, DC.
2.	Hunter, M., L., Gibbs, J. P., (2007). Fundamentals of Conservation Biology. 3 rd Edn. Blackwell Publishing, Malden.
3.	Myers, N., Mittermeier, R., A., Mittermeier, C. G., Fonseca, G., A., da, Kent, J., (2000). Biodiversity Hotspots for Conservation Priorities. Nature, 403, 853-858.
4.	Rodgers, N. A., Panwar, H. S. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report Wildlife Institute of India, Dehradun.

On-line resources to be used if available as reference material

On-line Resources

Biodiversity: **Author:** John Spicer

Brian W. van Wilgen: Biological Invasions in South Africa

Relevant review articles/research papers/handouts of latest development in the subject

