

CVM UNIVERSITY

MASTER OF SCIENCE

(ZOOLOGY)

PROGRAMME

Under Choice Based Credit Scheme

Structure with Effect From: 2020-21



M.Sc. ZOOLOGY Programme Details

Programme Objectives (POs):

At the time of completion of the programme the student will have developed extensive knowledge in various areas of Zoology. Through the stimulus of scholarly progression and intellectual development the programme aims to equip students with excellence in education and skills, thus enabling the student to pursue a career of his/her choice. By cultivating talents and promoting all round personality development through multi-dimensional education a spirit of self-confidence and self-reliance will be infused in the student. The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individuals.

Programme Specific Outcomes (PSOs):

At the end of the two years programme the student will understand and be able to explain different branches of Zoology. The student will be able to explain about various applications of Zoology such as Ecology & Biodiversity, Cell Biology, Mammalian Physiology, Wildlife & Animal Behaviour, Aquaculture and Developmental Biology. He/she will be able to design and execute experiments related to Physiology, Immunology, Animal Biotechnology, Molecular Biology, Genetics & Cytogenetics and Bioinformatics tools will be able to execute a short research project incorporating techniques of Basic and Applied Zoology under supervision. The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired.

Programme Structure:

The M.Sc. Zoology programme is a two-year course divided into four-semesters. A student is required to complete hundred credits for the completion of course and the award of degree. A student has to accumulate twenty-five credits in each of the four semesters.

PART ONE	FIRST YEAR	SEMESTER I	SEMESTER II
PART TWO	SECOND YEAR	SEMESTER III	SEMESTER IV

CVM University
Programme- Master of Science
Under Choice Based Credit Scheme
Structure with Effect From: 2020-21

M.Sc. ZOOLOGY
SEMESTER-I

Course Type	Course Code	Name of Course	T/P	Credits	Exam Duration (Hrs)	Components of Marks		
						Internal	External	Total
						Total/Passing	Total/Passing	Total/Passing
Core Course	PG01CZOO01	Ecology and Biodiversity	T	4	3	30/10	70/28	100/40
	PG01CZOO02	Bioanalytical Techniques and Instrumentation	T	4	3	30/10	70/28	100/40
	PG01CZOO03	Cell Biology	T	4	3	30/10	70/28	100/40
	PG01CZOO04	Practical based on PG01CZOO01 and PG01CZOO02	P	4	3	30/10	70/28	100/40
	PG01CZOO05	Practical based on PG01CZOO03 and PG01EZOO0X	P	4	3	30/10	70/28	100/40
	PG01CZOO06	Comprehensive Viva	P	1			50/20	50/20
Elective Course	PG01EZOO01	Fundamentals of Biochemistry and Bioenergetics	T	4	3	30/10	70/28	100/40
	PG01EZOO02	Applied & Economic Zoology	T	4	3	30/10	70/28	100/40
	PG01EZOO03	Toxicology	T	4	3	30/10	70/28	100/40
	PG01EZOO04	Model Organisms Genetics	T	4	3	30/10	70/28	100/40

CVM University
Programme- Master of Science
Under Choice Based Credit Scheme
Structure with Effect From: 2020-21

M.Sc. ZOOLOGY
SEMESTER- II

Course Type	Course Code	Name of Course	T/ P	Credits	Exam Duration (Hrs)	Components of Marks		
						Internal	External	Total
						Total/Passing	Total/Passing	Total/Passing
Core Course	PG02CZOO01	Genetics and Cytogenetics	T	4	3	30/10	70/28	100/40
	PG02CZOO02	Mammalian Physiology	T	4	3	30/10	70/28	100/40
	PG02CZOO03	Immunology	T	4	3	30/10	70/28	100/40
	PG02CZOO04	practical based on PG02CZOO01 and PG02CZOO02	P	4	3	30/10	70/28	100/40
	PG02CZOO05	practical based on PG02CZOO03 and PG02EZOO0X	P	4	3	30/10	70/28	100/40
	PG02CZOO06	Comprehensive Viva	P	1			50/20	50/20
Elective Course	PG02EZOO01	Biostatistics	T	4	3	30/10	70/28	100/40
	PG02EZOO02	Microtechniques	T	4	3	30/10	70/28	100/40
	PG02EZOO03	Omics and Computational Biology	T	4	3	30/10	70/28	100/40
	PG02EZOO04	Population Genetics	T	4	3	30/10	70/28	100/40

**CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
SEMESTER – I
M.Sc. ZOOLOGY**

SYLLABUS EFFECTIVE FROM: 2020-2021

PG01CZOO01: ECOLOGY AND BIODIVERSITY

Course objective:

The aim is to achieve deeper knowledge on ecology and biodiversity and the services that ecosystems provide to human societies, the connection between biodiversity and ecosystem services, and how human societies depend on these services.

Course Learning Outcomes:

Unit 1: Be able to outline different concepts of ecology and discuss the biosphere, biomes and biogeography aspect of ecology.

Unit 2: Be able to explain the basic of population dynamics concept and role and also discuss the modular organisms population regulation, population size regulators and patterns in population dynamics community structure.

Unit 3: Be able to outline different concepts of biodiversity and discuss the uses, values, loss of biodiversity.

Unit 4: Be able to outline and apply different perspectives and questions within conservation biology related to biodiversity and discuss the environmental education.

Unit – 1 Biosphere, biomes and Biogeography:

The Biosphere: Biotic Environment: Types of interaction, Intra-specific relationships, Interspecific relationships, Biotic and Abiotic Interactions: Complexity, Pathogens & climate, Abiotic effects on competition. Habitats & Niches: Habitats, Niches – Determining niches, Exclusion principle; Species coexistence – Size ratios, Niche overlap, Fundamental & raised niches, Resource partitioning, Character displacement, Inter-specific competition Biomes: Terrestrial biomes, Wetland & freshwater biomes, Coastal & marine biomes Biogeography: Species distribution, Historic effects of plate tectonics - Past continental movements, Patterns of biogeography

Unit – 2 Population Dynamics:

Population Dynamics: Populations & population change, Dispersal, Dormancy, Study of populations – Basic equation, Age structure, Fate of cohort, Age at Death, Long-term population studies; Demographic data – Life tables, Population pyramids, Survivorship curves, Evolutionary strategies – r & K-strategies; Modular organisms Population Regulation: Population growth – Exponential, Logistic growth curve; Population size regulators – Types, Space, Food & water, Territories, Herbivores & Predators, Weather & climate, Parasites & diseases, Natural disasters, Self-regulation & stress; Patterns in population dynamics Community Structure (Succession): Vegetation changes, Types & Causes of succession, Processes - Primary seres (Xeroseres, Hydroseres, Heterotrophic), Patterns of succession – Variation, Termination, Diversion, Human influence on succession, Climax.

Unit – 3 Biodiversity and Uses, Values, Loss:

Biodiversity (General): Types of Biodiversity (Genetic, Species, Ecosystem), Global Biodiversity, Mega-diversity Countries of World, Endemism & Hotspots of Biological Diversity, Biodiversity of India, Hotspots of Indian Biodiversity, Goals of Biodiversity Conservation Biodiversity (Uses, Values, Loss): Biodiversity Values, Uses & Values of Biodiversity, Major Causes for Loss of Biodiversity, Listing of Threatened Biodiversity, IUCN Red Data Books, Endangered Flora and Fauna of India.

Unit – 4 Biodiversity Conservation and Environmental Education:

Biodiversity (Conservation): Ex-situ Conservation: Cryo-preservation, Botanical Gardens, Seed Banks, Gene Banks, Germplasm Reserves, In-situ Conservation: Social Forestry, Agro-forestry, National Parks & Sanctuaries, Biosphere Reserves. Environmental Education: Introduction, Definition, Goals, Objectives, Guiding principles of environmental education, Environmental

education programmes, Environmental education in India (Formal & Non-formal), Environmental information, Environmental organizations & agencies.

REFERENCE 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)

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

SEMESTER – I

M.Sc. ZOOLOGY

SYLLABUS EFFECTIVE FROM: 2020-2021

PG01CZOO02: BIOANALYTICAL TECHNIQUES AND INSTRUMENTATION

Course Objectives:

The course will enable the students to understand the principle and working of visualization techniques, separation techniques, spectroscopic techniques for analysis of the samples and principles and applications of tracer techniques in biology. Principles and applications of different types of microscopy, principle & application of cytophotometry and flow cytometry, centrifugation, electrophoresis chromatography, spectroscopy, radioactivity, radiation counters, x-ray diffraction will be known to the students.

Course Learning Outcomes:

Unit 1: Deals with the knowledge of different types of microscopes such as Light microscope, Compound microscope, Dark field, Bright field, Stereo microscope, Confocal, Phase contrast microscope, Fluorescent microscope, Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM). It also deals with the principle and application of cytophotometry and flow cytometry.

Unit 2: Enrich the concept and application for separation of molecules by different types of centrifugation techniques. Knowledge of separation by horizontal and vertical gel electrophoresis is also anticipated. The separation of molecules by different types of chromatographic techniques will be learnt.

Unit 3: Explore the consideration of principle and analysis of samples by different spectroscopic techniques such as UV, Visible, IR (including FTIR and ATR), AAS, NMR, Mass, MALDI-TOF, fluorescence, CD spectroscopy etc. will be learnt.

Unit 4: Gather the concept of radioactivity autoradiography, different types of counters used to trace the radiation will be studied. The principle and application of x-ray diffraction methods to study the structure of biopolymer will be known.

CONTENTS:

Unit I

Visualization techniques:

Principle of working and applications of bright field & dark field microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy. Principle and applications of cytophotometry and flow cytometry.

Unit II

Separation techniques:

Basic principle and application of analytical and preparative centrifugation, settling time & velocity, types of rotor, sedimentation coefficient, relative centrifugal force (RCF) differential, density and ultracentrifugation.

Principle and applications agarose and 2D gel electrophoresis. Capillary electrophoresis and its applications. Native-PAGE, SDS-PAGE

Principle, methodology and applications of gel-filtration, ion-exchange and affinity chromatography; Thin layer and High Performance Thin Layer Chromatography. Gas chromatography, High performance liquid chromatography and FPLC.

Unit III

Spectroscopy

Basic principle of electromagnetic radiation, instrumentation and applications of UV, Visible, IR (including FTIR and ATR), AAS, NMR, Mass, MALDI-TOF, fluorescence and CD spectroscopy.

Unit IV

Principle and applications of tracer technique in biology:

Concept of radioactivity, rate of radioactive decay; units of radioactivity- uses of radioisotopes in life sciences and biotechnology; autoradiography; cerenkov radiation; radiation dosimetry; ionization and scintillation based detection of radioactivity.

Principle of biophysical methods used for analysis of biopolymer structure: X-ray diffraction.

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.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
SEMESTER – I
M.Sc. ZOOLOGY
SYLLABUS EFFECTIVE FROM: 2020-2021
PG01CZOO03: CELL BILOGY

Course Objectives:

The major objective of this paper is to develop clear understanding of various aspects of cell biology along with diverse metabolic pathways existing at cellular level in relation to survival and propagation. This course enables the students to understand the structure and function of cell organelles, protein transport mechanism, intracellular signalling mechanism and acquainted with cell cycle, its regulation and apoptosis.

Course Learning Outcomes:

Unit 1: The students will understand the evolution of the cell, Cell as a unit of living organisms. They will learn structural details of prokaryotic and eukaryotic cells, their cell wall, cell membrane and other outer appendages.

