# 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 |
| | PG01EZOO4 | 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, Harbivores & 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**

**Spectropscopy**

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 secretary 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 PG01CZOO01and PG01CZOO02

### List of Practicals:

1. Introductory Aspects of Ecology
2. To determine the Minimum Size of Quadrate by Species-Area-Curve Method
3. To determine the Minimum Number of Quadrate
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 PG01CZOO03and 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 breading 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 breading 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 strat-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 consequenses 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 asprin with their toxic effects on tissues.

**Unit II**

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

**Unit III**

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

**Unit 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*.

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**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 Arabidoposis 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. Sinnot, L. C. Dunn & T. Dobzhansky. Principles of Genetics, Tata Mcgraw Hill Publishing Company Limited, New Delhi, ISBN: 978-0070994133.
4. P. K. Gupta, Genetics. Rastogi Publications, Meerut, India., ISBN: 81-7133-842-9.

5. Gardner E. J., Simmons M. J. & Snustad D. P. Principles of Genetics. Eighth edition. John Wiley & Sons Inc. ISBN 9971-51-346-3.
6. Klug W. S. & Cummings M. R. Concepts of Genetics. Seventh edition. Pearson Education. ISBN 81-317-0811-X.
7. Stent G. S. & Calendar R. Molecular Genetics: An Introductory Narrative. Second edition CBS Publishers and Distributors, New Delhi ISBN 81-239-0857-1.
8. Streips U. And Yasbin R. Modern Microbial genetics, Wiley-Liss, USA. ISBN: 0-471-38665-0.
9. Molay S., Cronan J. & Frifelder, D. Microbial Genetics Narosa Publishing House, New Delhi. ISBN: 81-7319-697-4.
10. Genetics by B. D. Singh

**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 **s**tudents 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-dominanace
- 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. Sinnot, L. C. Dunn & T. Dobzhansky. Principles of Genetics, Tata Mcgraw Hill Publishing Company Limited, New Delhi, ISBN: 978-0070994133.
4. P. K. Gupta, Genetics. Rastogi Publications, Meerut, India., ISBN: 81-7133-842-9.
5. Gardner E. J., Simmons M. J. & Snustad D. P. Principles of Genetics. Eighth edition. John Wiley & Sons Inc. ISBN 9971-51-346-3.
6. Klug W. S. & Cummings M. R. Concepts of Genetics. Seventh edition. Pearson Education. ISBN 81-317-0811-X.
7. Stent G. S. & Calendar R. Molecular Genetics: An Introductory Narrative. Second edition CBS Publishers and Distributors, New Delhi ISBN 81-239-0857-1.
8. Streips U. And Yasbin R. Modern Microbial genetics, Wiley-Liss, USA. ISBN: 0-471-38665-0.
9. Molay S., Cronan J. & Frifelder, D. Microbial Genetics Narosa Publishing House, New Delhi. ISBN: 81-7319-697-4.
10. Genetics by B. D. Singh

# 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.

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**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, Immunofluroscence, FACS

**Unit III**

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

**Unit IV**

- Cell mediated effector response (Generation of effector CTL's, Granzyme and Perforin Mediated Cytolysis, Fas-FasL Mediated Cytolysis, NK cell mediated cytolysis

- Cytokines: properties, receptors, associated diseases, therapeutic applications, cytokine signalling pathways: JAK-STAT and FAS-FASL signalling pathways
- Immune response to infection by viruses, bacteria, fungi and parasite: Mechanism of Immune response and evasion by pathogen

**References**


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

# LAB-I PG02CZOO04

## Practicals based on PG02CZOO01and PG02CZOO02

## Based on Genetics & Cytogenetics and Mammalian Physiology

**List of Practicals**

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 $\chi^2$ – 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 Microtehnique, 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

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# 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, trascriptomics, 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

**Reference Books:**


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