Unit 2: The students can gain knowledge for molecular organization of Mitochondria, Chloroplast. Will know the ultrastructure and functions of Nucleus, Endoplasmic reticulum, Golgi complex, Lysosomes and other microbodies. They will also gain the knowledge of Protein sorting: organelle biogenesis and protein secretion, synthesis and its intracellular traffic, vesicular traffic in the secretory pathways

Unit 3: Will get the information for cytoskeleton topography which include the role of Microtubule and its dynamics, motor proteins, Microfilament and its functions, Intermediate filaments and their functions, Cilia and centrioles

Unit 4: Will be acquainted with overview of the Cell cycle and its control, the molecular mechanisms for regulating mitotic events, checkpoints in cell cycle regulation and signalling pathways which regulate apoptosis process

CONTENTS:

Unit I

- The origin and Evolution of cells, Evolution of metabolism, Diversity of cell size and shapes, Structure of Prokaryotic and Eukaryotic cells, Single cell to multicellular organism
- The Structure of cell membrane: The fluid Mosaic Model, Membrane lipids and Proteins, The Glycocalyx, Transport across plasma membrane.
- Endocytosis: Phagocytosis and Receptor mediated endocytosis)
- Cell walls and extracellular matrix & Cell Matrix Interactions
- Cell-Cell interactions: Adhesion protein, Tight junctions, gap junctions and plasmodesmata.

Unit II

- Cell Organelles: Molecular organization of Mitochondria, Chloroplast, Ultrastructure and Functions of Nucleus
- Molecular 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

- The cytoskeleton, the nature of cytoskeleton, Intermediate filaments, Microtubules: Organization of tubules, assembly and organization within the cells, microtubule motors and movements, cilia and flagella: structure and function.
- Cell signalling: Signalling molecules and their receptors, Functions of cell surface receptors, pathways of intracellular signal transduction, signal transduction and cytoskeleton.

Unit IV

- Cell growth and division, Overview of the Cell cycle and its control, the molecular mechanisms for regulating mitotic events, Cell cycle control in mammalian cells, Checkpoints in cell cycle regulation, regulators of cell cycle progression-MPF, cyclins and CDKs, Inhibitors of cell cycle progression; M-phase and cytokinesis.
- Programmed Cell Death: Difference between necrosis, apoptosis and necroptosis, Caspases, Central regulators of apoptosis (Bcl-2 family), signalling pathways that regulate apoptosis.

References Books:

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

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

SEMESTER – I

M.Sc. ZOOLOGY

SYLLABUS EFFECTIVE FROM: 2020-2021

LAB-I PG01CZOO04

Practicals based on PG01CZOO01 and PG01CZOO02

List of Practicals:

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

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

SEMESTER – I

M.Sc. ZOOLOGY

SYLLABUS EFFECTIVE FROM: 2020-2021

LAB-II PG01CZOO05

Practicals based on PG01CZOO03 and PG01EZOO01

Based on - Cell biology and Fundamentals of Biochemistry & Bioenergetics

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. Localization of Cell Organelle and Determination of Chlorophyll and Carotenoids
7. Estimation of Amino Acid (Proline)
8. Estimation of Amino Acid (Methionine from Food Grains)
9. Study of Cell structure (Eukaryotic & Prokaryotic)
10. Study of Meiosis and Mitosis

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
SEMESTER – I
M.Sc. ZOOLOGY
SYLLABUS EFFECTIVE FROM: 2020-2021

PG01EZOO01: FUNDAMENTALS OF BIOCHEMISTRY AND BIOENERGETICS

Course Objectives:

The major objective of this paper is to develop clear understanding of various aspects of biochemistry which includes properties of biomolecules, their metabolism and regulation. This course content enables students to better understand concept of bioenergetics and its importance in cellular metabolism. Moreover, useful to understand key role of water in metabolism which maintain acid base equilibrium at cellular level as well as an importance of physiological buffers.

Course Learning Outcomes:

Unit 1: Will have learnt carbohydrates, their types and properties. Further, will be acquainted with central metabolic pathways for carbon metabolism in bacteria enlisting differences with eukaryotic systems and their regulation in diverse physiological conditions.

Unit 2: Understands types of amino acids and their properties. Moreover, will have gathered understanding of inorganic and organic nitrogen assimilation and its regulation. Also knows role of glutathione in cellular redox regulation and biochemistry of glutamate overproducing strains. Will understand biochemical basis of nucleotides and its metabolism.

Unit 3: Will understand details of lipid, its metabolism and regulation along with biochemical basis of lipid accumulation at cellular level.

Unit 4: Will have learnt basic concepts of bioenergetics and its importance in cellular metabolism. The students will be aware with different electron carriers compounds and their role in ATP generation. Moreover, gain in depth knowledge of Water and Acid-Base Equilibrium.

CONTENTS:

Unit I

Carbohydrates and Glycobiology: Monosaccharide - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and nonreducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides).

Carbohydrate metabolism: Glycolysis, Gluconeogenesis, PP Pathway, Citric acid cycle- steps involved, amphibolic nature, anaplerotic reactions, Coordinated regulation of glycolysis and gluconeogenesis, Glycogen synthesis

Unit II

Amino acids: Structure of amino acids, physical, chemical and optical properties of amino acids, Classification of amino acids, Peptides and Proteins, Secondary, tertiary and Quaternary structure of proteins

Protein metabolism: Nitrogen metabolism, Biosynthesis of amino acids, molecules derived from the amino acids, amino acid oxidation and production of urea

Nucleotides and Nucleic acids: Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry – UV absorption, effect of acid and alkali on DNA.

Nucleotides metabolism: Biosynthesis and Degradation of Nucleotides

Unit III

Lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes, Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids, Lipids as signals, cofactors and pigments

Lipid Metabolism: Biosynthesis of fatty acids, Triacylglycerol, membrane lipids and cholesterol, Fatty acid catabolism

Unit IV

Bioenergetics: The laws of thermodynamics, concept of entropy and free energy; ATP synthesis and hydrolysis, Biological oxidation: oxygenases, hydrolases, dehydrogenases, free energy changes and redox potentials, Gibbs energy

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization, ATP- synthetase complex, Chemiosmotic theory of Energy Coupling, Inhibitors of ETC

Water and Acid-Base Equilibrium: Ionization of Water, Weak Acids, and Weak Bases, buffering against pH Changes in Biological Systems: Henderson and Hassebach equation, Buffers and their importance, pKa of amino acid and their relevance, Importance of discontinuous buffer system used in SDS PAGE, Water as a Reactant

References Books:

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

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

SEMESTER – I

M.Sc. ZOOLOGY

SYLLABUS EFFECTIVE FROM: 2020-2021

PG01EZOO02: APPLIED AND ECONOMIC ZOOLOGY

Course Objectives:

The goal of this course is to understand the concepts of the applied and economically important fields of zoology like Poultry, Aquaculture, Sericulture, Dairy science and Apiculture. It would make the students understand the breeding and rearing of chickens, even about the disease and products of poultry. To understand scope and status of Aquaculture and the economic importance of sericulture. To explore the importance of livestock and its impact on society. Students will learn the types, organization and life history of honey bees for production of honey- as in apiculture.

Course Learning outcomes:

After successfully completing this course, students will be able:

Unit I: To know the habitat, food & feeding of fowls. They will understand the breeding and rearing of chickens, even about the disease and products of poultry.

To understand scope and status of Aquaculture. Students will learn about different types of Aquaculture systems, even about the different species of cultivable fish. Students will also know about the planning and construction of Fish farm, which will help them to start-up with small scale fish farm.

Unit II: Students will understand the economic importance of Sericulture with global perspective. Students will know the stages, species and host plant of silkworm. Students will understand about the equipments, management, pest, predators and disease of silkworm.

Unit III: To explore the importance of Livestock to agriculture and its relation to national economy. About the different breeds of buffalos and cows. To understand status of Dairy industry and the role of cooperative societies. About the management, control of parasites and disease of livestock's.

Unit IV: To know the about the apiculture like types and cast of Honey Bee, Social Organization of Honey Bee, Life History Honey Bee, Structure of bee hive. The economically important species of Apis for unifloral and multifloral honey production.

Unit-1: 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-2: SERICULTURE

- History and economic importance of sericulture in India and worldwide
- Different stages of silkworm (Egg to Adult stages)
- Morphology and life cycle of Bombyx mori, structure and functions of silk glands
- Different species of silkworm and their Host plants
- Silkworm rearing, Equipments used and management practices
- Pest, predators and disease of silkworm and their management

Unit-3: 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

Unit-4: Apiculture:

- Types and cast of Honey Bee
- Social Organization of Honey Bee
- Life History Honey Bee
- Structure of bee hive

- Flora of Apiculture
- Methods of bee keeping, Products of bee keeping
- Bee enemies(predators)
- Diseases of Honey Bee

REFERENCES BOOKS:

1. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.
2. Gupta S.K.,Gupta P.C.(2006) Genera and Appied Ichthyology.
3. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea &Fabiger Publisher.
4. Tomar B.S. (2011) Introduction To Economic Zoology. Emkay Publications, Delhi- 110051.
5. Jawaid Ahsan,(1985) A Handbook on Economic Zoology,S.Chand & Company Ltd.,New Delhi
6. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
7. Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
8. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. KitabMahal publications, India.
9. Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
- 10.Barbara R.L.,Scott,Foreman & Company:Engaland,1972.Essential human anatomy and Physiology
11. G.J.Tortara,John Wiley & sons,(2003),New York,Atlas of Human Anatomy/Skeleton
- 12, G.J.Tortara Wiley India. Private Ltd.,New Delhi.Anatomy and Physiology
13. K.D.Chatterjee,K.D CBS Publishers & Distributors, Private Ltd.,New Delhi. Parasitology, Protozoology and Helminthology

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDHYANAGAR

SEMESTER - I

M.SC. ZOOLOGY

SYLLABUS EFFECTIVE FROM: JUNE-2020-21

PG01EZOO03: TOXICOLOGY

Course Objectives:

The course will cover basic toxicology and ecotoxicology, including how toxic substances are taken up in the organisms, distributed, biotransformed and excreted, how toxic substances react with biomolecules and downstream consequences for the organism, as well as knowledge about toxic substances, e.g. metals, organic contaminants and pesticides. The course aims to provide a general view of the topic by bridging human toxicology and ecotoxicology.

Course Learning Outcomes:

Unit 1:

Upon completion of this unit, the student should have an understanding of basic principles, factors and effect of toxic substances in the body parts.

Unit 2:

Students should gained knowledge of mechanisms of action for toxic substances also understand the exposure, uptake, metabolism, distribution and excretion of toxicants.

Unit 3:

Student should know different categories of toxic substances/ pesticides.

Unit 4:

Students would be able to understand heavy metal toxicity.

Contents

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 aspirin 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 Excitable 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 IV

- Metal Toxicity: Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors, affecting metal toxicity effect of light, temperature & pH.
- Air pollution: Common air Pollutant & their sources. Air pollution & ozone. Air pollution due to chlorofluorocarbons (CFCS) and asbestos.

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.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHYANAGAR
SEMESTER - I
M.SC. ZOOLOGY
SYLLABUS EFFECTIVE FROM: JUNE-2020-21
PG01EZOO04: Model Organisms Genetics

Course Objectives:

The basic principles of genetics have been elucidated largely by studies using a small number of species: from the peas used by Mendel to more recent examples such as the zebrafish. In this course highlights many of these key species that have become model organisms, including the yeast (*Saccharomyces cerevisiae*), the nematode (*Caenorhabditis elegans*), the fruit fly (*Drosophila melanogaster*), and the mouse (*Mus musculus*). Students should know Why were these species chosen to study genetics? What important findings in genetics have these studies yielded? How do you 'do' genetics in these model systems? How can experiments with these species help us to understand the basis of human genetic disease?

Course Learning Outcomes:

Unit 1:

Students should know various Model systems in Genetic analysis.

Unit 2:

Student should understand life cycle and Genetic techniques associated with *C. elegans*.

Unit 3:

Highlights advantages and Life cycle of Arabidopsis and mouse

Unit 4:

Gains knowledge about life cycle and advantages of *Saccharomyces cerevisiae*.

Contents:

Unit I

Model systems in Genetic Analysis: Bacteriophage, *E. coli*, *Neurospora crassa*, yeast, Arabidopsis, maize, Drosophila, *C. elegans*, Zebra fish, *Homo sapiens*- General outline of life cycle, importance in Genetic analysis.

The Fruit Fly *Drosophila melanogaster*: Introduction, Advantages of *D. melanogaster* as a model genetic organism.

The Bacterium *Escherichia coli* : Advantages of *E. coli* as a model genetic organism, The *E. coli* genome, Life cycle of *E. coli*, Genetic techniques with *E. coli*.

Unit II

The Nematode Worm *Caenorhabditis elegans*: Advantages of *C. elegans* as a model genetic organism, Life cycle of *C. elegans*, The *C. elegans* genome, Genetic techniques with *C. elegans*.

Unit III

The Plant *Arabidopsis thaliana*: Advantages of Arabidopsis as a model genetic organism, The Arabidopsis genome, Life cycle of Arabidopsis, Genetic techniques with Arabidopsis,

The Mouse *Mus musculus*: Advantages of the mouse as a model genetic organism, Life cycle of the mouse, The mouse genome, Genetic techniques with the mouse.

Unit IV

The Yeast *Saccharomyces cerevisiae*: Advantages of yeast as a model genetic organism, Life cycle of yeast, The yeast genome, Genetic techniques with yeast.

Functional genomics and animal models in human disease: An overview; cDNA/gene cloning; site-directed mutagenesis; mammalian tissue culture; cell line transfections; functional assays; Use of model organisms, methods for generation of transgenic animals/ knock in, knock out models (microinjection, ES cell transformation); mutagenesis; RNAi approach; Some examples.

Reference Books:

1. Genetics: A Conceptual Approach, 4 th Edition by Benjamin A. Pierce, ISBN-13: 978-1-4292-3250-0.
2. Strickberger M.W. Genetics. Third Edition. Prentice-Hall of India Pvt. Ltd, New Delhi, 2005. ISBN: 81-203-0949-9.
3. Emund W. Sinnott, 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

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDHYANAGAR
SEMESTER - II
M.SC. ZOOLOGY
SYLLABUS EFFECTIVE FROM: JUNE-2020-21

PG02CZOO01: Genetics and Cytogenetics

Course Objectives:

The objectives of this course are to make students understand basic principles of Genetics and Cytogenetics. The Science of genetics includes the rules of inheritance in cells, individuals and populations and the molecular mechanisms by which genes control the growth, development and appearance of organisms. While cytogenetics is a branch of science that deals with study of hereditary materials at cellular level. Various types of chromosomal abnormalities exist in human originated from either structural or numerical variations in the chromosomes. It is now a days very important to identify genome, genes and even single nucleotide associated with various qualitative and quantitative traits in the organisms to do the needful for the betterment of organisms or for commercial purpose where tools and techniques of genetics and cytogenetics are very much useful.

Course Learning Outcomes:

Unit 1: Students should be able to acquire basic knowledge on Mendelism (Laws of inheritance), Modes of inheritance dominance, multiple alleles and Polygenic inheritance.

Unit 2: Students should understand the process of linkage, Crossing over and Chromosome mapping, Sex determination and sex linkage.

Unit 3: Students are able to understand collection, transport and storage of samples for cytogenetic analysis and various types of chromosomal abnormalities Students are able to prepare the karyotypes from blood sample. From karyotyping students able to understand and identify various types of chromosomal abnormalities.

Unit 4: Student will able to perform various staining and banding techniques for the identification of normal and abnormal chromosomes. Students will learn chromosomal staining, banding and FISH techniques for the classification and identification of chromosomal abnormalities.

Contents:

Unit-1: Mendelian Genetics, Deviation from Mendelism and inheritance pattern

- Introduction to genetics.
- Law of segregation, Independent Assortment, Monohybrid Cross, Dihybrid Cross, trihybrid Cross, Test cross, back cross.
- Modes of inheritance
- Dominance: complete dominance, incomplete dominance, codominance, over-dominance
- Multiple alleles: ABO blood groups in human, Rh blood group system
- Polygenic inheritance and lethal genes

Unit-2: Linkage, Crossing over and Chromosome mapping

- Linkage, Crossing over
- Cytological basis of crossing over, Molecular mechanism of crossing over
- Chromosome mapping: two factor crosses, three factor crosses
- Chromosome maps.
- 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: Chromosomal abnormalities

- Collection, transport and storage of samples for cytogenetic analysis Morphology and classification of chromosomes.
- 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).

Unit-4: Chromosomal preparations, banding and staining techniques

- Chromosomal preparations from whole blood
- Conventional staining (Giemsa and aceto-orcein)
- Giemsa banding, Quinacrine banding, Constitutive heterochromatin banding Reverse banding
- Nucleolar organizing region staining
- Sister chromatid exchange Miscellaneous/Other banding Techniques.
- Applications of fluorescence *in situ* hybridization to chromosome analysis.
- Latest techniques- Fiber FISH, Spectral karyotyping and Chromosomal painting

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. Sinnott, 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

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – II
SYLLABUS EFFECTIVE FROM: 2020-2021

PG02CZOO02: MAMMALIAN PHYSIOLOGY

Course Objectives:

The goal of this course is to develop understanding for the fundamental concepts of physiology of nutrition and digestion. To Develop understanding of blood vascular system. Develop the fundamental concepts of physiology of respiration. Develop basic understanding of nervous system and its interactions with other systems. Familiarize students with renal physiology and reproductive systems.

Course Learning Outcomes:

Unit 1: Student will be able to know about the nutrition and types of foods. They will understand metabolism of carbohydrates, proteins and lipids and students will enable to understand the digestion and absorption of these components. Students will also know about the types, properties and contraction relaxation process in muscles tissue.

Unit 2: Student will be able to learn the physiology of respiration i.e. exchange of respiratory gases, transport of respiratory gases in blood and overview of respiratory disorders. Students will also learn circulatory system, components of blood, blood clotting mechanism and about the types of blood groups.

Unit 3: To understand the organization of nervous system, structure and types of neurons. Student will be able to understand the signal transmission, membrane potential and synapses. Students will learn about neurotransmitters and overview of disorders of nervous system.

Unit 4: Understanding for Excretory system; ultrafiltration, reabsorption and secretion as transport mechanisms involved in urine formation. Understand the role of kidney in body water, electrolyte and acid-base balance. Student will enable to understand the physiology of reproductive system. Hormonal regulation of female reproductive cycle. Student will able to understand the Birth control methods.

Unit I:

Physiology of Nutrition and Digestion: The essential nutrients, types of food, vitamins, minerals, water and the concept of 'balanced diet'. An overview of human digestive tract. Physiological role of digestive juices. Digestion and absorption of carbohydrates, proteins and fats, Neural and endocrine regulation of gastro-intestinal movement and secretion.

Physiology of Muscular System:

An overview of the muscular tissue: types of muscle tissue, properties and functions of the muscle tissues. Skeletal muscle tissue and types. Contraction and relaxation processes and metabolism of skeletal muscle fibres.

Unit II:

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

Physiology of Circulation: An overview of human circulatory system. The myogenic heart. Pacemaker system and conducting fibers, Neural, humoral and pharmacological regulation of cardiac amplitude and frequency, 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 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 renninangiotensin system in renal functions.

Physiology of Reproductive Systems: An overview of organization of human male and female reproductive systems. Histological features of male and female gonads. The process of gametogenesis (spermatogenesis and oogenesis). Phases and hormonal regulation of female reproductive cycles. Birth control: Physiology of birth control methods.

Reference Books:

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

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – II
SYLLABUS EFFECTIVE FROM: 2020-2021

PG02CZOO03: Immunology

Course Objectives:

The objective of this course is to understand various components of the host immune system; their structure, organization and role in defense mechanism. The student will gain knowledge to understand the operational mechanisms which underlie the host defense system. It would make them clear to understand genetic organization and expression of receptors to show immune response. They will also learn the role of immune system in health and diseases.

Course Learning Outcomes:

Upon successful completion of the course, the student will learn:

Unit 1: Will be able to understand the types of immunity and basic components of immune system; the role played by complement system as an interface between innate and adaptive immunity.

Unit 2: Will be able to understand the genetic organization of the genes meant for expression of immune cell receptors and the basis of the generation of their diversity. The principle of antigen-antibody interactions and methods to measure them will become clear to students.

Unit 3: Will be able to understand the importance of MHC molecule in an individual's immunity to various antigens, the mechanism of antigen processing and presentation. They will be able to understand the mechanism of B and T cell activation and memory generation.

Unit 4: The students will gain knowledge about the mechanism of cell mediated immunity. They will learn about the cytokines, important biopharmaceuticals and their role in modulation of immune response. The students will also learn how body shows different kinds of immune response to different infections.

Contents:

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, Immunofluorescence, 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 cytotoxicity)

- 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.

LAB-I PG02CZOO04

Practicals based on PG02CZOO01 and PG02CZOO02

Based on Genetics & Cytogenetics and Mammalian Physiology

List of Practical

PRACTICALS

1. Demonstration of Barr body
2. Problems based on Mendelian Genetics
3. To study on the problems related to sex determination.
4. A practical understanding on linkage and crossing over.
5. Whole blood culture for chromosome preparation
6. To prepare and perform Giemsa staining
7. To identify banded human chromosomes
8. Determination of Bleeding time
9. Determination of Clotting time
10. Preparation of haemin crystals
11. Test for salivary amylase
12. Determination of hemoglobin by hemoglobinometer
13. Determination of RBCs by hemocytometer
14. Determination of WBCs by hemocytometer
15. Osmotic fragility test
16. Blood grouping
17. Qualitative analysis of urine sample

LAB-II PG02CZOO05

Practicals based on PG02CZOO03 and PG02EZOO01

Based on Immunology & Biostatistics

List of Practicals:

1. To perform total WBC count using Haemocytometer
2. To Perform Differential Leukocyte count
3. To learn the technique of Ouchterlony Double Diffusion
4. To learn the technique of Radial Immunodiffusion
5. To learn the technique of Immunoelectrophoresis
6. To perform sandwich Dot ELISA test for antigen
7. To learn the technique of latex -agglutination
8. To separate lymphocytes by density gradient method
9. To convert ungrouped data in to grouped data using Sturge's formula.
10. To study representation of data by one dimensional diagram.
11. To study representation of data by two dimensional diagram.
12. To study representation of data by means of graphs. (Histogram & frequency polygon).
13. To study the data representation by graphs (Frequency polygon & frequency curve).
14. To study how to calculate descriptive statistics for the given data. (Mean mode, median, standard deviation and mean deviation).
15. To study the concept of permutation and combination in practical counting problems.
16. To study the concept of normal distribution and apply it to practical problems.
17. To study the concept of estimation (point estimation and interval estimation).
18. To apply the concept of skewness in the field of biosciences.
19. To apply the concept of F- test for biological problems.
20. To apply the concept of χ^2 – test for biological problems.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – II
SYLLABUS EFFECTIVE FROM: 2020-2021

PG02EZOO01: BIOSTATISTICS

Course Objectives:

The course aims to develop competency and expertise in the application of statistical methods applied to biological data obtained in experimental techniques.

Course Learning Outcomes:

Unit 1: Student will be able to know about basic terms and use in biostatistics. They will understand types of data, their organisation and various graphical representation methods to represent data, and will enable students to understand the basic statistics and its importance in research.

Unit 2: Student will be able to calculate various measures of central tendencies, measure of dispersion and measure of kurtosis and skewness and its importance.

Unit 3: To understand the exact method of data analysis for the problem under investigation. Student will be able to perform various hypothesis testing like T-test, F-test, and chi square tests and its application in biological sciences.

Unit 4: Understanding for drawing valid inferences and to plan for future investigations. Student will be able to perform Correlation & regression calculations and its application in Biological sciences. Student will able to perform ANOVA testing.

CONTENT:

Unit I:

Data Collection and Presentation

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:

Descriptive Statistics

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.

Unit III:

Statistical hypotheses: Null and Alternative hypotheses.

Statistical Tests: Acceptance region and Rejection Region. Types of errors and power of the test. Goodness of fit tests.

Random Variables: Discrete and Continuous. Some examples from biological sciences.

Probability Distributions: General Normal Distribution, Standard Normal Distribution ; Sampling Distributions- t, chi-square and F distributions.

Significance Tests for Normal Distribution: One sample tests for mean – z test and t-test.

Two sample tests for normal distributions: Tests for means (i) when variances are known (ii) when variances are unknown. Tests for equality of variances.

Paired t-test for equality of means.

Confidence Intervals

Unit IV:

Correlation: Covariance, Calculation of covariance, correlation analysis and correlation Coefficient calculated from ungrouped data.

Regression: Simple linear regressions analysis, regression coefficients, Linear regression line or equation

Analysis of Variance: Completely Randomized Design, Randomized Block Design

References:

- Fundamentals of statistics by S.C. Gupta
- Principles of Biostatistics by Marcello Pagano and Kimberlee Gaurea
- Biostatistics : A Foundation For Analysis in the Health Sciences by Daniel, Wayne (Seventh Edition), Wiley India Pub.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – II
SYLLABUS EFFECTIVE FROM: 2020-2021
PG02EZOO02: MICROTECHNIQUES

Course Objectives:

The course will enable the students to understand the principle of microscopy types of microscopy used to explore the knowledge of microtechniques. The measurement of size of microorganisms, sanctioning of the bigger specimens by using microtome, preparation of temporary and permanent slides of the specimen will be known.

Course Learning Outcomes:

Unit 1: Deals with the concept and principle of microscopy. It provides the understanding of different optical components of microscopy,

Unit 2: Enrich the knowledge of different types of microscopes such as Light microscope, Compound microscope, Dark field, Bright field, Stereo microscope, Confocal, Phase contrast microscope, Fluorescent microscope, Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM).

Unit 3: Explore the need and methods of measurement of microorganisms by micrometry. The calibration and working with the stage and ocular micrometer. Illustrations and concept of photomicrography will also be known.

Unit 4: The concept of killing and fixation agents, dehydration of the specimens, embedding of specimens in paraffin wax, free hand sanctioning, mounting of sanctioned specimen on slide, staining of specimens and different types of staining will be known.

CONTENTS:

Unit 1

Principles of microscopy – eyepiece lens and objective lenses; Magnification, Resolving power, numerical aperture. Mechanical components: base, pillar, stage, sub stage, body tube, focusing knobs, nose pieces. Optical components: mirror, objectives, ocular lens, condenser, Focussing slides under low/ high power and oil immersion.

Unit 2

Types of microscopes: Light microscope, Compound microscope, Dark field, Bright field, Interference microscope (Stereo microscope), Confocal, Inverted microscope, Phase contrast microscope, Fluorescent microscope, Electron microscope: Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM)

Unit 3

Measurement of Microorganisms- Micrometry – Stage micrometer, Ocular micrometer, Calibration and working. Preparation of illustrations using camera lucida, digital camera and photomicrography.

Unit 4

Killing and fixation agents - carnoy's formula, F. A. A.

Dehydration– general account of dehydration (Ethanol, Isopropyl alcohol, Acetone, Glycerine). Ethanol – Xylene series and Tertiary Butyl Alcohol Series

Infiltration – paraffin wax method, Embedding

Free hand sectioning- Microtome (Rotary and sledge) serial sectioning and its significance.

Mounting- A brief account on whole mounting, maceration, smears and squash preparation, application of permanent whole mounts, permanent sections.

Staining- Classification: natural dyes, coal tar dyes, double staining, vital staining; simple, Gram staining, negative staining, capsule staining, spore staining, flagellar staining, nuclear staining and acid fast staining, stains: saffranin, hematoxylin, acetocarmine.

References

1. Plant Microtechnique, Johansen D.A. 1940, Mc Graw – Hill Book Company, Inc. New York.
2. Manual of Microbiology – Tools and Techniques, Kanika S. 2007, Ane's student edition.
3. Botanical Microtechnique; principles and Practice, Khasim S.K., 2002, Capital Publishing Company New Delhi.

4. Essentials of botanical microtechnique, Toji T. 2004, Apex Infotec Publ.
5. Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st ed. Wiley-Liss, 2001.
6. R. Marimuthu – Microscopy and Microtechnique, MJP Publishers, 2015.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – II
SYLLABUS EFFECTIVE FROM: 2020-2021

PG02EZOO03: Omics and Computational Biology

Course Objectives:

The course will enable the students to understand the concept of genome mapping, genome sequencing, functional genomics, basic concepts of proteomics tools, data mining, basic concepts and tools of lipidomics, glycomics and phosphoproteomics. Storage and retrieval of various types of databases collection and storing of sequence data will be understood by the students. Students will also be able to know the local and global alignment through scoring matrices, gene prediction methods, RNA fold analysis, splice site identification.

Course Learning Outcomes:

Unit 1: Deals with genome, genomics and transcriptomics. The concept and application of physical map, genetic map, genome sequencing, functional genomics, small or large regulatory RNAs and dark matter will be known.

Unit 2: Gathers information regarding concept of proteomics, metabolomics and lipidomics. The basic tools of proteomics, metabolomics, lipidomics and their applications will be learnt by the students.

Unit 3: Deals with the primary and secondary databases, collection, storage and retrieval of databases, knowledge of freeware, software and hardware. The sequence databases, sequence format, annotation and archival of databases will be understood.

Unit 4: Accords the sequence alignment and applications. The choice of alignment, local alignment, global alignment scoring matrices, codon usages analysis, RNA fold analysis, splice site identification will also be studied by the students.

Unit 1: Genome, Genomics & Transcriptomics

Genome mapping: Physical and Genetic Map, Genome Sequencing, Next generation sequencing methods, Genome Annotation, Functional Genomics. Transcription factor binding sites, RNA-Seq, Microarrays, Regulatory RNAs: small or large, Computational prediction of miRNA target genes, RNA Dark matter

Unit 2: Proteomics, Metabolomics & Lipidomics

Basic concepts, Tools of proteomics- SDS PAGE, 2D PAGE, Liquid chromatography, Mass Spectrometry (ESI and MALDI), Protein identification by peptide mass fingerprinting, Applications of proteomics.

Fundamental concept, data integration and data mining; Tools of metabolomics-Capillary electrophoresis, Gas chromatography, Electrochemical detectors.

Basic concepts and tools of lipidomics, glycomics and phosphoproteomics.

Unit 3:

Biological Literature Information access, storage and retrieval systems- Primary and secondary databases of genomics, transcriptomics, proteomics and metabolomics. Knowledge on freeware and commercial software. Importance of hardware and software creations.

Collecting and Storing Sequence Data: Sequence assembly; Submission of Sequences; Sequence accuracy; Sequence databases; Sequence formats; Annotation and Archival.

Unit 4:

Sequence alignment and applications: Uses: Choice to be made for alignment; Scoring matrices; Homology and related concepts; Dot Matrix methods; Dynamic programming methods for global and local alignments tools- FASTA, BLAST, statistical and Biological significance.

Nucleic acid sequence analysis: Reading frames; Codon Usage analysis; Translational and transcriptional signals; Splice site identification; Gene prediction methods; RNA fold analysis

REFERENCES

1. Introduction to Proteomics -Tools for the New Biology by Daniel C. Liebler, Humana Press.
2. Mass Spectrometry for Biotechnology by Gary Siuzdak, Academic Press.
3. Proteomics for Biological Discovery by Timothy Veenstra and John Yates, Wiley.
4. Metabolomics- Methods and Protocols by Wolfram Weckwerth, Humana Press.

5. Lipidomics- Technologies and Applications by Kim Ekroos, Wiley-VCH.
6. Web/Journal Resources.
7. Transcriptomics: Expression Pattern Analysis, Virendra Gomase, Somnath Tagore; VDM Publishing, 2009 – Science.
8. Current Protocols in Bioinformatics, Edited by A.D. Baxevanis et al, Wiley Publishers. 2005.
9. Bioinformatics by David W. Mount, Cold Spring Harbor Laboratory Press. 2001.
10. Fundamental concepts of Bioinformatics by D.E. Krane and M.L Raymer, Pearson Education. 2003.
11. Bioinformatics and Functional Genomics by Pevsner, J., John Wiley and Sons, New Jersey, USA. 2003
12. Principles of Genome Analysis and Genomics (3rd Ed.) by Primrose, S.B. and Twyman, R.M., Blackwell Publishing Company, Oxford, UK. 2003.
13. Introduction to proteomics – Tools for the new biology (1st Ed.) by Liebler, D.C., 2002, Human Press Inc., New Jersey, USA.
14. Bioinformatics: Sequence and Genome Analysis by Mount, D., Cold Spring Harbor Laboratory Press, New York. 2004.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – II

SYLLABUS EFFECTIVE FROM: 2020-2021

PG02EZOO04: Population Genetics

Course Objectives:

The course will enable the students to understand the importance of genetics at population level. A thorough understanding of the population genetics is necessary to comprehend the evolutionary processes. This course will make the students to understand the forces that have an impact on levels of genetic variations in natural and/or experimental populations for both qualitative and quantitative traits. Various type of DNA markers and the range of tools for their detection to enable advanced studies on molecular population genetics. Population genetics helps in identifying genetic diversity based on the statistical comparisons.

Various factors such as mutation, migration, selection and genetic drift alters gene and genotype frequency. This course are very much useful for the identification of genetic variabilities within the populations. Hardy – Weinberg laws are useful for the identification of lethal alleles in the populations.

Course Learning Outcomes:

Unit 1: Deals with Concept and theories of evolution, Hardy-Weinberg law and its applications in calculating gene and genotype frequencies.

Unit 2: Discussing factors influencing gene and genotype frequencies such as mutation, migration, selection and genetic drift.

Unit 3: Deals with the Molecular population genetics, Molecular evolution (neutral theory, punctuated equilibrium), DNA-based phylogenetic trees, Molecular phylogenetics of *Homo sapiens*

And Molecular clock.

Unit 4: students should understand various selection and breeding Methods in animals. It also provides informations on Inbreeding and assortative mating and construction of Path diagram.

Contents

UNIT - I

Concept and theories of evolution

Microevolution in Mendelian population

Mendelian Population

Allele frequencies and genotype frequencies

Hardy-Weinberg equilibrium and conditions for its maintenance

Chromosomal, DNA and allozyme polymorphism in natural population

UNIT - II

Deviations from Hardy-Weinberg Equilibrium

Mutation

Selection (Types of selection, selection coefficient, selection in natural populations)

Genetic drift

Migration

UNIT - III

Molecular population genetics

Molecular evolution (neutral theory, punctuated equilibrium)

DNA-based phylogenetic trees

Molecular phylogenetics of *Homo sapiens*

Molecular clock

UNIT - IV

Selection and Breeding Methods in animals

Line Breeding

Ordinary Breeding

Cross Breeding

Artificial selection

Nonrandom breeding

Inbreeding and assortative mating

Path diagram construction and inbreeding coefficient

Reference Books:

- Population Genetics by Rao and Nallari
- Genetics of Populations by Philip W Hedrick
- Genetic Variation and its Maintenance Roberts & DeStefano

Course Credit Scheme
M.Sc. Zoology Semester III

Course Type	Course Code	Name of Course	T/P	Credits	Exam Duration (Hrs)	Components of Marks		
						Internal	External	Total
						Total/Passing	Total/Passing	Total/Passing
Core Course	101460301	Animal Biotechnology	T	4	3	40/16	60/24	100/40
	101460302	Wild life and Animal Behavior	T	4	3	40/16	60/24	100/40
	101460303	Developmental Biology	T	4	3	40/16	60/24	100/40
	101460304	LAB-I (Practical based on 101460301 and 101460302)	P	4	3	40/16	60/24	100/40
	101460305	LAB-II (Practical based on 101460303 and any one of the Elective)	P	4	3	40/16	60/24	100/40
	101460306	Comprehensive Viva	P	1			50/20	50/20
Elective Course	101460307	Bioinformatics	T	4	3	40/16	60/24	100/40
	101460308	Human Parasitology	T	4	3	40/16	60/24	100/40
	101460309	Molecular and Applied Endocrinology	T	4	3	40/16	60/24	100/40
	101460310	Cancer Genetics	T	4	3	40/16	60/24	100/40
Total Credits				25				650

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – III
SYLLABUS EFFECTIVE FROM: 2020-2021
101460301: ANIMAL BIOTECHNOLOGY

Course Objectives:

- The goal of this course is to provide the necessary theoretical knowledge on animal cells for *in vitro* studies, maintenance of animal cells *in vitro*, manipulation of animal cells *in vitro*, and application of molecular techniques to *in vitro* situations.
- To familiarize students with the principles and basic facts of Animal Cell Culture and with some of the laboratory techniques and equipment used in the acquisition of *in vitro* cell culture.
- The course will be a short primer to understand how ‘animal cell culture technologies’ have strengthened the bio-medical research from basic research to the modern drug discovery.
- Animal cell culture was first performed in the very first decade of 19th century. Since then, tremendous development has taken place in this field. The lectures will help the researcher to appreciate the developments during last hundred years and will help them to independently set up cell culture laboratories.
- The laboratory component of the course is designed to reinforce the topics discussed in lecture, as well as to familiarize students with some of the laboratory techniques and equipment used in the acquisition of Animal cell culture.

Student Learning Outcomes: Upon successful completion of lecture portion of this course, the students will be able to:

- ✓ demonstrate knowledge of basic cell culture techniques
- ✓ demonstrate knowledge of establishment of cell lines and their maintenance
- ✓ demonstrate knowledge on design and use the cell culture facilities
- ✓ critically evaluate cell cultures constraints and possibilities as an *in vitro* model
- ✓ discuss the advantages and limitations of primary cell culture compared to immortalized or transformed cell lines
- ✓ discuss techniques for producing Transgenic Animals

Unit I:

- Introduction and scope of Animal Biotechnology
- Basic requirements for animal tissue culture: Infrastructure, necessary equipments and accessories for animal tissue culture lab.
- Culture Media: Different types of media-Natural media, Defined media, Serum free media Chemical, physical and metabolic functions of different constituents of culture media.
- Role of serum in tissue culture media
- Sterilization techniques
- Biohazards and Bioethics

Unit II:

- Biology and characterization of cultured cells
- Basic techniques of animal cell culture: Primary culture techniques,
- Enzymatic and mechanical disaggregation techniques
- Sub culture methods
- Development of cell lines, nomenclature and types of cell lines.
- Explant culture, Organ culture – 3Dimensional culture
- Large scale culture of cells-suspension and monolayer culture
- Cell separation methods
- Cell cloning
- Transformation and immortalization

Unit III

- Application of animal tissue culture
- Contaminants- source, types and prevention
- Cell viability Cytotoxicity assays
- Cryopreservation of cultured cells
- Hybridoma technology – production of MAbs.
- Vaccine Production

Unit IV

- Transgenic Animal Technology:
- Techniques for producing transgenic Animals,
- Application of transgenic animals
- Artificial animal breeding, Artificial insemination,
- In vitro fertilization (IVF), Embryo Transfer, Embryo sexing
- Tissue Engineering- scaffold materials, synthesis of scaffold, cell sources and applications of Tissue engineering

Reference Books:

- 1) Culture of animal cells: A manual of basic technique- R. Ian Freshney, Wiley Publication.
- 2) Animal cell culture & technology-M. Butler.
- 3) Animal cell culture techniques- M. Clynes, Springer.
- 4) Animal Biotechnology- M. M. Ranga. Agrobios (India).
- 5) Animal Biotechnology-Young, Murray, Moo. Pergamon Press, Oxford.
- 6) Methods in Cell Biology-Vol. 57, Animal cell culture methods- Mather, J.P., Academic Press.
- 7) Animal Cell Biotechnology-Spier, R.E. Academic press.
- 8) Animal biotechnology – P. Ramadass, MJP Publishers
- 9) Biotechnology- U.Styanarayan, Books and Allied (P) Ltd
- 10) <https://nlist.inflibnet.ac.in/search/Record/EBC1094235>
- 11) <https://nlist.inflibnet.ac.in/search/Record/EBC1495640>
- 12) <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=1094235&query=animal+biotechnology>

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

SYLLABUS EFFECTIVE FROM: 2020-2021

101460302: Wild Life and Animal Behaviour

OBJECTIVES:

The course is an introduction to wildlife and animal behaviour and gives an account of the tools used to study wildlife and animal behaviour. Topics covered are to equip students with adequate knowledge of various biodiversity monitoring methodologies, conservation and management issues of vertebrate pests, wildlife conflict and over abundant species, wildlife health and diseases. Develop student's interest, knowledge and understanding of the behaviour of animals in their natural environments. Enable students to use the knowledge of the behaviour and biology of animals in order to effect the protection and conservation of species and their habitats. Develop practical skills in species and habitat survey alongside techniques in behavioural observation to prepare students for employment.

COURSE OUTCOMES:

- Develop an understanding of how animals interact with each other and their natural environment. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
- Students will gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management. Develop an ability to analyze, present and interpret wildlife conservation management information. Students will understand wild life damaging factors and role of different agency to protect wild life such as WWF. Also gain knowledge about different nation projects regarding wild life.
- Learn a wide range of theoretical and practical techniques used to study animal behaviour. Develop skills, concepts and experience to understand all aspects of animal behavior.
- Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives. Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild. Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment.

UNIT-I:

Definition, significance and wildlife zones of India. Protected Area Systems (PAS): Concept and management. Wild life census: its planning, understanding of sample counts, block counts, road side counts, dung counts, pugmark census, water - hole census

Methods in field biology: Methods of estimating population density of animals, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization-ground and remote sensing methods.

UNIT-II:

Wildlife management (History and current advances): Protected areas and role of PAs in wildlife conservation, Community and conservation, Current wildlife conservation practices in India.

Wild life damage, its nature and definition, various methods to control wild life damage, role of WWF, IUCN, UNEP, Red Data Book; Categories of Endangered Wildlife Species.

National projects: Project tiger, Project elephant, Project rhinoceros, Project crocodile

UNIT-III

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; Altruism and Evolution - Group Selection, Kin Selection, Reciprocal Altruism, Concept of Learning, Memory, Cognition, Sleep and Arousal, 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.

Reference Books:

1. Mohan P. Arora 1995. Animal Behaviour, Himalaya Publishing House
2. Reena Mathur, ANIMAL BEHAVIOUR. Rastogi Publications, ISBN: 9789350781609, 9789350781609
3. Reena Mathur, Wildlife conservation and management, Rastogi Publications
4. Gee EP. 2000. The wildlife of India. Harper Collins Publication.
5. Johnsingh AJT. (Ed.). 2003. The Mammals of South Asia: Ecology, Behaviour and Conservation. Permanent Black.

6. Prater, S.H. 1971. The Book of Indian Animals. Oxford University press, Bombay.
7. Negi, S.S. 1993. Biodiversity and its Conservation in India. India Publishing company, New Delhi.
8. Dasmann, R.F. 1982. Wildlife Biology. Wiley Pub. New York.
9. <https://nlist.inflibnet.ac.in/search/Record/EBC2006070>
10. <https://nlist.inflibnet.ac.in/search/Record/EBC1895513>
11. <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=5837838 & query=Animal+Behaviour>
12. <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=3317359 & query=Animal+Behaviour>

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

SYLLABUS EFFECTIVE FROM: 2020-2021

101460303: Developmental Biology

Course Objectives:

The objective of this course is to provide a comprehensive understanding of the concepts of early animal development. Students taking this course must develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals. In this course a particular model of *Drosophila* system will be discussed in detail. Instead, different concepts of animal development will be elaborated in one model system or the other.

Once the concepts are taught the students will be made familiar with different approaches that have been used to study such concepts. Further topics that will be discussed are stem cells and regeneration, the developmental basis of genetic diseases as well as the developmental mechanisms of cell signalling.

Course Learning Outcomes:

Students who successfully complete the course will be able to:

Unit I: describe and order the main stages of development common to most multicellular organisms. Describe the main anatomical changes that occur during development. Identify the cellular behaviors that lead to morphological change during development.

Unit II: Describe the hierarchy of gene activation that occurs in early *Drosophila* development. Understand how gene activation plays a role in differentiation and development. Describe the unique characteristics of the different genes and explain how they act as master regulators of development in multicellular organisms.

Unit III: Describe the main signalling pathways that play important roles in development. Explain how induction and competence of embryonic cells play important role in development.

Unit IV: Describe how hormones work as mediator for metamorphosis in Amphibians and insects. Understand how errors in development lead to congenital defects and spontaneous abortion. Causes of Infertility and IVF treatment.

UNIT-I: Overview of Embryogenesis in Mammals:

Spermatogenesis, Oogenesis, structure of spermatozoa and ovum, Fertilization, Cleavage patterns, Blastulation, Gastrulation, Comparative account of gastrulation; Early development in Sea urchin, *C. elegans*; *Drosophila*; Amphibia; Birds; Mammals. Organogenesis

Basics of stem cells.

UNIT-II: Genetics of Axis Specification in *Drosophila*:

Early *Drosophila* development- fertilization, cleavage

Genes that Pattern the *Drosophila* body plan- Anterior-posterior polarity in the oocyte, Dorsal-ventral patterning in the oocyte.

Generation the Dorsal-ventral pattern in the Embryo.

Segmentation and Anterior-Posterior body plan- segmentation genes; Gap genes, pair-rule genes & segmentation polarity genes.

Homeotic selector genes

UNIT-III Cell Communication In Development:

Cell adhesion, cell migration

Cell signaling- induction and competence, reciprocal induction, regional specificity of induction, genetic specificity of induction.

Paracrine factors- Inducer molecules; FGF and RTK pathway, JAK-STAT pathway, Hedgehog pathway, Wnt pathway, SMAD pathway.

Juxtacrine signaling- Notch pathway

Extracellular Matrix as a source of developmental signals.

UNIT-IV Birth Defects, Endocrine Disruptors and Aging:

Hormones as mediators of development: Amphibian metamorphosis, Insect metamorphosis

Genetic errors of human development, 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 Shukul, 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
8. <https://nlist.inflibnet.ac.in/search/Record/EBC217940>
9. <https://ebookcentral.proquest.com/lib/inflibnet-books/detail.action?docID=1482087&query=Developmental+Biology>

101460304: LAB-I (Practical based on 101460301 and 101460302)

1. Introduction of animal tissue culture laboratory with necessary equipments and accessories.
2. Preparation of culture media
3. Sterilization of culture media
4. Primary culture from Chick embryo.
5. Cell counting using hemocytometer.
6. Cell viability
7. Short term lymphocyte culture.
8. Chromosome preparation from cultured cells.
9. Cytotoxicity test-MTT
10. Study of animals in different habitats.
11. Field Study: Bird watching.
12. Field study: Behavioral activity of wild animals.
13. Tools and techniques used in wildlife.
14. To study nests and nesting habits of the birds and social insects.
15. To study the behavioural responses of wood lice to dry and humid conditions.
16. To study geotaxis behaviour in earthworm.
17. To study the phototaxis behaviour in insect larvae.
18. Study and actogram construction of locomotor activity of suitable animal models.
19. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
20. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

101460305: LAB-II (Practical based on 101460303 and 101460307 (Bioinformatics))

1. To study different stages of embryogenesis.
2. To study different developmental stages of chick embryo.
3. To prepare whole mount of chick embryo.
4. To study the morphology and motility of sperm.
5. To study viability of sperm.
6. Total count of spermatozoa in semen sample.
7. Acrosomal integrity test.
8. Teratogen activity test
9. Introduction of different database of NCBI
10. Introduction of PIR, ExPasy, EMBL, SCOP,CATH
11. Database introduction- Pfam, Prodom
12. Introduction of Genome browser – UCSC, ensemble, vista, WGS by NCBI, RAST
13. Use of L-ALIGN
14. Clustal-W and Phylogenetic Analysis
15. Protein Sequence Databases and visualization by RASMOL & SPDBV
16. Homology modeling, structure validation and quality of protein structure
17. *In Silico* study of ligand protein interaction
18. Introduction to Reactome and iPath3 (Metabolic Pathway Databases)

101460306-COMPREHENSIVE VIVA (BASED ON ALL THEORY PAPERS)

**CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR**

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

SYLLABUS EFFECTIVE FROM: 2020-2021

101460307: BIOINFORMATICS

Course Objectives:

The course will enable the students to understand the concept of bioinformatics, various types databases and their importance. This course will enable to students for algorithms and concept of sequence alignments, understanding the phylogenetic relationship among the organisms in evolution. Students will also able to know the 2D structure and 3D structure of protein which ultimately enable the students to understand the active site prediction, drug design & development.

Course Learning Outcomes:

Unit – I: Envisages about the concept of bioinformatics and its application. It provides the knowledge of various databases, nucleic acid databases, protein sequence databases, formats of various databases and their importance.

Unit – II: Gathers information regarding concept of scoring matrix, search of databases, algorithms of the BLAST and FASTA. The students will learn the basic concepts of pairwise sequence alignment and multiple sequence alignments.

Unit – III: Deals with the pairwise and multiple sequence alignment for analysis of nucleic acid and proteins sequences. The students will also learn to construct the phylogenetic trees, molecular basis of evolution using different methods.

Unit – IV: Accords to gain the knowledge of structure of protein, prediction of 2-dimensional, 3-dimensional structure of protein and their algorithms. Students will enable to predict the active site of protein, folding of protein, protein modeling and drug design using software.

UNIT – I

Introduction to Bioinformatics:

Overview, Internet and bioinformatics, Applications.

Introduction and Bioinformatics Resources:

Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, Literature databases:

Nucleic acid sequence databases: GenBank, EMBL, DDBJ

Protein sequence databases: SWISS-PROT, PDB, SCOP, CATH

Genome Databases at NCBI, EBI

Other Databases of Patterns/Motifs/System Biology (Gene and protein network database and resources)

Various file formats for bio-molecular sequences: genbank, fasta, gcg, msf, nbrfpir etc.

Basic concepts of sequence similarity, identity and homology, Definitions of homologues, orthologues, paralogues, xenologus.

UNI – II

Sequence analysis:- Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.

Sequence-based Database Searches: what are sequence-based database searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA.

Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Needleman & Wunchsh, Smith & Waterman algorithms for pairwise alignments, Progressive and hierarchical algorithms for MSA.

UNIT – III

Functional genomics

Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results.

Multiple sequence Alignment: CLUSTAL W

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).

UNIT – IV

Molecular Modeling

Structural classification of proteins, Protein structure analysis, Classes, folds, motif, domain Secondary structure and evaluation: algorithms of Chou Fasman, GOR methods.

Tertiary Structure: basic principles and protocols, Methods to study 3D structure.

Active site prediction, Protein folding, Protein modeling and drug design.

REFERENCES BOOKS

1. Mount DW, Bioinformatics: Sequence and Genome Analysis (2nd edition). Spring Harbor Press.
2. Arthur Lesk. Introduction to Bioinformatics. Oxford University Press.
3. S. C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery) 4th Edition
4. Ghosh Z and Mallick B, Bioinformatics-Principles and Applications, Oxford University. Press (First Print: 2008; Second Print: 2009)
5. Creighton TE, Protein Structure: A Practical Approach
6. Creighton TE, Protein Structure and Molecular Properties, Freeman
7. Leach AR, Molecular Modeling : Principles and Application
8. Bourne PE, Weissig H, Structural Bioinformatics, Wiley Schlick T. Molecular Modelling and Simulation An Inter disciplinary Guide, Springer
9. Pevzner PA Computational Molecular Biology, An Algorithmic Approach. Prentice Hall
10. Thomas Lengauer, Bioinformatics - From Genomes to Therapies: Volume 1.
11. <https://www.ebi.ac.uk/services>
12. <https://www.ncbi.nlm.nih.gov/guide/all/>
13. <https://www.genome.gov/>

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – III
SYLLABUS EFFECTIVE FROM: 2020-2021

101460308: Human Parasitology

Course Objectives:

This course is aimed to provide the students with an introduction to the field of medical parasitology. It focuses on the parasitological terms, types of parasites, habitats, hosts and different life cycles. It also includes the sources of infection, pathogenesis, clinical manifestations, methods of diagnosis, prevention and control. The classification of different parasites is also included.

Course Learning Outcomes:

At the end of this course the students will be able to:

Unit I: Identify the different types of parasites and its Hosts. Understand the interrelationship between host and parasites, and mode of transmission of parasites.

Unit II: Describe Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of Protozoa and Cestoda

Unit III: Understand Classification, Geographical distribution, Morphology, Life - cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of Trematoda and Nematoda

Unit IV: Discuss Immunology, Genetics & Molecular Biology of Parasites like Trypanosoma, Plasmodium, Platyhelminthes and Nematodes

Unit-I: Introduction to Parasites

Introduction to parasites of man, scope and definition of parasites/parasitology

Animal Association, Types of Parasites and Hosts

Interrelationship between Host and Parasites responses and hosts to parasitic infection

Mode of transmission of parasite, Host specificity and parasitic adaptation

Unit-II: Protozoa and Cestoda Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of:

Protozoan parasites: Entamoeba Sps, Trypanosoma Sps., Leishmania Sps.

Intestinal flagellates Giardia Sps, Trichomonus Sps

Cestodes: Taenia Sps, Diphilobothrium Sps.

Classification of Parasitic Protozoans and parasitic cestodes

Unit- III: Trematoda and Nematoda Classification, Geographical distribution, Morphology, Life - cycle, Transmission, Pathogenecity, Treatment and Prophylaxis of:

Trematodes: SchistosomoSps, FaciolaSps, Echinococcus Sps.

Nematodes: WuchereriaSps, AncylostomaSps, Dracunculus Sps.

Plant & Soil nematodes: Cyst nematode, citrus nematode

Biodiversity & Taxonomic overview of Helminth Parasites

Unit - IV: Immunology, Genetics & Molecular Biology of Parasites

Trypanosoma: Diploid & Sexual stage, Molecular characteristics of surface coat, Variable surface glycoprotein (VSG) and VSG gene expression.

Plasmodium: Diploid & haploid stages, Chromosome polymorphism, gene encoding Circum sporozoite protein & merozoites S-antigens, surface antigen diversity. Resistance of Malaria to drugs, its mechanism & assessment.

Platyhelminthes: Inseminative behaviour, parthenogenesis and polyspermy, sex determination, sex linked inheritance in Schistosomes.

Nematoda: chromosome germ line limited DNA & chromatin diminution in Ascaris.

REFERENCE BOOKS:

1. Comparative protozoology, Ecology, Physiology, Life history, Anderson, O.R., Springer verlag, Berlin.
2. General Parasitology, Cheng T. C., Academic Press.
3. Modern Parasitology, Cox F.E.G.,Eds.Parasitology in focus, facts & trends, Melhorn h., Eds., Spriger Verlag, Beriin.
4. Medical Parasitology, Piakarsky G. L., Springer Verlag, Berlin.
5. Modern Parasitology, Cellular immunological & immunological aspects, Wyler D. J., Eds., W. H. Freeman, NY
6. Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London. Soulsby, E. J. L. (1982).
7. A Text book of Parasitology, Bombay popular prakashan – by S.S. Kelkar and Rohini S. Kelkar.
8. Parasitology – by Chandler and Chands
9. Parasitology, Medical Pulisher Calcutta, 1987. K.D. Chaterjee.
10. Parasitology – By Ramniksood, C.B.S. Publisher, New Delhi – 1993.
11. <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=5493877&query=Parasitology>
12. <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=165957&query=Parasitology>
13. <https://nlist.inflibnet.ac.in/search/Record/EBC165957>

PRACTICALS:

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods
2. Smear preparation for protozoa
3. Study of life cycle, role as vector & control measures of: a) Ticks (Argas, Boophilus)
b) Mosquito - anyone from - Anopheles/ Aedes/ Culex; c) Any two flies: Tabanus/ Phlebotomus/ Sarcophaga. Cyclops
4. Ectoparasites & Endoparasites of wild rat, cattle, dog, chick & human including stages in excreta.
5. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
6. Preparation of whole mounts for helminthes
7. Collection of Parasites from digestive tract of Cockroach/gut / parasites of hen and their identification and preservation.
8. Spotters based on theory.

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – III

SYLLABUS EFFECTIVE FROM: 2020-2021

101460309: Molecular and Applied Endocrinology

OBJECTIVES:

This course is designed as a foundation for the further study of endocrinology at the cellular & molecular level as well as providing a firm basis for understanding normal hormonal control. After a basic primer in general endocrinology, examine the various mechanisms of steroid and peptide hormone action, as well as the cross talk between the pathways and their role in cellular signaling. Study the role of hormones in development. Then, focus on how these pathways are involved in human diseases such as diabetes, obesity and endocrine-related cancer and discuss mechanisms of endocrine disruption. Where appropriate, the underlying pathologies of important endocrine diseases will be discussed.

COURSE OUTCOMES:

- Students will be able to identify the organs involved in endocrine function, will know the major hormones that are produced by these organs and will know the physiological effect of these hormones. In addition, students will be introduced the different endocrine methodologies.
- Students will be able to understand general classification of hormones and pheromones. Hormones synthesis, storage, metabolism and its control. Students will also learn endocrinology of pregnancy.
- In addition, students will be introduced to the molecular mechanisms of action of many of these mediators and will start to appreciate biochemical and signalling events at the cellular and whole animal level.
- An understanding of appropriate key human endocrine disorders will also be discussed.

Unit1:

- 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.

Unit2:

- General classes of hormones: Peptide, Thyroid, Steroid, Neuro-transmitters, Neuropeptides, Chaperones, 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.

Unit3:

- 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.

Unit4:

- 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.

ReferenceBooks:

- MolecularEndocrinology:FranklynF.Bolander.Elsevier-AcademicPress.
- MolecularCellBiology:
J.Darnell,H.LodishandD.BaltimoreScientificAmericanBook,Inc.USA
- VertebrateEndocrinology:Norris,D.O.AcademicPress,NewYork
- Endocrinology,Vol.I,II,III:DGroot.L.J.(ed.),W.B.SaundersPhiladelphia
- BiochemicalActionsofHormones:Litwack,G.AcademicPress.PrinciplesofAnatomyandPhysiology:Tortora,G.J.John Wiley&Sons,Inc.
- EssentialEndocrinology:Brook,C.G.D.andMarshall,N.J.BlackwellPublishing.
- <https://nlist.inflibnet.ac.in/search/Record/EBC297039>
- <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=282124&query=Endocrinology>

PRACTICAL:

1. In situ demonstration of endocrine glands of rat.
2. Histology slides of Endocrine glands - Pituitary, Thyroid, Parathyroid,
3. Thymus, Adrenal, Pancreas, Ovary & Testis, and Uterus.
4. Identification of Gonadotrophin in Human urine samples.
5. Effect of thyroxin and thiourea (antithyroid agent) on oxygen consumption in fish.
6. Effect of parathormone on serum calcium levels in Rat.
7. Effect of insulin and adrenalin on blood glucose levels in Rat.

CHARUTAR VIDYAMANDAL UNIVERSITY
VALLABH VIDYANAGAR
MASTER OF SCIENCE - ZOOLOGY
SEMESTER – III
SYLLABUS EFFECTIVE FROM: 2020-2021
101460310: CANCER GENETICS

Course Objectives:

At the end of this course, the student will be able to:

1. Students able to understand various types, properties and progression of cancers.
2. Provides information about various genetics and epigenetics factors causing cancers.
3. Focusing on tumor markers, Tumor viruses and Chromosomal defects in cancers.
4. Students understand selected familial cancers occurring in populations

Course Learning Outcomes:

Unit 1: Student will be able to know about Types and properties of cancers, theories associated with cancer, Angiogenesis and Metastasis.

Unit 2: Highlights Oncogenes, Tumour suppressor genes, DNA repair genes and genetic instability, Epigenetic modifications, telomerase activity, centrosome malfunction, Cell cycle dysregulation .

Unit 3: To understand the Chromosomal aberrations in neoplasia, Tumour specific markers, Overview of Tumor viruses and Cervical cancer,

Familial cancers: Retinoblastoma, Wilms' tumour, Prostate cancer, Colorectal cancer, Breast cancer

Unit 4: Focusing on the **Diagnosis and treatment of Cancer.**

Course Outcomes

At the end of this course, the student will be able to:

1. Students able to understand various types, properties and progression of cancers.
2. Provides information about various genetics and epigenetics factors causing cancers.
3. Focusing on tumor markers, Tumor viruses and Chromosomal defects in cancers.
4. Students understand selected familial cancers occurring in populations
5. To define the genetic instability, involvement of cancer stem cells and treatment strategies for cancer

UNIT I:

Introduction to cancer, Types and properties of cancers, Cell transformation and tumorigenesis

Genetic heterogeneity and clonal evolution, Cancer and environment: physical, chemical and biological carcinogens (Viruses).

Angiogenesis – Angiogenesis, mechanism and role in tumour; Metastasis – Overview of metastasis – Seed and soil theory and beyond; epithelial to mesenchymal transition, signalling pathways in metastasis.

UNIT II:

Oncogenes, Tumour suppressor genes, DNA repair genes and genetic instability, Epigenetic modifications, telomerase activity, centrosome malfunction, Cell cycle dysregulation – Cancer gene pathways converge on cell cycle regulators, Cyclins and cyclindependent kinases; Cell Cycle Checkpoints (deficient).

UNIT III:

Chromosomal aberrations in neoplasia, Tumour specific markers, Overview of Tumor viruses and Cervical cancer,

Familial cancers: Retinoblastoma, Wilms' tumour, Prostate cancer, Colorectal cancer, Breast cancer.

UNIT IV: Diagnosis and treatment of Cancer

Conventional and new diagnostic techniques, molecular screening and detection. Conventional therapy, Gene therapy, Immunotherapy, Hormone therapy, multi-targeted therapy (allele-specific, antibody-mediated inhibition of RTKs, personalized cancer therapy), patient-derived xenografts (PDXs), clonal evolution and cancer resistance.

The stem cell theory of cancer, origin of cancer stem cells, markers of cancer stem cells.

REFERENCE BOOKS:

1. Molecular Biology of the Cell by Alberts *et al*
2. Genes VIII by Lewin
3. Molecular Cell Biology by Lodish *et al*
4. Molecular Genetics of Cancer by Stillman
5. Cell Biology by Cooper
6. <http://www.aribas.edu.in/Library.aspx> (e - Library)

PRACTICALS:

1. Preparation of Culture Media for Chromosomes analysis.
2. Human Blood Lymphocyte Culture
3. Genetic diagnosis of cancer by PCR
4. Visit to medical hospitals and report submission
5. A novel non-invasive method for detection of breast and ovarian cancer using volatile organic compounds from urine
6. Comet assay for genotoxicity
7. Visit to centres like GCRI- for spectral karyotyping and other techniques

CHARUTAR VIDYAMANDAL UNIVERSITY**Course Credit Scheme****M.Sc. Zoology Semester IV**

Course Code	Name of Course	T/ P	Credits	Exam Duration (Hrs)	Components of Marks		
					Internal	External	Total
					Total/ Passing	Total/ Passing	Total/ Passing
101460401	Regenerative Medicine	T	4	3	40/16	60/24	100/40
101460402	Aquaculture & Fisheries Technologies	T	4	3	40/16	60/24	100/40
101460403	Lab I (Practicals based on 101460401 and 101460402)	P	4	3	40/16	60/24	100/40
101460404	Comprehensive Viva	P	1			50/20	50/20
101460405	Dissertation	P	12			300/120	300/120
	OR						
101460406	Molecular Biology	T	4	3	40/16	60/24	100/40
101460407	IPR and Biosafety	T	4	3	40/16	60/24	100/40
101460408	Lab II (Practicals based on 101460406 and 101460407)	P	4	3	40/16	60/24	100/40

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

SYLLABUS EFFECTIVE FROM: 2020-2021

101460401: REGENERATIVE MEDICINE

Course Objectives:

Regenerative Medicine is an exciting emerging discipline, which aims to develop novel therapeutics to repair and regenerate damaged and diseased organs. The course will enable the students to understand the concept introduced in this interdisciplinary stem cell and regenerative medicine course. These therapeutics utilize stem cells, gene therapy, biomaterials, engineered tissue and biologically active compounds. The Course will address the science behind Regenerative Medicine as well as its application to human disease.

Course Learning Outcomes:

At the end of this course the students will be able to:

Unit I: Understand the basic types of stem cells, its properties, characteristics. Gain the knowledge of different sources of stem cells. Describe the molecular mechanism of pluripotency mechanism of stem cells and microenvironment of stem cells.

Unit II: Gain the detail knowledge about different types of stem cells like HSC, MSCs, VSEL. Learn about the different techniques of therapeutic cloning and conversion of somatic cell into pluripotent stem cells by iPSC technique.

Unit III: Envisages about the clinical applications of stem cells to cure Cardiac diseases, Diabetes, Spinal cord injury, Autoimmune diseases and wound healing. Accords to gain the knowledge about Cancer stem cells. The students will learn the ethical issues related stem cells.

Unit IV: Gain the knowledge of fundamental mechanisms of cell function and developmental processes to controlling cell behavior for tissue engineering. Emphasis will be on the use of biomaterials and engineering approaches to control the cellular microenvironment and steer stem cell differentiation, both for fundamental understanding and in clinical translational applications.

UNIT-I: Basic Biology of stem cells:

- Historical & Future Perspectives of Stem Cells.
- Definition and Properties of stem cells, types and sources of stem cells, Embryonic and Adult stem cells (Comparison of Embryonic and Adult stem cells)
- Embryonic Stem cells: Basic embryogenesis, properties, source, pluripotency and differentiation of ES cells.

- Molecular bases of Pluripotency, Mechanism of self-renewal, cell cycle regulation in stem cells.
- Adult stem cells: Characteristics, normal differentiation pathway, transdifferentiation (plasticity), Adult stem cells in different tissues; epithelial, skeletal, endothelial, Bone marrow & stromal, Hematopoietic etc.,
- Stem cell niches.

UNIT-II: Types of stem cells:

- Hematopoietic stem cells- differentiation, marker identification, sources of HSCs, applications of HSCs.
- Mesenchymal stem cells- properties, sources, identification and characterization, Examples UCMSCs, ADMSCs.
- VSEL- isolation and identification
- Stem cells in Dental pulp
- SCNT- Somatic Cell Nuclear Transfer
- iPSCs- induced Pluripotent Stem Cells

UNIT-III: Clinical applications of stem cells

- Stem cell therapies in Cardiac repair, Diabetes, Spinal cord injury, Auto immune disorders, Dermal wound healing- burns & skin ulcers, Neurodegenerative disease.
- Cancer stem cells- Stem cell origin in cancer, clonality and heterogeneity Tumor stem cells.
- Stem cells and ethics.

UNIT-IV: Tissue Engineering:

- Historical perspective
- Scaffold materials- Natural, semi-synthetic & synthetic.
- Synthesis of TE scaffolds- Nanofiber assembly, Textile technology, Solvent casting & particulate leaching (SCPL), Gas foaming, Emulsification/Freezdrying.
- Cell Sources- Autologous, Allogenic, Xenogenic, syngenic. Stem cells in Tissue Engineering.
- Applications of Tissue engineering.

References:

1. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology. (2009), Elsevier Academic press. ISBN: 978-0-12-088442-1.
2. Adult stem cells; KursadTurksen: Human Press ISBN-1-58829-152-9.
3. Animal Biotechnology- M.M.Ranga; AGROBIOS ISBN-81-7754-309-1.
4. R. Lanza and I. Klimanskaya, Essential Stem Cells Methods. (2009), Academic Press

5. J. J. Mao, G. Vunjak-Novakovic et al (Ed): Translational Approaches in Tissue Engineering & Regenerative Medicine 2008, Artech House, INC Publications.
6. Robert Lanza et al. Principles of Tissue Engineering, 3rd Edition. Academic Press; 3rd edition.
7. Stein et al. Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual. Wiley-Blackwell; 1 edition
8. Lanza et al. Handbook of Stem Cells, Two-Volume Set: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells (v. 1).Academic Press.
9. Regenerative Medicine and Cell Therapy (Hossein Baharvand, Nasser Aghdami. 2012)
10. Principles of Regenerative Medicine 2nd Edition (Anthony Atala, Robert Lanza, James A. Thomson & Robert Nerem. 2010)
11. <http://stemcells.nih.gov>
12. <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=3021190&query=REGENERATIVE+MEDICINE>
13. <https://ebookcentral.proquest.com/lib/inflibnet-books/detail.action?docID=5493878&query=REGENERATIVE+MEDICINE>

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

SYLLABUS EFFECTIVE FROM: 2020-2021

101460402: Aquaculture & Fisheries Technologies

OBJECTIVES:

Describe the knowledge necessary for professional or academic work in the field of aquaculture and fisheries. This includes knowledge in the areas of ecology, oceanography, biology, physiology, health, reproduction, nutrition, behavior, and genetics. Evaluate the importance of diversity, equity, and justice, as well as the role of social factors (e.g. culture, economics, policy) on aquaculture and fisheries from local to global scales. Demonstrate the basic technical skills necessary for work in aquaculture and fisheries (e.g. boats, diving, system design, scientific method, data collection and analysis). Create local and global solutions to complex challenges in aquaculture and fisheries.

COURSE OUTCOMES:

- To know the basis of technologies of fisheries and aquaculture, to understand the principles of its importance, purpose and application. To know the conditions of development of aquatic organisms and its habitat conditions, formation and change patterns of yielding in relation with the environmental changes of anthropogenic influence.
- To know the fisheries and aquaculture schemes used in breeding, rearing and feeding technologies in farms, their purpose and principles of application, be aware of the fisheries and aquaculture design and construction principles, taking into account the legislation and directives.
- Describe the fisheries and aquaculture business management features, methods, and strategies for aquaculture business development, operational funding, fisheries and aquaculture production innovation and marketing issues and strategies.
- To know the different diseases which affect the fisheries and aquaculture production. Design and construction control methods to prevent disease in culture system. Student also knows about recent developments in marine biotechnology and their applications.

UNIT – I

- Introduction, Definition, Scope, and Importance of Fisheries
- Origin and Evolution of Teleost Fishes.
- Classification and general characters of Fishes and Prawns.
- Taxonomic identification of Fresh Water fishes by the Morphometric Method.
- Classification of Fresh water bodies – Rivers, Lakes and Ponds.
- Ecology of Lentic and Lotic water bodies.

- Physico - Chemical (Temperature, Light, Hardness, pH, Chlorides, Dissolved Oxygen Alkalinity and Acidity) and Biological characteristics of water bodies.

UNIT – II

- Culture practices: Indian major carps and exotic carps; Shrimps and prawns
- Induced Breeding: Hormonal regulation of gonadal development, Activity of Gonadotropinreleasing hormone, application of hormones in aquaculture.
- Sex determination and control.
- Induction of maturation and spawning.
- Methods of fishing: Crafts and Gear technology,
- Migration in fishes

UNIT – III

- Structure and Management of Culture ponds, types of Fish seed
- Mono culture, Polyculture and Composite fish culture.
- Integrated Aquaculture and its relevance.
- Plankton and its significance in Aquaculture
- Aquafeed: Nutrition, Feed formulation, Feed additives, Alternative feed ingredients.
- Fishproducts and byproducts, fish processing, production of fish sauce by lactic acidfermentation. Microbial hazards in seafood.

UNIT – IV

- Determination of Health Condition in Fishes and Ectoparasites of Fishes
- Types of Diseases- viral, bacterial, fungal, protozoan and other parasitic diseases; Diagnosis; Control measures;
- Role of biopesticides; Drug resistance
- Recent developments in marine biotechnology.
- Inheritance of quantitative traits.
- Jellyfish Green Fluorescent Proteins and their applications.

REFERENCE BOOKS:

- Jayaram K. C. 1981. The fresh water fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka.
- Jhingran V. G. 1985. Fish and Fisheries of India.
- Kurian, C. V. and Sebastian, V. O. 1986. Prawns and Prawn fisheries of India.
- Jones, F. R. H. 1968. Fish Migration.
- Rao, K. L. 1975. India's water wealth.
- Balakrishnan, N. N. and Thampy, D. M. 1980. A textbook of marine ecology.
- Lakra W. S., Abidi SAH, Mukherjee SC and Ayyappan S. 2004. Fisheries Biotechnology.
- Harvey, B. J. and Hoar, W. S. 1979. Theory and practice of induced breeding in fishes.
- T. V. R. Pillay. 1993. Aquaculture – Principles and Practices. Fishing News Book.

- <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=4592415&query=Aquaculture+%26+Fisheries+Technologies>
- <https://ebookcentral.proquest.com/lib/inflibnet-books/detail.action?docID=1120763&query=aquaculture>
- <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=289460&query=aquaculture>

101460403: Lab I (Practicals based on 101460401 and 101460402)

1. Isolation and Culture of Hematopoietic Stem cells
2. Isolation and Culture of Mesenchymal Stem cells
3. Preparation of scaffolds
4. Cell culture on Scaffolds
5. Isolation of VSEL cells
6. Morphometric and Meristic data of Fishes (At least 3 types).
7. Collection, Identification and Screening of fish for Ecto and Endo parasites
8. Collection, Preservation and Identification of plankton.
9. Estimation of PH, Temperature, Chlorides, Dissolved Oxygen from water samples.
10. Estimation of Organic matter of bottom soil.
11. Visit to local fish seed production center.

101460404: COMPREHENSIVE VIVA BASED ON ALL THEORY PAPERS

101460405: DISSERTATION

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

SYLLABUS EFFECTIVE FROM: 2020-2021

101460406: Molecular Biology

Course Objectives:

The objectives of this course are to make students understand how molecular machines are constructed and regulated so that they can accurately copy, repair, and interpret genomic information in prokaryotes and eukaryotic cells. Further, to appreciate the subject of molecular biology as a dynamic and ever-changing experimental science.

Course Learning Outcomes:

Unit 1: Students should be able to acquire basic knowledge on DNA structure, different conformations of DNA, supercoiling and DNA-protein interactions.

Unit 2: Students should be clear about organization of prokaryotic and eukaryotic genomes and should learn various molecular events that lead to duplication of DNA.

Unit 3: Students should have understood the process of transcription in prokaryotic and eukaryotic cells. They should have clear understanding of pre and post transcriptional modifications happening in the cells.

Unit 4: Student should have learnt protein synthesis in prokaryotic and eukaryotic cell along with processing of proteome in cell.

Contents:

UNIT -1

DNA structure

Chemistry of DNA, DNA structure, Different conformations of DNA (B, A and Z), Denaturation and Renaturation (Cot curves) of DNA. DNA topology: Supercoiling, Biology of Supercoiled DNA, DNA topoisomerases and their mechanism of action. DNA- protein interactions: General features, Sequence specific DNA binding protein motifs, ssDNA binding proteins.

UNIT –II

Organization of genome and its replication

Packaging of DNA and organization of chromosome in bacterial cells; Packaging of DNA in eukaryotic nucleosome and chromatin condensation, assembly of nucleosomes upon replication, chromatin modification.

Mechanism of DNA polymerase catalyzed synthesis of DNA, Types of DNA polymerases in bacteria, Initiation of DNA replication and its regulation in prokaryotes, assembly of replisome and progress of replication fork, termination of replication. DNA replication in eukaryotes and archaea. Inhibitors of DNA replication.

UNIT -III

Transcription

RNA polymerases, features of prokaryotic and eukaryotic promoters, assembly of transcription initiation complex in prokaryotes and eukaryotes, and its regulation; synthesis and processing of prokaryotic and eukaryotic transcripts.

UNIT-IV

Translation & Processing of proteome

Structure and role of t-RNA in protein synthesis, ribosome structure, basic features of genetic code and its deciphering, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes).

Post-translational processing of proteins (protein folding, processing by proteolytic cleavage, processing by chemical modification, Inteins), Protein degradation.

Books Recommended

1. Lewin's Genes X: Jocelyn E. Krebs
2. Molecular Biology of the Gene 6th Edition: Watson et al
3. Molecular Genetic of Bacteria 3rd Edition: Snyder and Champness
4. Molecular Biology: Genes to Proteins, 4th Edition: Burton E Tropp
5. Principles of Genetics 6th Edition: Snustad and Simmons
6. Genomes, 3rd Edition: T.A. Brown
7. <https://nlist.inflibnet.ac.in/search/Record/EBC269863>
8. <https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=437543>

CHARUTAR VIDYAMANDAL UNIVERSITY

VALLABH VIDYANAGAR

MASTER OF SCIENCE - ZOOLOGY

SEMESTER – IV

SYLLABUS EFFECTIVE FROM: 2020-2021

101460407: IPR AND BIOSAFETY

Course Objectives:

The objectives of this course are to provide basic knowledge on intellectual property rights and their implications in biological research and product development. This course enables the student to become familiar with India's IPR Policy to learn biosafety and risk assessment of products derived from biotechnology and regulation of such products.

Course Learning Outcomes:

Unit – I: Students should know origin of IPR and its relevant history along with different organisations which led to current state of IPR in order to better appreciate it.

Unit – II: Students should be able to understand the IPR, its types and the type of legal rights it provides to the owner.

Unit – III: Students should know about different types of Patents, procedure for filing a patent, their rights and different organizations across the globe who accepts patents.

Unit – IV: Students should have understood the concept of Biosafety, Biological and Physical level of containment, Risk assessment, GLP, GMP etc.

UNIT – I

Need for Intellectual Property Rights

Introduction to history of ITO, GATT, WTO, WIPO and TRIPS; plant variety protection and farmer's rights act; concept of 'prior art': invention in context of "prior art"; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.

UNIT – II

Intellectual Property Rights & Its Types

Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP.

UNIT – III

Patenting

Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for

filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting - disclosure/non-disclosure - patent application - forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for Patenting introduction to existing schemes.

UNIT – IV

Biosafety

Biosafety and Biosecurity - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops.

Reference Books:

1. Ethics in engineering, Martin. M.W. and Schinzinger.R. 3rd Edition, Tata McGraw-Hill, New Delhi. 2003.
2. BARE ACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
3. Kankanala, K . C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd., Noida, India.
4. Jose B. Cibelli, Robert P. Lanza, Keith H. S . Campbell, Michael D.West. 2002. Principles of Cloning, Academic Press, SanDiego, Gurdon.
5. Hoosetti, B.B.2002. Glimpses of Biodiversity. Daya, New delhi.
6. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.
7. <http://www.cbd.int/biosafety/background.shtml>
8. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section_3.html
9. Bioethics and Biosafety, M.K. Sateesh

101460408: LAB II (PRACTICALS BASED ON 101460406 AND 101460407)

1. Amino acid titration curve
2. DNA estimation by DPA method and UV absorption
3. RNA estimation by orcinol method
4. Isolation of chromosomal DNA
5. Separation of proteins by PAGE
6. Design of r-DNA laboratory
7. Various methods to discard the Bio-hazardous waste
8. Introduction to intellectual property
9. Method to handle the recombinants
10. Patent Case Study